study Programme

Electromechanical Engineering

2025-2026

MANUAL STUDY PLAN

&

MODULE SHEETS

Electromechanical Engineering Program

The electromechanical engineering program has been completely redesigned according to new realities. It provides all students with solid training in the main areas of mechanical engineering and electrical engineering which prepares them to practice the engineering profession in industry. Basic courses in electromechanical engineering emphasize analysis, design and implementation. From the first year, students follow specialty courses and carry out an integrative project allowing them to apply the knowledge acquired. The program integrates the use of modern design tools as well as an enriched experimental component.

After solid basic training in ElectroMechanical Engineering acquired during the first four semesters, engineering students choose from two specialty courses:

- Automatic and mechatronics.
- Aeronautics
- Industrial maintenance

At the end of a semester of courses in their Responsible, the engineering student completes their training with a six-month End of Study Project (PFE) in industry.

Contents Table

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Electromechanical Engineering Study Plan

Electromechanical Engineering : Common Core : S1

Code	Subject	Coef	Credit	Course/week	Practical/week
FR-ABC	French	1,5	2	1,5	
ENG-ABC	English	1,5	2	1,5	
GELM 3 103	Mathematics for engineers	3	3	3	
GELM 3 104	Probability and Statistics	1,5	2	1,5	
GELM 3 105	Electrical circuits	3	4	1,5	1,5
GELM 3 106	Analog electronics	3	4	1,5	1,5
GELM 3 107	Fluid mechanics	3	3	3	
GELM 3 108	MMC	3	4	3	
GELM 3 109	Materials & Structures	2,25	3	1,5	0,75
GELM 3 110	Thermic	2,25	3	2,25	
	Total	24	30		

Electromechanical Engineering : Common Core : S2

Code	Subject	Coef	Credit	Course/week	Practical/week
FR-ABC	French	1,5	2	1,5	
ENG-ABC	English	1,5	2	1,5	
GELM 3 203	Electrotechnics	2,5	3	1,5	1
GELM 3 204	Signal treatment	2,5	3	1,5	1
GELM 3 205	CAO Electrical Systems	1,5	2		1,5
GELM 3 206	Mechanical design 2	1,5	2	1,5	
GELM 3 207	Certification Preparation CAO1	1,5	2		1,5
GELM 3 208	Mechanical engineering	1,5	2		1,5
GELM 3 209	Manufacturing processes	3	3	1,5	1,5
GELM 3 210	Metal Structures and Welding Processes	1	1		1
GELM 3 211	RDM	2,25	3	2,25	
GELM 3 212	Thermic machines	1,5	2	1,5	
GELM 3 213	Quality - Certification - Standards	2,25	3	2,25	
	Total	24	30		

Electromechanical Engineering : Common Core : S3

Code	Subject	Coef	Credit	Course/week	Practical/week
FR-ABC	French	1,5	2	1,5	
ENG-ABC	English	1,5	2	1,5	
TV-401	MOS Certification	1,5	2		1,5
GELM 4 104	Servicing and regulation	3	3	1,5	1,5
GELM 4 105	Embedded Systems and Microcontrollers	3	3	**1.5**	1.5
GELM 4 106	Mechanical design 3	1,5	3	1,5	
GELM 4 107	Certification Preparation CAO2	0,75	3		0,75
GELM 4 108	Solid mechanics	3	3	3	
GELM 4 109	Production Techniques and FAO	3	3	1,5	1,5
GELM 4 110	Organization & Production Management	2,25	3	2,25	
GELM 4 101	Control & Reliability/GMAO	3	3	1,5	1,5
	Total	24	**30**	**24**	

ectromechanical Engineering : Automation and mechatronics Major: S4

Code	Subject	Coef	Credit	Course/week	Practical/week
FR-ABC	French	1,5	2	1,5	
ENG-ABC	English	1,5	2	1,5	
GELM 4 203	Programmable controllers	3	3	1,5	1,5
GELM 4 204	Robotics	2,25	3	1,5	0,75
GELM 4 205	vibrations Mechanics	2,25	3	1,5	0,75
GELM 4 206	ERP & GPAO	1,5	3		1,5
GELM 4 207	Lean manufacturing	1,5	2	1,5	
GELM 4 208	Hydraulic and pneumatic systems	1.5	2	0	1,5
GELM 4 209	Modeling and management of electrical networks	1,5	2	1,5	0
GELM4-AM 101	General mechatronics	1.5	2	1.5	0
GELM4-AM 102	Advanced Automatics	3	2	1.5	1.5
TV-402	Scientific Project PFA	3	4	0	3
	Total	24	**30**		

Electromechanical Engineering : Aeronautics Major: S4

Code	Subject	Coef	Credit	Course/week	Practical/week
FR-ABC	French	1,5	2	1,5	
ENG-ABC	English	1,5	2	1,5	
GELM 4 203	Programmable controllers	3	3	1,5	1,5
GELM 4 204	Robotics	2,25	3	1,5	0,75
GELM 4 205	vibrations Mechanics	2,25	3	1,5	0,75
GELM 4 206	ERP & GPAO	1,5	3		1,5
GELM 4 207	Lean manufacturing	1,5	2	1,5	
GELM 4 208	Hydraulic and pneumatic systems	1.5	2	0	1,5
GELM 4 209	Modeling and management of electrical networks	1,5	2	1,5	0
GELM4-Aero 101	General avionics	1.5	2	1.5	0
GELM4-Aero 102	Fluid dynamics and principles of aerodynamics	3	2	1.5	1.5
TV-402	Scientific Project PFA	3	4	0	3
	Total	24	**30**		

Electromechanical Engineering: Industrial Maintenance Major: S4

Code	Subject	Coef	Credit	Course/week	Practical/week
FR-ABC	French	1,5	2	1,5	
ENG-ABC	English	1,5	2	1,5	
GELM 4 203	Programmable controllers	3	3	1,5	1,5
GELM 4 204	Robotics	2,25	3	1,5	0,75
GELM 4 205	vibrations Mechanics	2,25	3	1,5	0,75
GELM 4 206	ERP & GPAO	1,5	3		1,5
GELM 4 207	Lean manufacturing	1,5	2	1,5	
GELM 4 208	Hydraulic and pneumatic systems	1.5	2	0	1,5
GELM 4 209	Modeling and management of electrical networks	1,5	2	1,5	0
GELM4-MI 101	Industrial maintenance management and strategies	1.5	2	1.5	0
GELM4-MI 102	Diagnostics and predictive maintenance	3	2	1.5	1.5
TV-402	Scientific Project PFA	3	4	0	3
	Total	24	**30**		

Automation and mechatronics Major : S5

Code	Matière	Coef	Credit	Course/week	Practical/week
TV-501	human resources management GRH	1,5	3	1,5	
TV-502	Law of work	1,5	2	1,5	
TV-503	Preparation for certification in Entrepreneurship	1,5	2	1,5	
ELM-A&M 5 104	Design and modeling of mechatronic systems	3	3	1,5	1,5
ELM-A&M 5 105	Numerical modelling	3	3	1,5	1,5
ELM-A&M 5 106	Mechanisms theory	2,25	3	2,25	
ELM-A&M 5 107	Robotic Programming	1,5	2		1,5
ELM-A&M 5 108	Machine control	3	3	1,5	1,5
ELM-A&M 5 109	Smart sensors and data processing	1.5	2	1,5	
ELM-A&M 5 110	Modeling, Identification and Monitoring of systems	2,25	3	2,25	
ELM-A&M 5 111	Advanced API Programming	1.5	2		1.5
TV-504	Connected objects (IOT)	1,5	2		1,5
	Total	24	**30**		

Aeronautics Major : S5

Code	Subject	Coef	Credit	Course/week	Practical/week
TV-501	human resources management HRM	1,5	3	1,5	
TV-502	Law of work	1,5	2	1,5	
TV-503	Preparation for certification in Entrepreneurship	1,5	2	1,5	
ELM-Aéro 5 104	Vol mechanics	2,25	2	2,25	
ELM-Aéro 5 105	Embedded electrical systems in aeronautics	1,5	2	1,5	
ELM-Aéro 5 106	Radar theory	1,5	2	1,5	
ELM-Aéro 5 107	Aeroacoustics	1,5	2	1,5	
ELM-Aéro 5 108	Aerodynamics	1,5	2	1,5	
ELM-Aéro 5 109	Combustion	2,25	3	1,5	0,75
ELM-Aéro 5 110	Structural mechanics	1,5	2	1,5	
ELM-Aéro 5 111	Thermal modelling	3	3	1,5	1,5
ELM-Aéro 5 112	Turbomachinery & Turbulence	3	3	1,5	1,5
TV-504	Connected objects (IOT)	1,5	2		1,5
	Total	24	30		

Industrial Maintenance Major : S5

Code	Subject	Coef	Credit	Course/week	Practical/week
TV-501	human resources management GRH	1,5	3	1,5	
TV-502	Law of work	1,5	2	1,5	
TV-503	Preparation for certification in Entrepreneurship	1,5	2	1,5	
ELM-MI 5 104	Maintenance tools	2,25	3	2,25	
ELM-MI 5 105	Repair techniques	2,25	3	0,75	1,5
ELM-MI 5 106	Safety of industrial installations	2,25	3	2,25	
ELM-MI 5 107	Optimization of production systems	2,25	3	2,25	
ELM-MI 5 108	Machine control	3	3	1,5	1,5
ELM-MI 5 109	Advanced Automation and Robotics	3	3	1,5	1,5
ELM-MI 5 110	CND	3	3	1,5	1,5
TV-504	Connected objects (IOT)	1,5	2		1,5
	Total	24	30		

S06 : Professional Semester

Codes	Teachings	Coef	Credit	Course/week	work/week
Pro- 5 2 01	Introductory course	10	3	/	/
Pro- 5 2 02	Course development		3	/	/
Pro- 5 2 03	PFE		24	/	/
		24	**30**	**18**	**6**

Content sheets

COMMON CORE

Course Specification

Mathematics for engineers

1. General

Coded	GELM 3 103	Level/Semester	*1/S1*	Coefficient	*3*	Credits	*3*
Course	*Engineer*					Volume. H. (CI)	*42*
Responsible	*Zied Garbouj*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*30*
Module	Mathematics for engineers					Version	*09/2023*

Course description (Course objective):
This course allows students to gain advanced knowledge of mathematics and develop skills to solve engineering problems using mathematical techniques.

Prerequisites:	*Keywords :*
L1 and L2 mathematics courses *Mathematical tools at a BAC+2 level*	-Functions with a real variable (limit and continuity). - Derivation and primitive. - Integral calculation. -Differential equations.

Specific objectives of the course (OBJ $_i$):
At the end of this course, students will:
OBJ 1: Be able to calculate Fourier transforms of non-periodic functions. **OBJ 2:** Understand the notion of the convolution product. **OBJ 3:** Understand the concepts of Laplace transforms and inverse Laplace transforms. Be able to solve a differential equation using Laplace transforms. **OBJ 4:** Know how to decompose a periodic signal into a Fourier sum.

Necessary material :

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	Chapter 1: Laplace Transformation - General - Properties - Convolution	6h	Introduction to the Laplace transform and its use to solve linear Ordinary Differential Equations (ODE) of order n
3-4	-Practical methods for calculating the image and an original -Application: Use the Laplace transform to solve a differential equation	6h	
5-6	TD-Series 1	*6h*	
7-8	Chapter 2: Fourier Transformation -General	*6h*	In this chapter, to simplify, we will introduce the notion of Fourier transform on R rather than on R^d. This short chapter is an interesting application of

9-10	-Terms -Properties	*6h*	the previous integration course, in the sense that many results are used (dominated convergence theorem, continuity and differentiability theorems for parameter integrals, convolution product, density of step functions in L 1 ...).
11-12	-Convolution - Inversion - Plancherel and Parseva formulas TD=Series 2	*6h*	
13-14	Detailed series of exercises throughout the course	*6h*	Evaluate the overall level of students and rectify gaps

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ■ *No*	
DS - Supervised Duty	■ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	■ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ■ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*

- ***<u>100% CI material : Average = 40% DS + 60% EE</u>***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ■ *No*
- *Authorized search engine* : ☐ *Yes* x *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Mathematics for engineers. Authors: Yves Leroyer and Patrice Tesson - Edition Dunod
- Kreyszig, E. (2011). *Advanced Engineering Mathematics* (10th Edition). Wiley.
- Stroud, K. A., & Booth, D. J. (2020). *Engineering Mathematics* (8th Edition). Red Globe Press.

7- Working environment (Facilities necessary for learning)

Course Specification

Probability and Statistics

1. General

Coded	/ GELM 3 104	Level/Semester	*1/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Engineer*					Volume H. (CI)	*21h*
Responsible	*Ben Haj Mbarek mohamed Hedi*					volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*27*
Module	*Probability and Statistics*					Version	*09/2023*

Course description (Course objective):
study of the laws governing random events, including the collection, analysis, interpretation, and display of numerical data.

Prerequisites:	*Keywords :*
Basic algebra	*- Probability* *- Statistics* - random experience

Specific objectives of the course (OBJ $_i$):
Upon completion of this module, the student will be able to: OBJ 1: random variable study. OBJ 2: Variance and standard deviation calculation.

Necessary material :
NONE

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-3	Chapter 1: INTRODUCTION TO CALCULATION OF PROBABILITIES 1. Basic concepts 1.1 Notions of random experience and fundamental set 1.2 Concept of event 1.2.1 Relationships between events 1.2.2 Complete event system 2. Probable space and probability 2.1 Axioms of probability 2.2 Properties 3. Conditional probability 3.1 Definition 3.2 Formula for total probabilities 4. Independence of events 5. Bayes formula	*4.5*	*At the end of this chapter, the student will be able to:* knowledge of the conditional probability and Independence of events
4-6	CHAPTER 2: COUNTING METHODS AND PROBABILISTIC DRAWING SCHEMES 1. Enumeration method: combinatorial analysis 1.1 The multiplication rule 1.2 Permutations 1.3 Arrangements 1.4 Combinations 2. Probabilistic drawing schemes: urn models 2.1 General 2.2 Urn models	*4.5*	combinatorial analysis , Permutations , Arrangements , Combinations and Urn models
7-10	CHAPTER 3: RANDOM VARIABLES 1. General and distribution function 2. Discrete random variables 2.1 Definition of a random variable and distribution function 2.2 Moments of a discrete random variable 2.2.1 Mathematical expectation 2.2.2 Variance and standard deviation 3. Continuous real random variables 3.1 Definition of a real continuous random variable 3.2 Density function of a continuous random variable	*6*	*able to calculate the* Mathematical expectation, variance and standard deviation

	3.3 Moments of a discrete random variable 3.3.1 Mathematical expectation 3.3.2 Variance and standard deviation 3.4 Quantile of a continuous random variable 4. The moment generating function 5. Transformation of random variables		
11-14	CHAPTER 4: USUAL LAWS 1. Discreet laws 1.1 Bernoulli's law 1.2 The Binomial law 1.3 Poisson's law 2. Continuous laws 2.1 The Uniform Law continues 2.2 The exponential law 2.3 The Normal law and the reduced centered normal law 2.4 Laws derived from the normal law	*6*	*Knowledge of different usual laws*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ■ *No*	
DS - Supervised Duty	■ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	■ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ■ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ■ *No*
- *Authorized search engine* : ☐ *Yes* x *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

https://math.univ-lyon1.fr/irem/IMG/pdf/PolyTunis_A_Perrut.pdf

- Bernard CourtebNone, *À l'école des probabilités*, Press univ. Franche-Comté, 2006, 282 p.
- Bernard CourtebNone, *Mathématiser le hasard,* Vuibert, 2008
- Virginie Delsart et Nicolas Vaneecloo, *Méthodes statistiques de l'économie et de la gestion*, Presses Univ. Septentrion, 2010, 317 p.
- Ross, S. M. (2020). Introduction to Probability and Statistics for Engineers and Scientists (6th Edition). Academic Press.
- Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2017). Probability & Statistics for Engineers & Scientists (9th Edition). Pearson.

7- Working environment (Facilities necessary for learning)

Course Specification

Electrical Circuits

1. General

Coded	*GELM3105*	Level/Semester	*1/S1*	Coefficient	*3*	Credits	*4*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Kais BOUZRARA*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*55*
Module	*Electrical circuits*					Version	*09/2023*

Course description (Course objective):
The general objective of this module is to present the basic notions of electronics , the fundamental methods of calculating direct current and alternating current electrical circuits .

Prerequisites:	*Keywords :*
Basic electricity, electrokinetics	*Thévenin, Norton's theorem, Millmann's theorem, Kinnely's theorem).*

Specific objectives of the course (OBJ $_i$):
***OBJ 1 :** Study of electrical circuits in continuous mode (determination of electrical quantities: voltage and current in each dipole constituting the circuit)*   ***OBJ 2 :** Study of electrical circuits in sinusoidal regime (determination of electrical quantities: voltage and current in each dipole constituting the circuit)*   ***OBJ 3 :** Transient study of first order electrical circuits*

Necessary material :
Test plates, resistors, capacitors, inductors, ammeters, voltmeters, low frequency generators, oscilloscopes.

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1-4	***Linear electric circuits in continuous mode** : definitions, elements of the electric circuit, Ohm's and Kirchhoff's law, fundamental theorems (association of dipoles,*	*6*	*Study of electrical circuits in continuous mode*

	superposition theorem, Thévenin's theorem, Norton's theorem, Millmann's theorem, Kinnely's theorem).		
5-8	***Linear electrical circuits in sinusoidal regime** : characteristics of a sinusoidal signal, its Cartesian, Fresnel and complex representation, passive dipoles in sinusoidal regime, powers in sinusoidal regime.*	*6*	*Study of electrical circuits in sinusoidal regime:*
9-12	***Linear electrical circuits in transient regime** : Definitions (steady regime, variable regime, permanent regime, transient regime, etc.), equation of transient regimes, Responses of first order circuits (Charging/Discharging of a capacitor through a resistor , establishment and breaking of current in a choke through a resistor), Responses of first order circuits (Charging/Discharge of a capacitor through a resistor and a choke, etc.)*	*6*	*Transient study of first order electrical circuits*
13-14	***Quadrupoles** : Definition, Reciprocity and Symmetry, Characteristic Quantities, Study of different Matrix representations, Association of Quadrupoles, Adaptation of impedances*	*3*	*Study of the modeling of quadrupoles using matrix representations*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***Verification of Kirchhoff's laws, the voltage and current divider** :* Carrying out measurements of current intensity and electrical voltage in a direct current circuit. Practical verification of Kirchhoff's laws, voltage divider and current divider.	*3*	*Mastery of Kirchhoff's laws, voltage and current divider*
3-4	***Application of some theorems of circuit analysis electrical** :* Study and verification of the superposition theorem. Study and verification of Thévenin's theorem. Use of electrical appliances.	*3*	*Mastery of Thévenin's theorem and superposition*
5-6	***Study of some electrical circuits in sinusoidal regime** :* Study of circuits comprising passive elements R, L and C in sinusoidal regime. Experimental determination of the phase shift between two electrical quantities	*3*	*Analysis of electrical circuits in sinusoidal regime*
7-8	***Application of some theorems in sinusoidal regime:*** Study and verification of Kirchhoff's laws, voltage divider and	*3*	*Application of Kirchhoff's laws to*

	current. Study and verification of Thévenin's theorem. Use of electrical appliances		*electrical circuits in sinusoidal regime*
9-12	***Study of RC, RL and RLC circuits in transient mode:*** use of the oscilloscope to visualize electrical signals. Transient study of RC, RL and RLC circuits and verification of experimental results with theory. Experimental determination of the characteristic time constant of the circuit using an acquisition with the oscilloscope.	*6*	*Study of electrical circuits in transient conditions*
12	*Practical exam*	*3*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑ *No*	
DS - Supervised Duty	☑ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*
EP - Practical test (TP - TP exam)	☑ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☑ No*
- *Authorized search engine : ☐ Yes ☑ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Electric Circuits" by James W. Nilsson and Susan A. Riedel
- Fundamentals of Electric Circuits" by Charles K. Alexander and Matthew NO Sadiku
- Electric Power Systems: A Conceptual Introduction" by Alexandra von Meier
- Circuit Analysis: Theory and Practice" by Allan H. Robbins and Wilhelm C. Miller
- Power System Analysis and Design" by J. Duncan Glover, Thomas Overbye, and Mulukutla S. Sarma

- Introduction to Electric Power and Drive Systems" by Paul C. Krause and Oleg Wasynczuk

7- Working environment (Facilities necessary for learning)

- *None*

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Course Specification

Materials and structures

1. General

Coded	GELM3109	Level/Semester	1/S1	Coefficient	2.25	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	21
Responsible	*Ahmed HADJ TAHER*					Volume. H. (TP)	10.5
Teaching methods	Lecture, interactive, direct instructions					Self study H.	43.5
Module	*Materials & Structures*					Version	09/2023

Course description (Course objective):
The manufacture of an object requires reflection on the function it will have to fulfill, the material which will constitute it and the manufacturing process which will achieve the desired shape. Thus, the notion of material is inseparable from the interest that the substance chosen may represent with the aim of obtaining a finished object having a precise function. *Every engineer must have a minimum knowledge of the mechanical behavior of materials. In addition, the engineer is frequently called upon to consult documents dealing with related subjects such as, for example, rational approach to the choice of materials, cleanliness of materials and microstructure.* *This course therefore has the main objective of familiarizing students with the field of materials, as well as providing them with in-depth knowledge of the properties of materials to better choose the right candidate according to the conditions of use.*

Prerequisites:	*Keywords :*
Bac+2 level	*Materials ; shapes; processes*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand and know the standardized designation, properties and areas of application of metallic materials and the techniques for their development.* ***OBJ 2 :*** *Describe the equilibrium structures, based on phase diagrams, of binary alloys (ferrous and non-ferrous alloys).* ***OBJ 3 :*** *Understand treatments to improve the use and serviceability properties of metallic materials*

Necessary material :
Data show ; handout

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1- -2	*Chapter 1: Metallic materials: Designation, properties and application*
	- *General Introduction*
	- *Properties*
	- *Material classification*
	- *Classification of metals and designation*
	  - *Ferrous metals (steel and cast iron)*
	  - *Non-ferrous metals*
	Chapter 2: Elaboration of metals
	- *Introduction*
	- *Production of ferrous metals*
	- *Production of non-ferrous metals*
	Tutorials
		3	*-Enter the standard designation, properties and areas of application of ferrous and non-ferrous materials*
			-Know the different processes for producing ferrous and non-ferrous metals.

3-4-5	*Chapter 3: Balance diagram of binary alloys* - *Introduction* - *Law of phases (Gibbs)* - *Binary alloy consisting of two phases in equilibrium* - *Alloy to a single solid solution* - *Two-solid solution alloy with a eutectic point* - *L->S cooling curve of an alloy* - *Cooling curve of a solid state alloy* *Chapter 4: Iron-Carbon Balance Diagram* - *Introduction* - *Iron Structure* - *Cementite balance diagram* - *Study of cooling of steels and cast irons* *Tutorials*	*4.5*	*-Analyze equilibrium diagrams of binary alloys* *-Analyze the Iron-carbon diagram*
6-12	*Chapter 5: Modification of mechanical properties* - *Introduction* - *Hardening by work hardening* - *Hardening by grain size refinement* - *Solid solution hardening* - *Structural hardening*	*10.5*	*-Know in general the different methods of improving mechanical properties*
	Chapter 6: Heat treatment of steels - *Introduction* - *The main types of heat treatment*		*-Know what heat treatment is*

	I- Austenization of steels - *Heating speed* - *Austenization temperature* - *Austenization time* - *Grain size* ***II- Isothermal transformations of steels*** - *Introduction* - *The different types of austenite transformations* - *Reading TTT diagrams or Iso-austenitic curves* - *Industrial isothermal heat treatments of steels* ***III- Anisothermal transformations of steels*** - *Introduction* - *Analysis of TRC diagrams* - *Residual austenite problem* - *Critical quenching speed* ***IV- Steel income*** - *Introduction* - *Different types of income* - *Evolution of properties during income* ***V- Annealing of steels*** - *Introduction* - *Different types of annealing* ***VI – Hardenability of steels*** - *Introduction* - *Factor influencing hardenability* - *Method for determining hardenability* *Tutorials*		*-Know the autenization parameters* *-Analyze the anisothermal quenching process* *-Know the purpose, stages and different types of steel income* *-Know the steps and different types of steel annealing.* *-Understand the factors influencing the hardenability of steels as well as these determination methods*
13-14	*Chapter 7: Surface treatments* - *Introduction* - *Mechanical treatment or work hardening* - *Quench hardening treatment after surface heating* - *Thermochemical treatment* *Tutorials*	*3*	*- Know the principle of some types of superficial treatments*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	No. HR	Goals
1-2	*Experimental determination of the austenitization temperature*	*3*	*- Know the austenitization parameters*

3-4	*Material characterization and hardenability testing*	*3*	*- Analyze the anisothermal quenching process - Detect the influence of tempering and annealing of steels*
5-6	*Tempering test and recrystallization annealing*	*3*	
7	*Practical exam, mini-project defense, …*	*1.5*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- References:

1 *- Materials sciences: Mechanical metallurgy from microscopic to macroscopic. Alain CORNET, Françoise LAWKA Edition Ellipse 2010.*

2 *- Metallurgy memory aid: Metals. Alloys. Properties. Guy Murry. New factory 2nd edition Paris 2010*

3- *Materials Sciences cheat sheet. Michel Dupeux.Edition DUNOD 2005 (new corrected edition).*

4- *Metallurgy: lessons and corrected exercises carried out by: Mr. BELAHOUEL Mohamed University of Science and Technology of Oran Mohamed BOUDIAFA. Algeria. AU: 2016-2017*

5- *Metallurgy specifications: development, structure-properties and standardization. J. BARRALIS, G. MAEDER, 6th edition. AFNOR, NATHAN.*

6- IRSID collection.

7- Theoretical and applied structural metallurgy. ALBERT DE SY, JULIEN VIDTS, 2nd editing. NICI, DUNOD.

8- Metallurgy. J.NIARD collection . NATHAN TECHNIQUE.

9- Treaty of materials. Wilfried Kurz, Jean P. Mercier and Gérald Zambelli. 2nd edition. French-speaking polytechnic and university presses.

***10-** Metallurgy from ore to material. Jean Philibert, Alain Vignes, Yves Bréchet and Pierre Combrade, 2nd edition. DUNOD.*

***11-** General metallurgy. J.Bénad , A.Michel, J.Philibert and J. Talbot. 2nd edition. MASSON.*

***12-** Basic principles of thermal, thermomechanical and thermochemical treatments of steels. A. Constant, G. Henry and JC Charbonnier. PYC edition.*

***13-** Materials volume 1: properties and applications. Mr. F. Ashby and HRD Jones. DUNOD.*

***14-** Materials volume 2: Microstructure and implementation. Mr. F. Ashby and HRD Jones. DUNOD.*

***15-** Materials, Jean-Paul Baïlon, Jean-Marie Dorlot 3rd edition: Presses Internationales Polytechnique 2000*

***16-** Tutorial: Materials Montreal Canada.*

***17-** Guide to industrial sciences and technologies. Jean-Louis Fanchon, 3rd edition, Nathon-Afnor*

7- Working environment (Facilities necessary for learning)

- *None*
- *…*

Course Specification

Analog Electronic

1. General

Coded	*GELM3106*	Level/Semester	*1/S1*	Coefficient	*3*	Credits	*4*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Amira HADJ FRADJ*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*55*
Module	*Analog electronic*					Version	*09/2023*

Course description (Course objective):
The Analog Electronics course aims to provide students with an in-depth understanding of the physical properties of materials in the development of electronic components and the use of these components in circuits and systems. This includes the study of electrical devices built around semiconductor technology.

Prerequisites:	*Keywords :*
- Basic knowledge of mathematics *- Prior knowledge of the basic concepts of analog electronics, such as the law of meshes, the law of nodes.*	*Semiconductor, electrical circuits, PN junction, Diode, NPN transistor,*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the fundamental principle of semiconductor usage and the structure of an extrinsic N-type and P-type semiconductor.* ***OBJ 2 :*** *Understand the principle of the junction diode and its structure.* ***OBJ 3 :*** *Understand the basic structure of an NPN and PNP bipolar transistor and study the current-voltage characteristic in static and dynamic conditions.*

Necessary materials: (Practical work)
Stabilized supply *Test plate to connect the different circuits* *Sons* *Ordinary diode 1N4001*

Bipolar transistor 2N2222 *Zener diode* *A voltmeter* *A milliammeter* *Resistances* *Capacitors*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-4	*Chapter 1: Junction diodes*	*6*	• *Understand the structure of a semiconductor (Electron, atom).* • *Understand the principle of the PN junction.* • *Study the current-voltage characteristic of a junction diode.* • *Study the different models of the diode.* • *Understand how a Zener diode works.*
5-9	*Chapter2: The bipolar transistor in static mode*	*7.5*	• *Understand the structure of an NPN and PNP bipolar transistor.* • *Know the electrical quantities associated with the transistor.* • *Know the different connections of transistors and study the common emitter assembly.* • *Trace the network of characteristics and static charge line of an NPN transistor (common emitter assembly)*
10-14	*Chapter 3: The bipolar transistor in dynamic mode*	*7.5*	• *Understand how the transistor works as a low signal amplifier.* • *Know the hybrid parameters of the NPN transistor.* • *Study the transistor equivalent diagram for small sinusoidal signals*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Study of a junction diode*	*3*	• *Master in practice using an ordinary diode 1N4001* • *Record the current-voltage characteristic of an ordinary 1N4001 diode in the forward and reverse directions.* • *Determine dynamic and static resistance.*
3-6	*Diode rectification and filtering.*	*6*	• *Rectify an alternating voltage in single-wave mode.* • *Study filtering using a capacitor.*
7-8	*The Zener diode*	*3*	• *Record the current voltage characteristic of a Zener diode in the forward and reverse directions.* • *Determine the dynamic resistance of a Zener diode.*
9-12	*Study of bipolar transistor 2N2222*	*6*	• *Study the common emitter assembly of a 2N2222 bipolar transistor in static and dynamic conditions.*
13-14	*Practical exam*	*3*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒*Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒*Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒*Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ✕ Yes ☐ No*
- *Authorized search engine : ☐ Yes ✕ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Thierry GERVAIS, **Electronics,** second edition, 2004.*
- *Gharsallah, Ali ; Ben-Nasrallah, Tarek ; Gargouri, Lassaad , **Exercises and corrected problems in analog electronics,** University Publication Center (CPU), Tunis, 2003*
- *Trabelsi, Hichem , **Logical, combinatorial and sequential circuits: courses and corrected exercises,** University Publication Center (CPU), Tunis, 2002*
- *Chekir, F .; Khirouni, K .; Belmabrouk, H. **, The basics of electromagnetism and electronics: course for first year students of science faculties and preparatory institutes** , 2000.*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Fluid mechanics

1. General

Coded	*GELM3107*	Level/Semester	*1/S1*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*42*
Responsible	*Jamel MLAOUHI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*29*
Module	*Fluid mechanics*					Version	*09/2023*

Course description (Course objective):
Fluid mechanics provides an in-depth understanding of the behavior of liquids and gases in motion, with practical applications in various fields of engineering.

Prerequisites:	*Keywords :*
General mechanic. Mathematics (vector and tensor calculation, differential equations, etc.)	*Fluid, Bernoulli, Navier-Stokes, Reynolds number*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Discover a first definition of a continuous medium.* ***OBJ 2 :*** *Understand the concept of pressure and incompressible fluid, the concept of viscosity.* ***OBJ 3 :*** *Differentiate between laminar flow and turbulent flow,* ***OBJ 4 :*** *assimilate the notion of boundary layer, introduce the notion of Drag and Lift forces.*

Necessary material :
…

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*
1-2	*Properties and types of fluids (liquids and gases)* - *Physical properties of fluids* - *Continuous media* - *Compressibility of fluids, Expansion, Density* - *Kinematic and dynamic viscosity* *Law of Newtonian fluids.*	*6*	*Discover a first definition of a continuous medium.*

	Constraint-speed gradient law *Influence of temperature*		
3-4-5	*Fluid Statics (Hydrostatics)* *Pressure variation within a fluid in static equilibrium.* *Law of hydrostatics.* *Pseudo static fluid equilibrium* *Archimedes thrust.* *Push on a wall.* *Center of thrust.*	9	*Understand the concept of pressure and incompressible fluid, the concept of viscosity.*
6-7-8	*Fluid kinematics* *Description of fluid flow.* - *Lagrangian description* - *Eulerian Description* *Particle derivative.* *Conservation of mass.* • *Principle* • *Continuity equation* *Graphical study of flow cases.* *Emission line, current line, current tube*	9	*Differentiate between laminar flow and turbulent flow,*
9-14	*Fluid dynamics (Hydrodynamics)* *Equation of motion of a perfect fluid* *- overall balance of movement quantities* - *Conservation of momentum - Euler's equation* *Energy equation* - *Energy conservation* - *Bernoulli's theorem* *Exchange of energy with the external environment* *Generalized Bernoulli equation.* *Equation of motion of a real fluid.* - *Navier–Stokes equation* - *Reynolds number* - *Boundary layer Energy losses*	15	*assimilate the concept of boundary layer.*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Fluid Mechanics; FM WRITE; Mr. Graw Hill.
- Fluid mechanics, elements of a first course; P. CHASSAING; Cépadués Editions.
- Fluid flows, methods and models; J. PADET; Masson.
- Applied fluid mechanics" by Gérard Grehan, Alain Pétréolle
- Fluid mechanics: Courses and exercises solved" by Sylvie Jourdain, Laurent Joly, and Mohamed Ouazzani
- Introduction to fluid mechanics" by Yves Achdou and Olivier Pironneau
- Hydraulics and fluid mechanics - 3rd edition" by Guy Planchant and Roger François
- Fluid mechanics - 2nd edition" by Michel Ledoux and Elisabeth Le Guerroué
- Fluid mechanics - Courses and corrected exercises" by Roger Stevens

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Continuum mechanics MMC

1. General

Coded	*GELM3108*	Level/Semester	*1/S1*	Coefficient	*3*	Credits	*4*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*42*
Responsible	*Chokri BOURAOUI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*54*
Module	*Continuum mechanics*					Version	*09/2023*

Course description (Course objective):
Continuum Mechanics aims to study the behavior of deformable materials on large scales. It deals with objects that can be modeled as continuous media, that is to say materials whose physical properties vary continuously at each point.

Prerequisites:	*Keywords :*
Linear Algebra and geometry course.	*Mechanics of continuous media, stress, deformation, elasticity, plasticity…*

Specific objectives of the course (OBJ $_i$):

OBJ 1 : *Understanding of Fundamental Concepts: Gain an in-depth understanding of fundamental concepts such as strain, stress, strain kinematics, balance of forces, and conservation laws.*

OBJ 2 : *- Materials Modeling: Be able to model the behavior of deformable materials as continuous media, using mathematical equations to describe relationships between material properties.*

OBJ 3 : *- Elastic Analysis: Understand the elastic behavior of materials, including the relationship between elastic stress and strain, as well as the determination of the elastic properties of materials.*

OBJ 4 : *- Study of Plasticity: Explore plasticity models to understand how materials permanently deform beyond their elastic limit.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Introduction to Tensor Calculus: (Tensor Algebra – Tensor Analysis)*	*3*	*Understanding of Fundamental Concepts: Gain an in-depth understanding of fundamental concepts such as strain, stress, strain kinematics, balance of forces, and conservation laws.*
2-3	*Study of deformations: (description of movement, deformation tensor, displacement fields, linearized deformation tensor, deformations and main directions)*	*6*	
4-5-6	*Study of constraints: (Fundamental laws of dynamics, conservation of momentum, Cauchy stress tensor, equilibrium equations, boundary conditions, constraints and principal directions)*	*9*	
7-8	*Behavioral laws: (generalized Hooke's law, material isotropy, experimental identification)*	*6*	*Material Modeling*
9-10-11	*General solution methods: (Direct method, inverse method, plane problems)*	*9*	*Elastic Analysis*
12-13-14	*Energy theorems: (Plastic deformation energies).*	*9*	*Study of Plasticity*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- G. DUVAULT, Mechanics of Continuous Media, Edition MASSON, Paris.
- J.OBALA , Exercises and Problems in Mechanics of Continuous Media, Edition MASSON, Paris, (1981).
- M. L.FARES , Physical Principles of the Mechanical Behavior of Materials, Publication of the University of Annaba.
- N. BOURAHLA, Resistance of Basic Materials, Saad Dahlab Blida University, GEOTEC Edition.
- S. BELKAHLA, Course of Elasticity Plasticity, Publication of the University of Annaba.
- O. RAHMANI, S.KEBDANI , Introduction to the Finite Element Method for Engineers, OPU Edition

7- Working environment (Facilities necessary for learning)

- *None*
- ...

Course Specification

Thermic

1. General

Coded	*GELM3110*	Level/Semester	*1/S1*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Akram MAZGAR*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*43.5*
Module	*Thermic*					Version	*09/2023*

Course description (Course objective):
Master the basic concepts of the different modes of heat transfer

Prerequisites:	*Keywords :*
Mathematical tools and notions of thermodynamics: - *Differential equations ; partial derivatives; mathematical operators, integrals* - *Heat, Work, Internal energy, enthalpy* - *1st and 2nd Principle of thermodynamics* - *Dimensional analysis*	*Conduction, Convection, Radiation*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Study the different modes of heat transfer*
OBJ 2 : *Establish the temperature distribution in one-dimensional stationary conduction with and without internal heat dissipation (plane, cylindrical and spherical configuration)*
OBJ 3 : *Introduce the concept of electrical analogy and define the notion of thermal resistance*
OBJ 4 : *Know how to use the different correlations in forced and natural convection in order to estimate the exchange coefficient*

Necessary material :
video projector

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-3	*The different modes of heat transfer (Fourrier's law, Newton's law, Stefan Boltzmann's law)*	*6*	*Know the three modes of heat transfer (Conduction, convection and radiation)*
4-8	*- One-dimensional stationary conduction without internal heat dissipation* *- Concepts of electrical analogy and thermal resistance*	*10*	*- Analyze heat transfer by conduction* *- Establish the temperature profile in a wall in the absence of an internal heat source* *- Determine the equivalent thermal resistance of a composite wall*
9-11	*One-dimensional stationary conduction with internal heat dissipation*	*6*	*Establish the temperature profile in a wall in the presence of an internal heat source*
12-14	*Heat transfer by convection*	*5*	*- Use the different correlations in natural and forced convection* *- Estimate the heat exchange coefficient*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☑ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☑ *No*
- *Authorized search engine* : ☐ *Yes* ☑ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

5- Web references (useful links):

- *MS* Radhouani, Thermal Transfers, 2001
- *P. Clavier,* Thermal transfers Exercises and corrected problems, 2022
- *F. Enguehard, J. Taine, E. Lacona,* Thermal transfers Introduction to energy transfers, 2021
- *MS* Radhouani, N. Daouas, Solved thermal exercises Volume I, 2008

Course Specification

Thermic Machines

1. General

Coded	*GELM212*	Level/Semester	*1/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Akram MAZGAR*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*27*
Module	*Thermic Machines*					Version	*09/2023*

Course description (Course objective):
describe the operating principle of a set of the most commonly used thermodynamic machines

Prerequisites:	*Keywords :*
Mathematical tools and notions of thermodynamics: - *Differential equations ; partial derivatives; integrals* - *Heat, Work, Internal energy, enthalpy* - *1st and 2nd Principle of thermodynamics*	*Driving machine, receiving machine, thermodynamic cycle, efficiency, coefficient of performance*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Classify thermal machines according to the conversion of the energy generated and according to the working fluid* ***OBJ 2 :*** *Describe the operating principle of a thermal machine* ***OBJ 3 :*** *Determine the performance of a thermal machine*

Necessary material :
video projector

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1	*The different types of thermal machines*	*3*	*Classify thermal machines according to the conversion of the energy generated and according to the working fluid*
2-11	*Thermal engines: (Carnot engine, gasoline engine, diesel engine, Stirling engine, etc.)*	*30*	*- Define a Carnot engine - Analyze the operation of dithermic engines - Calculate the efficiency of driving machines*
12-14	*Receiving thermal machines: (refrigerator, heat pump)*	*9*	*- Analyze the operation of receiving thermal machines - Calculate the coefficient of performance of a receiving thermal machine*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☑ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☑ *No*
- *Authorized search engine* : ☐ *Yes* ☑ *No*
- *Criterion 1: Clarity (10%)*
- *Criterion 2: Approach (70%)*
- *Criterion 3: Result (20%)*

5- Web references (useful links):

- E. Koller, Thermal machines, 2005
- *J. Majou, Thermodynamics Principles and thermal machines* , 2023

- *M. I.El -Khazen, Thermal machines: Fundamental notions and corrected exercises* , 2021
- *F. Moritz, Heat Engines in Their Relationship with Thermodynamics, 2018*

Course Specification

Manufacturing processes

1. General

Coded	GELM3209	Level/Semester	1/S2	Coefficient	3	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Safa Hraiech*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*28*
Module	*Manufacturing processes*					Version	*09/2023*

Course description (Course objective):
Choose the optimal manufacturing process(es) to obtain a proposed mechanical part.

Prerequisites:	*Keywords :*
Engineering sciences and techniques.	*Processes, manufacturing, machining, turning, drilling, milling, plastic deformation*

Specific objectives of the course (OBJ $_i$):

OBJ 1 : *Classify the processes for obtaining mechanical parts.*

OBJ 2 : *Identify the processes according to the material and the production program.*

OBJ 3 : *Produce parts by material removal.*

OBJ 4 : *Analyze and interpret definition drawings*

OBJ 5 : *Choose machining processes to use while respecting technical and economic aspects,*

OBJ 6 : *Choose the cutting tools according to the different machining operations;*

OBJ 7 : *Position and fix the part on the available machine tools;*

OBJ 8 : *Choose the optimal cutting parameters.*

OBJ 9 : *Check dimensional, geometric and surface condition specifications.*

Necessary material :
Table, video projector, machine tool, control instruments, machining tools

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	- *Typology of processes;* - *Classification of shaping processes;*	*1.5*	*Classify the processes for obtaining mechanical parts.*

2-3-4	- *Identification of processes according to the material and the production program:*
	  - *Production by material removal;*
	  - *Production by adding material;*
	  - *Production by molding;*
	  - *Production by deformation, Stamping – Stamping, Cutting – Bending – Stamping, Thermoforming;*
	  - *Economic aspect of the processes,*
	  - *Identification of parameters,*
	  - *Concept of economic performance;*
	  - *Waste management.*
		4.5	*Identify the processes according to the material and the production program.*

5-6-7-8	- Production of parts by material removal:
	  - Analysis and interpretation of definition drawings.
	  - Choice of machining processes to use while respecting technical and economic aspects:
	    - Filming,
	    - Milling,
	    - Drilling.
		6	*Produce parts by material removal.*

9-10	- *Positioning and fixing the part on machine tools.* - *Design of fixtures and machining and assembly jigs*	*3*	
11-12	- *Techniques and equipment for measuring dimensional, geometric characteristics and surface conditions.*	*3*	
13-14	- *Application exercises*	*3*	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	- *Discovery of machine tools (lathe, milling machine, drill) and machining and control tools.*	*3h*	*Classify the processes for obtaining mechanical parts.*

3-4	- *Carrying out simple operations on a tower* - *Getting started with the machine* - *Straightening and carriage* - *Control with caliper*	*3h*	*Produce parts by material removal.*
5-6	- *Carrying out simple operations on a milling machine* - *Getting started with the machine* - *Surfacing* - *Control with caliper*	*3h*	
7-8	- *Drilling on a drill* - *Small diameter* - *Large diameter using a pilot hole*	*3h*	
9-10	- *Practical exercise on a piece of revolution with several operations*	*3h*	
11-12	- *Practical exercise on a prismatic part with several operations*	*3h*	
13-14	- *Practical machining examination of the 2 machined parts*	*3h*	

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ■ *No*	
DS - Supervised Duty	■ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	■ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	■ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ■ No*
- *Authorized search engine : ☐ Yes ■ No*
- *Criterion 1: choice of machine tool (3 points)*
- *Criterion 2: choice of tools (3 points)*

- *Criterion 3: operating mode (4 points)*
- *Criterion 4: accuracy of dimensions (10 points)*

6- Web references (useful links):

- *Eric FELDER, M 3000 v2, Shaping of metals, Mechanical and thermal aspects, Engineering techniques, 2015.*
- *Pierre CUENIN, M 3 500, Foundry industry, Engineering techniques, 1994.*
- *Gilles DOUR, "Foundry alloys, processes, usage properties, defects", Editeur Dunod 2004, France.*
- *3 shaping processes " Hermès Science, Paris 1999, France.*
- *Daniel KREMER, Electroerosion machining, engineering techniques, BM 5271,2000.*
- *Michel EUDIER, Powder metallurgy, Generalities, Engineering techniques; M860, 1994.*
- *Julien Duvillet, Photochemical machining, CMT Rickenbach SA, 2017.*
- *Gilles CANNET and Michel DELZENNE, Thermal cutting and water jet cutting,*

7- Working environment (Facilities necessary for learning)

- *Manufacturing workshop (Lathe, Milling machine, Drilling machine, control and machining tools)*

Course Specification

Electrotechnics

11- General

Coded	*GELM3203*	Level/Semester	*1/S2*	Coefficient	*2.5*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Slah FARHANI*					Volume. H. (TP)	*14*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*36*
Module	*Electrotechnics*					Version	*09/2023*

Course description (Course objective):
Allow the student to acquire basic knowledge on the quantities relating to alternating current and three-phase systems as well as alternating / alternating conversion via single-phase and three-phase transformers and to understand the constitutions of electrical machines, their operations and their characteristics . The student must know the criteria for choosing the suitable motor to drive a mechanical system.

Prerequisites:	*Keywords :*
Basic electrical circuits	*Electrical network, Power, power factor, compensation, electromagnetism, electrical machines*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Analyze single-phase and three-phase, balanced and unbalanced electrical circuits.*
OBJ 2 : *Analyze the operation of iron-core coils as well as single-phase and three-phase transformers.*
OBJ 3 : *Learn the principles of electromechanical energy transformation.*

Necessary material :
Single-phase and three-phase alternating network, single-phase and three-phase loads (resistive, inductive and capacitive), measuring devices (voltmeter, ammeter, wattmeter), single-phase and three-phase transformer, rotating electrical machines (direct current machine, asynchronous machine, synchronous machine)

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Calculation of single-phase powers*	*3*	*Understand alternative quantities (voltages, currents, impedances), powers, power factor compensation.*
3-4	*Calculation of three-phase powers*	*3*	*Understand alternative quantities (voltages, currents, impedances), powers, power factor compensation.*
5-6	*Single-phase transformer*	*3*	*Understand the operation and constitution of an iron core coil, no-load transformer, loaded transformer, study of the transformer with Kapp's hypothesis, voltage drop, efficiency.*
7-8	*Three-phase transformer*	*3*	*Study the constitution of a three-phase transformer, the couplings, the hourly index, equivalent diagram and efficiency.*
9-14	*Rotating electrical machines*	*9*	*- Study the operation of rotating electrical machines (direct current machines and alternating current machines), power balance, efficiency, torque/speed characteristics.*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	No. HR	Goals
1-3	*Single-phase power measurements*	*3*	*- Allow the student to manipulate the wattmeter to measure the active, reactive and apparent powers of an industrial electrical installation in sinusoidal alternating*

			regime. - Know how to reduce voltage drops and power losses across power transmission lines, by improving the power factor.
4-6	Three-phase power measurements (delta coupling and star coupling)	3	- Allow the student to manipulate the wattmeter to measure the active, reactive and apparent powers of an industrial electrical installation in sinusoidal alternating mode. - Know how to reduce voltage drops and power losses across power transmission lines, by improving the power factor.
7-9	Study of the single-phase transformer	3	-Study the no-load and load operation of a single-phase transformer by measuring its voltage drop and determining its efficiency - Empty test - Short circuit test -Load test.
10-12	Study of rotating machines (direct current, asynchronous, synchronous)	3	Understand how the machine works, no-load test, load test.
13-14	Practical exam	2h	Summative evaluation

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ Yes ☐ No	
DS - Supervised Duty	x Yes ☐ No	20%
EE - Written test (Final exam)	x Yes ☐ No	60%
EP - Practical test (TP- TP exam / MP- Mini project)	x Yes ☐ No	20%

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* x *No*
- *Authorized search engine* : ☐ *Yes* x *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Bouchard, Réal-Paul and Olivier, Guy, Electrotechnique, editions of the École Polytechnique de Montréal.*
- *Wildi, Théodore, Électrotechnique, third edition, Laval University Press, Quebec.*
- *Hughes, E. (2016). Electrical and Electronic Technology (12th Edition). Pearson.*
- *Théodore, W. (2016). Electrical Machines, Drives and Power Systems (7th Edition). Pearson.*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Signal processing

1. General

Coded	*GELM3204*	Level/Semester	*1/S2*	Coefficient	*2.5*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Hassani MESSOUD*					Volume. H. (TP)	*14*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*38*
Module	*Signal processing*					Version	*09/2023*

Course description (Course objective):
Understand and assimilate the notion of signal as a carrier of information and energy as well as the different tools relating to the processing of this signal in particular its power and therefore its energy, its dependence on its past and the past of other signals known as correlation as well as the transmission of this signal in its analog form or after its digitization via sampling.

Prerequisites:	*Keywords :*
Mathematics for engineers	*Signal, Energy, spectrum, correlation, spectral density , modulation, demodulation*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the concept of signal as a carrier of information in the form of a given energy*
OBJ 2 : *Understand the characteristics of the signal in particular its spectrum, its correlation, its spectral density,*
OBJ 3 : *Understand the techniques for transmitting this signal in both analog and digital form.*

Necessary material :
Hardware

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. _ HR	Goals

1-2	***Chapter 1: Introduction to Signals*** - *Notion of signal: Definition, Example, usual signals, instantaneous power of a signal, average power, energy, interaction energy, etc.* - *Exercises*	3	***OB1:*** *Understand the concept of signal as a source of energy*
3-5	***Chapter 2: Characteristics of a signal*** - ***Spectrum of a signal*** • *Case of periodic signals* • *Case of non-periodic signals* • *Amplitude spectrum and phase spectrum* • *Energy and frequency power* • *Parseval 's theorem* • *Spectral density* - *Exercises*	4.5	***OB2:*** *Understand the correspondence between the temporal description and the frequency description of a signal*
6-7	- ***Correlation of a signal*** • *Autocorrelation* • *Intercorrelation* • *Link between energy and correlation* • *Spectral density and correlation* - *Exercises*	3	***OB2:*** *Understand the notion of correlation which expresses the dependence of the signal either on its past or on the past of other signals*
8-9	***Chapter 3: Sampling a signal*** - *Concept of sampling* - *Spectrum of the sampled signal* - *Sampling period and Shannon's theorem* - *Reconstruction of a signal* - *Exercises*	3	***OB3:*** *Understand the digitization of a signal with a view to its digital transmission as well as its reconstitution at the receiver level*
10-14	***Chapter 4: Transmission of a signal*** - *Modulating a signal* • *Amplitude modulation* • *Frequency modulation* • *Phase modulation* - *Demodulation of a signal* • *Amplitude demodulation* • *Frequency demodulation* - *Exercises*	7.5	***OB3:*** *Popularize the notion of transmission and reception of a signal*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. _ HR	Goals

1	***TP1:*** *Temporal and frequency study of periodic deterministic signals*	3	***OB1 & OB2:*** *Handle the matlab software* *Tracing a periodic signal* *Signal spectrum tracing*
2	***TP2:*** *Temporal study* *and frequency of signals* *non-periodic determinists*	3	***OB1 & OB2:*** *Tracing a non-periodic signal* *Plotting the Fourier Transform* *Signal spectrum tracing* *Shifted spectrum representation*
3	***TP3:*** *Sampling and reconstruction*	3	***OB3:*** *Study of* ideal sampling ***and*** real sampling *Reconstruction by zero-order blocker* *Reconstruction by linear interpolation*
4	***TP4:*** *Modulation and demodulation of a signal*	3	***OB3:*** *Representation of an amplitude, frequency and phase modulated signal and demodulation of an amplitude modulated signal*
	Practical exam	2	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☒*No*	
DS - Supervised Duty	☒*Yes* ☐ *No*	
EE - Written test (Final exam)	☒*Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒No*
- *Authorized search engine : ☐ Yes ☒No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*

- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Random functions; A. Blanc-Lapierre, B. Picin-bono .
- Digital signal processing; Mr. Bellanger.
- Filtering and its applications; M. Labarrère , JP Krief , B. Gimonet .
- Oppenheim, A. V., Willsky, A. S., & Nawab, S. H. (1997). *Signals and Systems* (2nd Edition). Prentice Hall.
- Proakis, J. G., & Manolakis, D. G. (2007). *Digital Signal Processing: Principles, Algorithms, and Applications* (4th Edition). Pearson.

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Mechanical engineering

1. General

Coded	GELM3206	Level/Semester	1/S2	Coefficient	1.5	Credits	2
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Safa HRAIECH*					Volume. H. (TP)	21
Teaching methods	Lecture, interactive, direct instructions					Self study H.	28
Module	*Mechanical design*					Version	09/2023

Course description (Course objective):
The mechanical design office aims to study the movement and behavior of objects, as well as the forces that influence them.

Prerequisites:	*Keywords :*
Engineering Sciences and Techniques; Mechanical concept	*Bending, buckling, friction, crank rod....*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : Allow the student to exploit their knowledge in engineering sciences by carrying out practical work.

Necessary material :
Torsion analysis test bench, Friction test bench, Buckling test bench, Bending test bench, Torsion test bench

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1.2	*friction*	*3*	*Identify and experimentally measure the friction coefficients of different materials*
3-4	*Flexion*	*3*	*Measure displacements under the action of bending forces and determine the characteristics of the material*

5-6	*TP Torsion*	*3*	*Measure distortion under the action of torsional torques and determine the characteristics of the material*
7-8	*Torsor Modeling TP*	*3*	*Know how to experimentally model a torso of mechanical actions*
9-10	*Tp Flambage*	*3*	*Experimentally determine the critical buckling force*
11-12	*Kinematics (Connecting Rod Crank)*	*3*	*Know how to graphically determine the speeds and accelerations of a system*
13-14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ *Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☒ Yes ☐ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- G.SPINNLER , "Design of machines", 3 Volumes, Presses polytechniques et universitaire romandes
- Mechanical Design, Vol. 1, Debongnie (Jean-François), Liège, 2007,
- Endurance calculations by similarity, 10th Mechanics Congress (Oujda, Morocco), April 2011.

- D. François, A. Pineau and A. Zaoui, Mechanical behavior of materials, vol. 2, Hermès, Paris, 1993

Course Specification

Certification Preparing CAO 1

1. General

Coded	*GELM3207*	Level/Semester	*1/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Maher ELTAIEF*					Volume. H. (TP)	*21*
Teaching methods	interactive, direct instructions, Project Based					Self study H.	*28*
Module	Preparing for CAD certification 1					Version	*09/2023*

Course description (Course objective):
Course description: *SOLIDWORKS certifications accurately assess knowledge and expertise with SOLIDWORKS software.*   *The program establishes an industry standard by which SOLIDWORKS professionals are evaluated through a comprehensive, unbiased test of their SOLIDWORKS knowledge in the areas of mechanical design and design validation. With this certification, you position yourself as a highly competent SOLIDWORKS professional. Recruiters can feel confident in their decision to hire a certified candidate, reducing the time it takes to onboard a new team member.*

Prerequisites:	*Keywords :*
Computer tools, technical drawing rules, mechanical design.	*CSWA, SOLIDWORKS Getting Started*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Master the SOLIDWORKS "sketch" tool;*   ***OBJ 2 :*** *Master the SOLIDWORKS "Function" tool and design parts;*   ***OBJ 3 :*** *Master the SOLIDWORKS "Assembly" tool and create systems;*   ***OBJ 4 :*** *Master the SOLIDWORKS "Drawing" tool;*

Necessary material :
Painting ; Video projector ; computer laboratory; SOLIDWORKS software

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	…	…	…
3-4	…	…	…
…	…	…	…
11-12			

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	No. HR	Goals
1-2	*SOLIDWORKS Interface*	*3*	*Recognize the "Draw" tools; "quotation", "modification"* *Using sketch relationships.* *Recognize the functions of adding material by:* *Extrusion, revolution, sweeping, smoothing…)* *Recognize the removal functions of the* *material by: extrusion, revolution, scanning, smoothing, etc.)*
3-4	*Sketch representation (part 1)*	*3*	*Create sketch entities (lines, rectangles, circles, arcs, ellipses, construction lines); Create sketch tools (offset, conversion, adjustment); Add sketch relationships;*
5-6	*Representation of sketches (part 2)*	*3*	*Master entities, tools and sketch relationships through application exercises*
7-8	*Application of functions and representation of 3D parts*	*3*	*Carry out bossing and material removal functions (extrusions, revolutions, sweeps, smoothing); Fillets and chamfers; Linear, circular and zone repetitions; Develop the conditions of the functions (start and end); Development of mass and material properties;* *Master the function tools through application exercises*
9-10	*Making the assemblies*	*3*	*Insert components by standard constraints (coincident, parallel, perpendicular, tangent, concentric, distance, angle); Use reference geometry (planes, axes, constraint references) ;*

			Master assembly tools through application exercises.
11-12	Creation of drawings	3	Prepare the cartridges; Create overall drawings; Insert the nomenclature; Produce definition drawings; Insert sectional, detailed, local sectional views, etc.; Insert geometric constraints and roughness; insert annotations.
13-14	Practical exam	3	Summative evaluation

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ Yes ☐ No	20%
DS - Supervised Duty	☐ Yes ☐ No	
EE - Written test (Final exam)	☐ Yes ☐ No	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ Yes ☐ No	80%

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes x No*
- *Authorized search engine : ☐ Yes x No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *https://solidworks.typepad.com/files/solidworksexercisepractices_tuto1a5.pdf .*
- *https://help.solidworks.com/2021/english/SolidWorks/sldworks/c_document_basics.htm.*
- *André Chevalier, "Industrial designer's guide"; 2004 edition.*
- *H. Ribrol, Mechanical construction drawing, edition of Lagrave 2001.*

7- Working environment (Facilities necessary for learning)

- *None*
- *…*

Course Specification

Mechanical Design 2

1. General

Coded	*GELM3206*	Level/Semester	*1/S2*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Maher ELTAIEF*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*27*
Module	*Mechanical Design 2*					Version	*09/2023*

Course description (Course objective):
Course description: *Movement transformation mechanisms are mechanisms that modify the type of movement between the leading organ and the driven organ.*   *The transformation of movement is a complex mechanical function , since it is carried out by a mechanism , or a set of components. It modifies the type of movement of one component of the mechanism in relation to another. Thus, a rotational movement of the driving member can cause a rectilinear translation movement in the driven member . The reverse is also possible.*

Prerequisites:	*Keywords :*
Mathematical tools (vector- Torseur, etc.); *Translation guidance- Rotation guidance- Bearing assembly- Mechanical connections*	*Equivalent Links- Motion Transformation System.*

Specific objectives of the course (OBJ $_i$):

OBJ 1 : *Establish the connection graph of a mechanism;*

OBJ 2 : *Establish the kinematic diagram of a mechanism;*

OBJ 3 : *Determine the equivalent bond; calculate the degree of mobility and hyperstatism of a mechanism;*

OBJ 4 : *Study and analyze the crank rod system.*

OBJ 5 : *Study and analyze the screw-nut system;*

OBJ 6 : *Study and analyze the cam and eccentric system;*

OBJ 7 : *Study and analyze the rack and pinion system.*

Necessary material :
Painting ; Video projector.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-4	*Chapter 1: Concept on the theory of mechanism*	*6*	*Define the static and kinematic twists of the connections;* *Make the connection graph; Create the kinematic diagram* *Determine the equivalent connection for parallel and series associations.* *Study a closed continuous chain mechanism, calculate the degree of mobility and hyperstatism;* *Tutorials.*
5-6	*Chapter 2: Study of a connecting rod crank system*	*4.5*	*Design and size a crank rod system; Establish the kinematic diagram;* *Calculate the degree of mobility and hyperstatism;* *Study reversibility;* *Establish mechanisms based on connecting rod crank* *Tutorials*

7-9	*Chapter 3: Study of a screw-nut system* *Tutorials*	*4.5*	*Design and size a screw-nut system; Establish the kinematic diagram;* *Calculate the degree of mobility and hyperstatism;* *Study reversibility;* *Design screw-nut based mechanisms.* *Master the screw-nut technology solution.*
10-11	*Chapter 4: Study of a cam and eccentric system*	*3*	*Design and dimension a cam and eccentric system; Establish the kinematic diagram;* *Calculate the degree of mobility and hyperstatism;* *Study reversibility;* *Establish cam-based and eccentric mechanisms* *Tutorials*
13-14	*Chapter 5: Study of a rack and pinion system*	*3*	*Design and size a rack and pinion system; Establish the kinematic diagram;* *Study reversibility;* *Establish rack and pinion based mechanisms* *Tutorials*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* x *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* x *No*
- *Authorized search engine* : ☐ *Yes* x *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Philippe Boisseau, Mechanical design, Dunod, 2011.*
- *Jean Louis Fanchon, Guide to industrial sciences and technologies, Precis Afnor-Nathan, 2022*
- *Francis Esnault, MECHANICAL CONSTRUCTION POWER TRANSMISSION. Volume 1, Dunod, 2007.*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Quality - Certification - Standards

1. General

Coded	GELM3213	Level/Semester	1/S2	Coefficient	2.25	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Chokri BOURAOUI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*43.5*
Module	*Quality – Certification – Standards*					Version	*09/2023*

Course description (Course objective):
Quality, Certification and Standards is a training course that aims to provide participants with an in-depth understanding of quality management principles, certification processes and associated standards .

Prerequisites:	*Keywords :*
Probability and statistics	*Standard, quality, certification, ISO, QMS*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand and implement the process approach in a company as part of a quality approach or a QSE approach (Quality, Safety, Environment)*
OBJ 2 : *Understand and use ISO 9001 and the main ISO 9000 standards*
OBJ 3 : *Master problem solving tools*
OBJ 4 : *Know the main continuous improvement methods and tools*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Quality management :*** *Introduction to basic quality concepts.* *Principles of quality management according to models such as ISO 9001.* *Continuous process improvement methods.*	4.5	*Understand and use ISO 9001 and the main ISO 9000 standards*

3-4-5	***Quality Standards:*** *Exploring international quality management standards.* *Examination of standards specific to the industry or sector of activity concerned.* *Application of standards to guarantee the quality of products or services.*	6.75	*Understand and implement the process approach in a company as part of a quality approach or a QSE approach (Quality, Safety, Environment)*
6-7-8	***Certificate :*** *Understanding of certification processes.* *Study of certification bodies and their roles.* *Certification preparation for businesses or professionals.*	6.75	
9-10-11	***Quality Management Systems (QMS):*** *Development and implementation of a QMS compliant with current standards.* *Internal and external audit to ensure compliance with quality standards.* *Management of documents and records linked to quality.*	6.75	
12-13-14	***Practical Cases and Case Studies:*** *Application of concepts learned through concrete case studies.* *Resolving quality issues.* *Simulations of audits and certification processes.*	6.75	*Master problem solving tools*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Quality management: tools and practical applications - Karou Ishikawa - Dunod edition 1996.
- The quality paradigm – Jean-Marie Gogue – 1997 economica edition
- World Class Quality: The 7 Shainin tools of quality – Keki R. Bhote (preface by Dorian Shainin) – Masson edition 1997.
- Teaching quality – Eurequip – Nathan edition 1998
- Treatise on total quality: the new management rules of the 90s – Vincent Labancheix – Dunod enterprise edition 1990
- Quality management – Jean Marie Grauvogel – HERMES edition 1989
- The 20 laws of quality: the Japanese experience at the service of your business – Katsuya Hosotani – Dunod edition 1994.
- The ISO 9001 standard of 1994 and the ISO 9001 standard of 2015

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

CAO electrical systems

1. General

Coded	GELM3205	Level/Semester	1/S2	Coefficient	1.5	Credits	2
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Kais BOUZRARA*					Volume. H. (TP)	*21*
Teaching methods	interactive, direct instructions, Project Based					Self study H.	*27*
Module	*CAD electrical systems*					Version	*09/2023*

Course description (Course objective):
Handle electrical circuit editing and simulation software. Master the preparation of printed circuits.

Prerequisites:	*Keywords :*
Basic notions of electronics	*ISIS, ARES, Arduino,…*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Getting to know ISIS and ARES*
OBJ 2 : *Design and simulation of a stabilized power supply*
OBJ 3 : *Become familiar with the ARDUINO board programming environment*
OBJ 4 : *Know how to program and simulate the operation of certain motors*

Necessary material :
Computer

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	…	…	…
3-4	…	…	…
…	…	…	…
11-12			

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***Introduction to Proteus Software (ISIS)** : familiarization with the tools for schematizing electronic assemblies*	*3h*	*Getting to Know ISIS*
3-4	***Introduction to Proteus Software (ARES):** familiarization with electronic assembly routing tools*	*3h*	*Getting to know ARES*
5-6	***Simulation and routing of a stabilized power supply** : Enter a stabilized 12V power supply under ISIS and its routing via ARES in order to obtain its printed circuit*	*3h*	*Design and simulation of a stabilized power supply*
7-8	***Introduction to the ARDUINO card and its development environment:** Presentation of the ARDUINO UNO card with its IDE by introducing the programming instructions through validation with examples*	*3h*	*Become familiar with the ARDUINO board programming environment*
9-12	***Simulation of a motor control card (DC and stepper) based on the ARDUINO UNO card:** Program the operation of a DC motor and a stepper motor using the IDE ARDUINO and simulation of operation under ISIS*	*6am*	*Know how to program and simulate the operation of certain motors*
13-14	*Practical exam*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☑ *Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☑ *No*	

EE - Written test (Final exam)	☐ *Yes* ☑ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☑ *Yes* ☐ *No*	*80%*

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents :* ☐ *Yes* ☑ *No*
- *Authorized search engine :* ☐ *Yes* ☑ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Development, Energy, and Power Generation Committee. IEEE Guide for the Commissioning of Electrical Systems in Hydroelectric Power Plants. Piscataway, NJ, USA, USA: Energy Development and Power Generation Committee of the IEEE Power Engineering Society, 1998. Print
- Doré, Claude. “Teaching Computer Systems in an Industrial Environment.” University of Sherbrooke, 1989. Print
- Hobman, G. “Electrical and Instrumentation CAD Improve Plant Design.” Hydrocarbon Processing 75.3 (1996): 133. Web.
- IEEE. “Graphic Symbols for Electrical and Electronics Diagrams.” 1975. Reaffirmed (1993): n. p. Print.

7- Working environment (Facilities necessary for learning)

- *None*
- *…*

Course Specification

Metal Structures and Welding Processes

1. General

Coded	*GELM3210*	Level/Semester	*1/S2*	Coefficient	*1*	Credits	*1*
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Mahdi HADJ SALAH*					Volume. H. (TP)	*14*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*7*
Module	*Metal Structures and Welding Processes*					Version	*09/2023*

Course description (Course objective):
Understand welding processes.

Prerequisites:	*Keywords :*
- Technology 1 - Technology 2	*Welding,* oxyacetylene welding, *MIG, MAG, TIG, etc.*

Specific objectives of the course (OBJ $_i$):
At the end of this module, the student must be able to: **OBJ 1 :** Understand welding processes. **OBJ 2 :** Choose the appropriate assembly technique and process . ***OBJ 3 :*** Define the parameters and the process for carrying out the appropriate technique .

Necessary material :
Two (2) coated electrode welding stations and one oxyacetylene welding station.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	…	…	…
3-4	…	…	…
…	…	…	…

11-12			

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	No. HR	Goals
1-3	*Health and safety: Safety in the welding workshop*	*3h*	*See dangers and solutions in the welding shop*
4-6	*The practical work concerns the use of different welding techniques*	*3h*	*Make a longitudinal track (or cord) on a sheet of metal by executing a rapid linear movement*
7-9	*Production of plan assemblies*	*3h*	*Create an assembly of the two sheets (planar assembly) with a slightly balanced advance mode and by melting the metal over the entire thickness*
9-12	*Making corner assemblies*	*3h*	*Create an assembly of the two sheets (corner assembly) with a slightly balanced advance mode and by melting the metal over the entire thickness*
13-14	*Practical exam*	*2h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ *Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☒ *Yes* ☐ *No*

- *Authorized search engine* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Welding: Theory and practices" by Henri Kouzmine-Karavaïeff and Jean-Pierre Croquet
- Steels and implementation processes" by Gérard Collot and Jean Lacombe
- Welding of steels" by Philippe Dupuy and Michel Villette
- Gere, J. M., & Timoshenko, S. P. (1997). *Mechanics of Materials* (4th Edition). PWS Publishing.
- Duley, W. W. (1990). *Materials for High-Temperature Welding* (2nd Edition). Wiley.

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

RDM

1. General

Coded	*GELM3211*	Level/Semester	*1/S2*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Imed KHEMILI*					Volume. H. (TP)	-
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*40*
Module	*Strength of materials*					Version	*09/2023*

Course description (Course objective):
Acquire basic knowledge of material resistance. *Study the resistance of beams and structures in order to determine or verify their dimensions capable of supporting the loads applied to them in acceptable safety conditions with a minimum of cost.*

Prerequisites:	*Keywords :*
Static	*Beam, Force, constraint, solicitation, law of behavior, resistance condition, resistance criterion,*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Determination of the nature of the stress from the cohesion torso.* ***OBJ 2 :*** *Application of the law of behavior to deduce the state of deformations from the state of stresses and vice versa* ***OBJ 3 :*** *Sizing of beams subjected to simple and compound stresses.*

Necessary material :

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Chapter 1: Basic Concepts*	*2.25*	*Reminder on the calculation of forces and*

	- Introduction to RDM (Basic Objectives and Assumptions) - Modeling of mechanical actions (Concept of force and moment) - Fundamental principle of statics - Torsor of internal forces (torsor of cohesion) - Correction of a series of exercises		moments and application of the PFS. Determination of the nature of the stress from the cohesion torso.
2-3	Chapter 2: Studies of stresses and deformations ▪ Study of constraints - Constraint around a point, normal and tangential constraints - Principal constraints, principal faces and principal directions - Plane elasticity: determination of stresses and principal directions by calculation and by the graphic construction of Möhr. - Resistance condition: Resistance criteria, safety coefficient, stress concentration, - Correction of a series of exercises	4.5	Determination of principal directions and principal constraints. Case of plane elasticity.
4-5	▪ Study of deformations: - Displacement and deformation around a point (of unit elongation or expansion and distortion or sliding) - Main deformations and directions, - Plane deformations - Correction of a series of exercises	4.5	Determination of principal directions and principal deformations.
	▪ Behaviour law - Elementary Hooke's law relating to normal and tangential stresses - Generalized Hooke's law (in plane elasticity and in space) - Special problems of elasticity (plane stresses and plane strains) - Correction of a series of exercises		Application of the law of behavior to deduce the state of deformations from the state of stresses and vice versa.
6	Chapter 3: Studies of simple stresses: Traction - simple compression. - Study of deformations (tensile test, longitudinal and transverse deformations) - Resistance condition - Rigidity condition.	2.25	Sizing of beams subjected to simple tension or compression.

	- *Case of thin envelopes* - *Composites* - *Simple compression* - *Correction of a series of exercises*		
7	*Chapter 4: Studies of simple stresses: Simple shear.* - *Shear modeling (shear test)* - *Study of deformations and stresses* - *Resistance condition* - *Calculation examples (determination of the diameter of a nail, verification of a pin, determination of a glued connection, connection by welding)* - *Correction of a series of exercises*	*2.25*	*Sizing of beams loaded with simple shear.*
8-9	*Chapter 5: Studies of simple stresses: Simple torsion.* - *Study of deformations (torsion test) and stress distribution in a straight section* - *Polar quadratic moment* - *Deformation equation, stiffness condition, torsional stress* - *Resistance condition* - *Correction of a series of exercises*	*4.5*	*Sizing of beams subjected to simple torsion.*
10-11	*Chapter 6: Studies of simple stresses: Simple bending.* - *Quadratic moment of a section* - *Normal stresses* - *Resistance condition* - *Bending deformation (Deformation equation, Arrow at a point)* - *Principle of superposition* - *Correction of a series of exercises*	*4.5*	*Sizing of beams subjected to simple bending.*
12-14	*Chapter 7: Studies of Composite solicitations.* - *Principle of superposition* - *Resistance criteria (Rankine, Tresca, Von-Mises)* - *Flexion-traction, Flexion-compression (normal stresses, critical section and resistance condition)* - *Flexion-Torsion (maximum stresses, resistance condition according to Rankine, according to*	*6.75*	*Sizing of beams subject to combined stresses.*

	Tresca and according to Von-Mises: concept of ideal moments of bending and torsion) - *Traction – Twist; Tension Shear* - *Twist – Shear* - *Deviated flexion* - *Correction of a series of exercises*		

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	No. HR	Goals
1-2			
...			
12	*Practical exam*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑*No*	-
DS - Supervised Duty	☑*Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☑*Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☑*No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☑Yes ☐ No*
- *Authorized search engine : ☐ Yes ☑No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Resistance of author materials: m. kerguignas, g. caignaert edition: bordas 1977
- Guide to calculation in mechanics authors: d. spenle, r. gourhant edition: hatchette 1996

- Resistance of author materials: a. guiet, l. geminard edition: dunod 1994
- Practical calculation of structures authors: wa jalil edition: eyrolles
- Resistance of materials: Courses and corrected exercises" by Jacques Mathieu
- Resistance of materials and structures: Courses and corrected exercises" by Jean Lebrun
- Strength of materials - Fundamentals and design methods" by Charles R. Steele and Louis Elger
-Resistance of materials: Courses, exercises and industrial applications" by Claude Bathias and André Pineau

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Servicing and regulation

1. General

Coded	*GELM4104*	Level/Semester	*2/S3*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					*Volume. H. (CI)*	*21*
Responsible	*Tarek GARNA*					*Volume. H. (TP)*	*21*
Teaching methods	Lecture, interactive, direct instruction					Self study H.	*34*
Module	*Servicing and regulation*					*Version*	*09/2023*

Course description (Course objective):
servo systems and the synthesis of correctors.

Prerequisites:	*Keywords :*
Basic notions of mathematics for the engineer	*Transfer function, Bode diagram, PID corrector.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Open-loop linear systems analysis* ***OBJ 2 :*** *Study of controlled systems* ***OBJ 3 :*** *Summary of PID type correctors*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*General information on regulation and control*	*3H*	*Introduce the principles of control and regulation*
3-5	*Temporal and frequency study of linear systems*	*4.5H*	*Calculation and representation of time responses and frequency diagrams*
6-8	*Performance of servo systems*	*4.5H*	*Analysis of stability, precision and response time*

9-12	*Synthesis of analog correctors*	*6H*	*Analog correctors and Ziegler-Nichols method*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-4)	*TP No. 1: Introduction to Matlab*	*6 a.m.*	*Become familiar with the syntax of the language and the different elementary operations as well as the basic functions used in Matlab.*
5-8)	*TP No. 2: Temporal and frequency study of elementary systems using Matlab software*	*6 a.m.*	*Using Matlab to study first and second order systems*
9-10)	*TP No. 3: Simulation of systems using Matlab-Simulink software*	*3 H*	*Become familiar with the Simulink tool*
11-12	*TP No. 4: PID (Proportional Integral Derivative) corrector*	*3 H*	*Summary of a PID corrector*
13-14	*Practical exam, mini-project defense, ...*	*3 H*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*20%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*60%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*

- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- M. KSOURI and P. BORNE, Industrial Regulation, Edition Technip, 1997.
- LOUIS MARET, Automatic regulation, Presse polytechniques, 1987.
- R. Ben Abdennour, P. Borne, M. Ksouri and F. M'Sahli, Identification and numerical control of industrial processes, Edition Technip, 2001.

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Reliability Control / GMAO

1. General

Coded	*GELM4101*	Level/Semester	*2/S3*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Imed KHEMILI*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*30*
Module	*Reliability control / GMAO*					Version	*09/2023*

Course description (Course objective):
Acquire basic knowledge of system reliability, maintenance, availability and safety.

Prerequisites:	*Keywords :*
Concepts of probability laws and statistics	*Random variable, Mathematical expectation, Poisson law, exponential law,*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand how the Maintenance service works regarding equipment monitoring* ***OBJ 2 :*** *Modeling the behavior of equipment according to its lifespan distribution using reliability laws.* ***OBJ 3 :*** *Determination of the maintainability of repairable systems, their average repair times as well as their average availability.*

Necessary material :
CMMS software

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Reliability of non-repairable components:* - *Classification of equipment (Fatigue and wear equipment: concept of failure rate)*	*3*	*Modeling the behavior of equipment according to its lifespan*

	- *Reliability parameters and relationships between them* - *Reliability models: exponential and Weibull: Calculation of reliability and average lifespan (MTBF).* - *Determination of reliability model parameters: Graphical method and maximum likelihood technique.*		*distribution using reliability laws.*
3-4	- *Development of the graphic method (operation and operating practice) and the maximum likelihood technique.* - *Correction of a series of exercises.*	*3*	*Determination of reliability model parameters from a sample of measurements.*
5-6	*Reliability of non-repairable systems.* - *Serial systems* - *Parallel systems* - *"Stand by" systems* - *Concept of redundancy (Optimization and general form)* - *Correction of a series of exercises*	*3*	*Calculation of system reliability and their average lifespan*
7-8	*Reliability of repairable systems.* - *Maintainability* - *Mean Time to Repair (MTTR)* - *Average availability* *Fixed a series of exercises.*	*3*	*Determination of the maintainability of repairable systems, their average repair times as well as their average availability.*
9-12	*Global approach to reliability using Markov chains.* - *Stochastic process.* - *Markov chains (graphical and matrix representation).* - *State probability vector* - *Regular stochastic matrices.* - *Typology of states (absorbing and transient)* - *Probability of absorption* - *Waiting time before absorption* - *Application to reliability*	*6*	*Calculation of the probability of proper operation and failure and calculation of lifespan in a space of discretized states and times.*
13-14	*Correction of a series of exercises*	*3*	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-4	*TP 1: Equipment and personnel management* - *Creation of the database (company, sectors and divisions, cost centers, equipment, articles)* - *Creation of personnel (the participants, their data, their families, their roles, etc.)*	*6*	*Understand the hierarchical structure of a production company and create its Tree Structure.*
5-6	*TP2: Management of corrective work* - *Intervention request (DI)* - *Taking into account the DI* - *Conversion to Work Order (BT)* - *BT planning* - *Activities on BT* - *Closure of BT* - *Intervention report (cost calculation)* - *Fault Tree)*	*3*	*Understand the process of handling failures and corrective interventions.*
7-8	*TP3: Management of preventive work* - *Creation of preventive ranges* - *Creation of counters (km or per hour)* - *Creation of Maintenance sheets (planning: Frequency according to calendar or counter)* - *Automatic generation of BTs* - *Activities on BT* - *Closure of BT* - *Intervention report (cost calculation)*	*3*	*Understand the process of planning operations and systematic preventive interventions.*
9-12	*TP4: Inventory and purchasing management* - *Creation of storage stores* - *Creation of suppliers* - *Stock entry (unit and multiple)* - *Stock releases* - *Stock reintegration* - *Transfer between 2 stores* - *Procurement management*	*6*	*Understand the process describing the movement of stocks and purchases.*
13-14	*Practical exam*	*3*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑*No*	-
DS - Supervised Duty	☑*Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☑*Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☑*Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☑No*
- *Authorized search engine : ☐ Yes ☑No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- J BUFFERNE, The TPM guide, Editions d'organization, 2006.
- M FREDERIC, Setting up a CMMS, Dunod, 2003.
- M JONQUIERES, Environmental management: ISO 14001:2004, AFNOR, 2005
- Y LAVINA, Continuous improvement in maintenance, Dunod, 2005.
- F. MONCHY, the maintenance function, Masson, 2003.
- S NAKAJIMA, Total Productive Maintenance (TPM): implementation, AFNOR, 1989
- TO PAGÈS, M GONDRAN. Reliability of Systems., Edition Eyrolles, 1980
- IN VILLEMEUR. Operational safety of industrial systems, Reliability - Factors
- Humans - Computerization, Édition Eyrolles, Paris, 1988.
- G ZWINGELSTEIN "Fault diagnosis", dealing with new serial diagnostic and maintenance technologies. Hermès Edition 1995

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Organization & Production Management

1. General

Coded	*GELM4110*	Level/Semester	*2/S3*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Habib Abdenneji*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*43*
Module	*Organization and management of production*					Version	*09/2023*

Course description (Course objective):
This course aims to improve the knowledge and skills of electromechanical engineers in the field of production organization and management. Participants will learn the fundamentals of production management, including planning, scheduling, controlling and improving manufacturing processes. They will also gain an in-depth understanding of the methods and tools used to optimize production efficiency and productivity.

Prerequisites:	*Keywords :*
Industrialization course	*Production management, Production scheduling, Planning, Scheduling*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the basic principles of production management* ***OBJ 2 :*** *Master the methods of planning and scheduling manufacturing processes* ***OBJ 3 :*** *Learn to control and improve production performance* **OBJ 4 :** *Apply the concepts learned to real production cases*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1-2	*Introduction to production management* • *Basic concepts of production management* • *Roles and responsibilities of the production manager* • *Principles of production optimization* • *Analysis of a production process and proposal for improvements*	4.5	*Understand the basic principles of production management*
3-4-5	*Aggregated Planning* • *Industrial and commercial plan* • *Master Production Program* • *Developing a production plan for a given scenario*	6.75	*Master global planning methods*
6-7-8-	*Detailed Planning* • *Calculation of Net Requirements (MRP0)* • *Capacity study and production regulation (MRP1)*	6.75	*Master manufacturing process planning methods*
9-10	*Production Management* • *Scheduling technique in functional workshop.* • *Task Scheduling Techniques*	4.5	*Master the methods of scheduling manufacturing processes*
11-12-13-14	*Production control and improvement* • *Measuring and monitoring production performance* • *Continuous improvement methods (JIT)* • *Management of production problems* • *Analysis of production data and proposal of improvement solutions*		*Learn to control and improve production performance*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*

- ***<u>100% CI material : Average = 40% DS + 60% EE</u>***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Brissard, JL and Polizzi, M. Tools for industrial production management, Afnor-gestion;
- Zermati, P. Practice of inventory management. Dunod;
- Vallet, G. Project planning techniques. Dunod, Paris.
- Beranger, P. The new rules of production, Dunod;
- Milan, A. Jouve, M. Communication and business organization. Collection - Breal.
- Engineering Techniques, Safety / prevention of industrial risks, AG 4- April 2004;
- COURTOIS A., MARTIN-BONNEFOUS C., PILLET M. Production management Éditions d'organization – 4th edition – 2006
- GEORGES Javel, Organization and Management of Production, Dunod, Paris, 2004;
- Alain Courtois, Maurice Pillet, Chantal Martin-Bouneffous, Production Management, organizational edition 2003.
- Operations Management" by Jay Heizer, Barry Render (2016)
- Production and Operations Analysis" by Steven Nahmias (2015)

Course Specification

Production techniques and FAO

1. General

Coded	*GELM 4109*	Level/Semester	*2/S3*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Hassine MARGHENI*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*30*
Module	*Production techniques and FAO*					Version	*06/2025*

Course Description (Course Objective):
Analyze the manufacturing of mechanical parts *Implement and program a numerically controlled machine tool.*

Prerequisites:	*Keywords :*
Manufacturing processes; mechanical design.	*MOCN, CNC, FAO, numerical control*

Specific course objectives (OBJ $_i$):

OBJ 1 : *Know the architecture and technology of Numerical Control Machine Tools (NCM)*

OBJ 2 : *Model part/machine relationships (Isostatism, support, effort, etc.)*

OBJ 3 : *Know the part mounting systems and tool attachment systems, turrets and tool magazines: (part coordinate system, tool coordinate system, offset and alignment)*

OBJ 4 : *Modeling of a CNC (machine configuration, origins, characteristic points, axes, machine coordinate system)*

OBJ 5 : *Identify the implementation parameters of MOCN (Vector Models).*

OBJ 6 : *Know the structure of an ISO program: (Program header, blocks, words, addresses, End of program, etc.)*

OBJ 7 : *Know the functions (preparatory G, auxiliary M, technological T, D, S, etc.) and their applications,*

OBJ 8 : *Program a profile and elementary operations (turning case, milling case);*

OBJ 9 : *Program machining cycles in turning and milling (drilling cycles, threading, roughing, pockets, etc.)*

Materials needed:
Table, video projector, CNC machine tool, PC with CAM software

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	- *Introduction to Numerical Control Machine Tools, their different architectures and technologies.* - *Comparison between conventional machines and numerically controlled machines.*	*3 hours*	*Know the architecture and technology of Numerical Control Machine Tools*
3	- *Model a MOCN (machine configuration, origins, characteristic points, axes, machine coordinate system)*	*1.5 hours*	*Modeling of a CNC (machine configuration, origins, characteristic points, axes, machine coordinate system)*
4-5	- *Workpiece mounting systems and tool attachment systems, turrets and tool magazines: (workpiece coordinate system, tool coordinate system, offset and alignment of coordinate systems)* - *Parameters for adjusting and implementing MOCN (Vector Models).*	*3 hours*	*Know the part mounting systems and tool attachment systems, turrets and tool magazines: (part coordinate system, tool coordinate system, offset and alignment of coordinate systems)*
6	- *Structure of an ISO program: (Program header, blocks, words, addresses, End of program, etc.)*	*1.5 hours*	*Know the structure of an ISO program: (Program header, blocks, words, addresses, End of program, etc.)*
7-8	- *Know the functions (preparatory G, auxiliary M, technological T, D, S, etc.) and their applications,*	*3 hours*	
9	- *Program the cutting conditions (spindle rotation management, feed management, watering);*	*1.5 hours*	
10	- *Program a profile and elementary operations (turning case, milling case);*	*1.5 hours*	
11-12	- *Machining cycles in turning and milling (drilling cycles, threading, roughing, pockets, etc.)*	*3 hours*	*Program machining cycles in turning and milling (drilling cycles, threading, roughing, pockets, etc.)*
13-14	- *Application exercises*	*3 hours*	

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
1-2	- *Discovery of the CNC machine and its components*	*3 hours*	*Know the architecture and technology of Numerical*

			Control Machine Tools
3-4	- *Adjustment of the position of the part origin relative to the measurement origin (PREF);* - *Adjusting the position of the program origin relative to the part origin (DEC1)*	*3 hours*	*Modeling of a CNC (machine configuration, origins, characteristic points, axes, machine coordinate system)*
5-6	- *Adjusting the tool gauges*	*3 hours*	
7-8	- *Enter a program using the machine's alphanumeric keyboard.* - *Machine a part on MOCN*	*3 hours*	*Program machining cycles in turning and milling (drilling cycles, threading, roughing, pockets, etc.)*
9-10	- *Programming a turning operation using CAM software*	*3 hours*	
11-12	- *Programming a milling machining operation using CAM software*	*3 hours*	
13-14	- *Practical exam (on FAO and MOCN)*	*3 hours*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ■ *No*	
DS - Supervised Homework	■ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	■ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	■ *Yes* ☐ *No*	*20%*

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ■ *No*
- *Authorized search engine* : ☐ *Yes* ■ *No*
- *Criterion 1: presentation of the copy (2 points)*
- *Criterion 2: accuracy of codes (5 points)*
- *Criterion 3: applied approach (3 points)*
- *Criterion 4: Validity of the program (10 points)*

6- Web references (useful links):

- *Bernard Méry Numerical Control Machines Edition: Hermes 1997*
- *Ronald CAMERON, Technology and numerical control machining Edition: SAINT-MARTIN*
- *B.CORNAND, F.KOLB, J.LACOMBE, I. RAK Machining and numerical control, Edition: 89 Revised and corrected*

7- Working environment (Facilities necessary for learning)

- *Manufacturing workshop (CNC lathe, CNC milling machine)*

Course Specification

Certification Preparing CAO 2

1. General

Coded	*GELM4107*	Level/Semester	*2/S3*	Coefficient	*0.75*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Maher ELTAIEF*					Volume. H. (TP)	*10.5*
Teaching methods	interactive, direct instructions, Project Based					Self study H.	*60*
Module	Preparing for CAD 2 certification					Version	*09/2023*

Course description (Course objective):
<u>Course description:</u>
SOLIDWORKS certifications accurately assess knowledge and expertise with SOLIDWORKS software.
The program establishes an industry standard by which SOLIDWORKS professionals are evaluated through a comprehensive, unbiased test of their SOLIDWORKS knowledge in the areas of mechanical design and design validation. With this certification, you position yourself as a highly competent SOLIDWORKS professional. Recruiters can feel confident in their decision to hire a certified candidate, reducing the time it takes to onboard a new team member.
Each CSWP certification certifies users' skills in the design and analysis of parametric parts and moving assemblies through the use of a set of complex functions in SOLIDWORKS software.

Prerequisites:	*Keywords :*
Computer tools, technical drawing rules, mechanical design, basic notions of SOLIDWORKS.	*CSWP, SOLIDWORKS Advanced Features*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Master advanced sketching tools;*
OBJ 2 : *Master advanced tools for functions and design of complex parts;*
OBJ 3 : *Master advanced tools for functions and design of complex parts;*
OBJ 4 : *Master advanced assembly tools and create more complex systems;*
OBJ 5 : *Master advanced drawing tools;*

Necessary material :

Painting ; Video projector ; computer laboratory; SOLIDWORKS software

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	…	…	…
3-4	…	…	…
…	…	…	…
11-12			

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Advanced sketching features*	*3*	*Use linked dimensions and equations to facilitate modeling; Use equations to establish relationships between dimensions; Updating parameters and dimensions;* *Modify the geometry of an initial part to create a more complex part*
3-4	*Advanced features of functions*	*3*	*Create configurations from other configurations; Modify configurations; Create configurations using families of parts; Know the mass properties; Modify and/or rearrange the characteristics of an existing part.*
5-6	*Advanced assemblies and drawing features*	*3*	*Create an assembly; Add parts to an assembly; Detect collision when moving a part of an assembly; Detect interference; Use basic and advanced constraints* *Insert subassemblies and make it flexible; Replace one part with another in an assembly; Use a coordinate system to perform mass property analysis; Produce technical drawings.*
7	*Practical exam.*	*1.5*	

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting

CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ *Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes x No*
- *Authorized search engine : ☐ Yes x No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *https://solidworks.typepad.com/files/solidworksentreprisespratiques_tuto1a5.pdf ;*
- *https://help.solidworks.com/2021/english/SolidWorks/sldworks/c_document_basics.htm.*
- *André Chevalier, "Industrial designer's guide"; 2004 edition.*
- *H. Ribrol, Mechanical construction drawing, edition of Lagrave 2001.*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Mechanical design 3

1. General

Coded	GELM4106	Level/Semester	2/S3	Coefficient	1.5	Credits	3
Course	Electromechanical Engineering					Volume. H. (CI)	21
Responsible	Maher ELTAIEF					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	50
Module	Mechanical Design 3					Version	09/2023

Course description (Course objective):
Course description: *The mechanical transmission of movement consists of transmitting a movement from one part to another without modifying its nature, using different types of systems.*   *When the movement coming from a force of a mechanical component is communicated to another without being transformed, there is transmission of movement. In a mechanical transmission system, the moving motor organ transmits the action to the receiving organ. These two organs can be directly in contact, but the transmission of movement can also be done using an intermediate organ.*

Prerequisites:	*Keywords :*
Mathematical tools (vector- Torseur…); Mechanical connections; motion transformation systems.	*Motion transmission system, gear train, coupling, clutch, brake, torque limiter.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Define motion transmission systems;*   ***OBJ 2 :*** *Determine the input-output law of motion transmission systems;*   ***OBJ 3 :*** *Define the characteristics of gears;*   ***OBJ 4 :*** *Study classic and epicyclic trains;*   ***OBJ 5 :*** *Indicate typical misalignments;*   ***OBJ 6 :*** *Define the function of a coupling, a clutch and a brake;*   ***OBJ 7 :*** *Study permanent and temporary couplings and demonstrate the most fundamental formulas;*

Necessary material :

Painting ; Video projector.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Chapter 1: the different motion transmission systems*	*1.5*	*Know the main motion transformation systems and their functional application;* *Determine the input-output laws.*
2-3	*Chapter 2: Motion transmission systems by gear: the characteristics of gears.*	*3*	*Know the different types of gears and their characteristics.*
4-5	*Chapter 3: Classical and epicyclic trains;*	*3*	*Create the kinematic diagram of the gear motion transmission systems;* *Define the usual operating cases for planetary gear trains;* *Determine the transmission ratio.*
6	*Directed work on gear motion transmission systems*	*1.5*	
8-9	*Chapter 4: Permanent couplings*	*3*	*Present and describe the main families of permanent couplings;* *Define the type of coupling chosen.* *Propose a constructive solution.*
10-11	*Chapter 5: Temporary couplings*	*3*	*Present and describe the main families of permanent couplings;* *Define the type of coupling chosen;* *Propose a constructive solution.*
12	*Chapter 6: Torque limiters*	*3*	*Present and describe the main torque limiters;* *Propose a constructive solution.*
13-14	*Tutorials for Chapter 4; 5 and 6*	*3*	*Tutorials*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* x *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* x *No*
- *Authorized search engine* : ☐ *Yes* x *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Philippe Boisseau, Mechanical design, Dunod, 2011.*
- *Jean Louis Fanchon, Guide to industrial sciences and technologies, Precis Afnor-Nathan, 2022*
- *Francis Esnault, power transmission mechanical construction. Volume 2, Dunod, 2007.*
- *M. Dejans, E. Lehu, R. Quatremer, Summary of mechanical construction, Edition AFNOR 2001.*
- *A. Chevalier, Industrial designer's guide, Hachette technique edition, 2002.*
- *André Ricordeau, Claude Corbet, Construction technology, Casteilla, 2001.*

7- Working environment (Facilities necessary for learning)

- *None*

Course Specification

Solid Mechanics

1. General

Coded	*GELM 4108*	Level/Semester	*2/S3*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*42*
Responsible	*Brahim MELAOUHI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*31*
Module	*Solid Mechanics*					Version	*09/2023*

Course description (Course objective):
The fundamental objective of this course lies in the consolidation of students' skills in rigid solid mechanics, aiming to instill a deep understanding of the principles governing the movement and dynamic behavior of mechanical systems and to develop practical expertise in the application of dynamic tools. By providing a solid foundation of scientific knowledge, this training aims to arm students with the skills and design tools necessary to interpret the laws of motion in a rigorous manner. Ultimately, this acquisition of knowledge serves as a foundation on which students will be able to build and deepen their expertise, thus forming a solid foundation for any subsequent pursuit in the field of rigid solid mechanics.

Prerequisites:	*Keywords :*
Vector calculation, Notions of torsors, Statics of solids, Kinematics, Matrix calculations, Mechanical connections	*Kinematics, Dynamics, equations of motion, Lagrange, PFD, inertia tensor.*

Specific objectives of the course (OBJ $_i$):
***OBJ 1 :** Provide the general bases essential for the analysis of rigid systems subjected to forces, for the study of mechanisms.*   ***OBJ 2 :** Determine the equations of motion of a mechanical system.*   ***OBJ 3 :** Analyze the movement and dynamic behavior of a mechanical system.*

Necessary material :
Presentation of mass geometry and use of digital tools, Use of   *Fundamental principle of dynamics, Industrial case study, Awareness of factors*   *load, Presentation of a digital resolution tool*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Ch.1 Reminder of kinematics of indeformable solids*** *Settings and location of a solid in space.* *Concept of position vector, concept of linear speed and angular speed.* *Kinematic Torsor* *Law of destruction of speeds in a solid* *Composition of movements (kinematic twisters)*	*3h* *3h*	- *Determine the expression for the speed and acceleration vectors of a point on a moving solid.*
3-4	*Composition of linear velocity vectors* *Composition of angular velocity vectors* *Composition of accelerations* *Kinematics of Solids in Contact* *Sliding speed* *Bearing condition without slip* *Angular swing speed* *Rolling angular speed* *Application exercises and tutorials (TDs)*	*3h*	- *Determination of the entry/exit law by the condition of the bearing without slip*
5-6	***Ch.2 Element of kinetics and geometry of masses*** *Elements of inertia* *Kinetic tensor* *Huygens' theorem* *Quantities of movement and acceleration* *Kinetic Torsor* *Balancing a rotating assembly* *Application exercises and tutorials (TDs)*	*3h* *3h*	- *Understand the basic principles of mass kinetics* - *Master the geometric concepts linked to moving masses*
6-7	***Ch.3 Dynamics of non-deformable solids*** *Dynamic result*		- *Understand the concept of dynamic torsor, its components and its use*

8-9	*Dynamic moment* *Dynamic torso* *Fundamental Principle of Dynamics (PFD)* *Application of general theorems to the system* *Power, Kinetic energy* *Equation of a solid dynamics problem* *Energy approach, equations of motion* *Determination of dynamic forces.* *Application exercises and tutorials (TDs)*	*3h* *3h* *3h*	*to represent the dynamic resultant and the dynamic moment of a solid.* - *Apply the fundamental principle of dynamics* - *Determine the equations of motion and dynamic forces in a mechanical system.*
10-11 11-12	***Ch.4 LAGRANGE equations*** *Fundamental principles :* *Reminder of the fundamental principles of solid mechanics* *Development and Formulation of Lagrange equations:* *Definition of generalized coordinates* *Calculation of partial and total derivatives in the Lagrangian formalism* *Importance of Lagrange equations in solving solid mechanics problems.* *Obtaining Lagrange equations for a system of solids* *Application examples:* *One degree of freedom systems* *Systems with multiple degrees of freedom* *Generalized constraints and forces* *Special cases and simplifications:* *Ideal constraints and holonomic constraints* *Case of conservative forces* *Case of dissipative forces*	*3h* *3h* *3h*	- *Understand the concept of Lagrange equations in the context of solid mechanics.* - *Apply Lagrange equations to model the motion of systems of solids.* - *Determining equations of motion for complex systems*

	General cases *Lagrange multiplier method* *Application exercises and tutorials (TDs)*		
13-14	***Ch.5 Principle of virtual works and virtual power*** *Importance of the principle of virtual works and virtual power.* *Principle of virtual work:* *Definition and explanation of the principle* *Mathematical formulation* *Use for static problem solving* *Practical examples* *Virtual power* *Introduction to the concept of virtual power* *Relationship between the principle of virtual works and virtual power* *Applications in dynamic solids analysis* *Exercises and practical applications* *Special cases* *Virtual work for constrained systems* *Applications to specific structures (beams, continuous beams, etc.)* *Analysis of connections and constraints* *D'Alembert's principle, constraint forces and virtual displacements* *Application exercises and tutorials (TDs)*	*3h* *3h* *3h*	- *Understanding of the Principle of Virtual Works (PTV).* - *Mastery of Concepts Related to PTV.* - *Solve complex problems in solid mechanics using PTV*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *AJ Ballereau, JP Busato, G. Tranier, Mécanique Industrielle Volumes 1 and 2, (1995), Edition: Foucher*
- *Jean-Michel Bauduin, Mechanics of systems and solids, (2000), Publisher: Ellipses*
- *Paul Roux, Mechanics of solid material systems, (1995), Edition: Ellipses*
- *D. Spenlé, R. Gourhant, Guide to calculation in mechanics, (1998), Edition: Hachette*
- *JC Bône, J. Morel, M. Bouch, General Mechanics, (1985), Edition: Dunod*
- *JP Laralde, Cinematics, (1989), Edition: Masson*
- *JP Laralde, Dynamics, (1988), Edition: Masson*

7- Working environment (Facilities necessary for learning)

Course Specification

Embedded systems and microcontrollers

1. General

Coded	GELM4105	Level/Semester	2/S3	Coefficient	3	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Nadia HAJJI*					Volume. H. (TP)	21
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*30*
Module	*Embedded systems and microcontrollers*					Version	*06/2025*

Course Description (Course Objective):
Be able to design, program and integrate an embedded microcontroller-based system for the control or supervision of automated systems.

Prerequisites:	*Keywords :*
logical systems.	

Specific course objectives (OBJ $_i$):	
OBJ 1 :	*Identify the different components of an embedded system*
OBJ 2 :	*Know the different techniques for designing an embedded system*
OBJ 3 :	*Know the characteristics of an embedded system.*
OBJ 4 :	*Learn how to program a microcontroller to control an embedded system.*

Materials needed:
Table; Video projector. *Development boards: Arduino, STM32 Nucleo, ESP32, Raspberry* *Modules: temperature sensors, ultrasound, LDR, IR, motors, LCD screens* *Software: Arduino, MPLAB*

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-4	*Introduction to Embedded Systems* *Definition and characteristics of*	*6*	*Description of the different constituent elements of an embedded system*

	an embedded system.		
5-8	*Embedded operating systems.*	*6*	*Description of an embedded operating system (or RTOS – Real-Time Operating System)* *Main features of the embedded operating system*
9-14	Design *of embedded systems.* *Tutorials: case study*	*9*	*Develop an integrated hardware and software solution, capable of performing a specific function autonomously, in real time and in a given environment.*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Getting started with the microcontroller programming environment*	*3*	*Know everything that is necessary for the operation of the microcontroller: the Arduino card, and the ESP32 card.*
3-4	*Getting Started with the Proteus IDE and Environment*	*3*	
5-6	*Study of an embedded system without an operating system.*	*3*	*The goal of this practical work is to develop and implement applications on an embedded platform without using an operating system.*
7-10	*Study of an embedded system with an operating system*	*6*	*The aim of this practical work is to develop and implement applications on an embedded platform with an operating system such as Linux or Windows.*
11-12	*Programming the main interfaces of an embedded system.*	*3*	*In this experiment, the student is required to program some interfaces of an embedded system such as a diode, an LCD display, a keyboard, etc.*
13-14	*Practical exam*	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*2 0%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes x No*
- *Authorized search engine : ☐ Yes x No*
  - *Criterion 1: Understanding of the content (4 points)*
  - *Criterion 2: Application of knowledge (10 points)*
  - *Criterion 3: Critical analysis (4 points)*
  - *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Jean-Bernard Guiot – Embedded systems: design and applications – Dunod Editions, 2021*
- *Luc LEMONNIER – C language for ARM Cortex microcontrollers – Dunod Editions, 2019*
- *Daniel Ternon – Microcontrollers and embedded systems – Ellipses Editions, 2020*
- *André LaMothe – The Big Book of Microcontroller Development – Pearson Editions*

7- Working environment (Facilities necessary for learning)

- *Title, Version, URL*
- *…*

Course Specification

Programmable controllers

1. General

Coded	*GELM4203*	Level/Semester	*2/S4*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Anis MHALLA*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*34*
Module	*Programmable controllers*					Version	*09/2023*

Course description (Course objective):
Master the operation and identify the components of a SAP *Mastering Grafcet* *SAP automation*

Prerequisites:	*Keywords :*
Automated systems	*Grafcet, Automaton, Gemma…*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Study of a SAP* ***OBJ 2 :*** *SAP ordering and management* ***OBJ 3 :*** *SAP programming*

Necessary material :
AUTOMAT, Scales, HMI

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*General information on SAPs* • *Definition* • *Functioning* • *Inputs/Outputs (I/O)* • *Programming*	*3*	*Provide an overview of SAPs*

<table>
<tr><td></td><td>Applications
Flexibility
Communication Networks</td><td></td><td></td></tr>
<tr><td>3-4</td><td>Grafcet
Stages (or states)
Transitions
Actions
Terms
Events
Level Actions</td><td>3</td><td rowspan="2">SAP ordering and management</td></tr>
<tr><td>5-6</td><td>Gemma
Structuring of the Gemma
Method of using GEMMA
Design of a sequential automation</td><td>3</td></tr>
<tr><td>7-14</td><td>API programming
Ladder Language (LAD)
Functional Block Language (FBD)
Instruction List Language (IL)
Ladder Diagram Language (SFC)
Structured State Language (ST)</td><td>12</td><td>SAP programming</td></tr>
</table>

3- Content elements (Practical work)

<table>
<tr><th>Week(s)</th><th>Activities/Content Elements</th><th>No. HR</th><th>Goals</th></tr>
<tr><td>1-2</td><td>Pneumatic Control</td><td>3</td><td rowspan="2">SAP ordering and management</td></tr>
<tr><td>3-4</td><td>Electropneumatic control</td><td>3</td></tr>
<tr><td>5-6</td><td>API Programming - Instruction List Language (IL)</td><td>3</td><td rowspan="4">SAP programming</td></tr>
<tr><td>7-8</td><td>API programming - Functional Block Language (FBD)</td><td>3</td></tr>
<tr><td>9-10</td><td>API programming - Ladder Diagram Language (SFC)</td><td>3</td></tr>
<tr><td>11-12</td><td>API Programming - Structured State Language (ST)</td><td>3</td></tr>
<tr><td>13-14</td><td>Practical exam, mini-project defense, ...</td><td>3</td><td>Summative evaluation</td></tr>
</table>

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- JM BLEUX – JL FANCHON, Industrial automation ETAPES collection – NATHON 1996
- JC BOSSY – P. FAUGERE – C. MERLAND, Le GRAFCET (Educative 1995)
- C. ROBINET – A. BIANCIOTTI – P. BOYE? Industrial automation and computing (Delagrave 1997)
- D. BLIN – J. DANIC – R. LE GARREC – F. TORLEZ – JC SEITE, Automation and industrial computing (Educative 1995)
- R. DAVID, H. ALLA, From GRAFCET to the Petri network, Ed Hermes
- G. CHEVALIER, B. GUILLOSSOU, GRAFCET and automation functions, Ed Dunod

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Robotics

1. General

Coded	*GELM4204*	Level/Semester	*2/S4*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Wafa BOUKADIA*					Volume. H. (TP)	*10.5*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*40*
Module	*Robotics*					Version	*09/2023*

Course description (Course objective):
The objective of this course is to determine a model for a robot and to master a control card (Nonepberry)

Prerequisites:	*Keywords :*
General mechanics and digital electronics	Robot, forward and reverse model, Nonepberry

Specific objectives of the course (OBJ $_i$):
***OBJ 1 :** Direct model*
***OBJ 2 :** Reverse model*
***OBJ 3 :** Raspberry card*

Necessary material :
Manipulating robots, computer and Nonepberry cards

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-4	*Modeling of mechanical systems*	*6*	*Determination of passage matrices*
5-7	*Direct model*	*4.5*	*Understand how to determine the direct model of a stationary robot*

8-10	*Jacobian matrix and inverse model*	*4.5*	*Calculation of inverse model of a robot*
11-14	*Micro-controller*	*6*	*Master the operation of the Nonepberry card*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	No. HR	Goals
1-3	Calculation of direct robot model by Matlab	*4.5*	*Master Matlab tools to calculate a robot model*
4-6	*Control of fixed robots using a* Raspberry card	*4.5*	*Robot control by a Nonepberry card to carry out a specific task*
7	*Exam*	*1.5*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* * *No*
- *Authorized search engine* : ☐ *Yes* * *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*

- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Jean-Pierre Merlet Parallel robots - Collection Treatise on new technologies - Robotics

- Etienne Dombre **Analysis and modeling of manipulating robots,** 288 pages, published 09/21/2001

- Siciliano, B., & Khatib, O. (2016). *Springer Handbook of Robotics* (2nd Edition). Springer.

- Ayala, M. (2004). *The 8051 Microcontroller* (3rd Edition). Thomson.

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Vibration Mechanics

1. General

Coded	*GELM 4205*	Level/Semester	*2/S4*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Brahim MLAOUHI*					Volume. H. (TP)	*10.5*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*39*
Module	*Vibration Mechanics*					Version	*09/2023*

Course description (Course objective):
The Vibration Mechanics course aims to provide students with an in-depth understanding of vibrational phenomena in mechanical systems. The main objective is to explore the fundamental principles that govern the oscillatory motion of structures, machines and mechanical components. Students will learn to analyze and model vibrations, examining factors such as natural frequency, damping, and vibration modes. The course also covers methods of measuring and controlling vibrations, and their importance in the design and maintenance of mechanical systems. With a focus on practical applications, students will acquire the skills necessary to solve complex vibration-related problems in various fields such as structural engineering, aerospace, machine mechanics, important case in point: suspensions , insulation, measuring devices, vehicles, machine faults...etc. In accordance with the description of the mechanics of vibrations of solids, the course is divided into five essential chapters for an in-depth understanding of this dynamic field.

Prerequisites:	*Keywords :*
- *Dynamics of the rigid solid* - *Linear second order differential equation with constant coefficients* - *Basics of linear algebra.*	*Vibration, Equation of motion, conservative system, dissipative system, resonance, frequency, vibration response.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Gain an in-depth understanding of the fundamental concepts of vibration mechanics* ***OBJ 2 :*** *Be able to model complex mechanical systems as vibrational systems, using differential equations* ***OBJ 3 :*** *Master the analysis of single degree of freedom systems, including the calculation of natural frequencies, eigenmodes and temporal responses.*

OBJ 4 : *Extend understanding to the analysis of systems with several degrees of freedom, by exploring numerical and analytical methods.*

OBJ 5 : *Understand the basic principles of vibration control and be able to apply control strategies to mitigate unwanted vibrations.*

Necessary material :
• *MATLAB environment installed.* • *Data files for the system studied (if necessary).*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Ch.1: Introduction to Mechanical Vibrations*** *Basics of vibration mechanics, Introduction to Vibrations: (Origins, causes, consequences, etc.).* *The basic models of vibration (mass, spring and damper)* *Fundamental concepts such as free and forced oscillations, degrees of freedom, and the basic elements of vibrational systems.*	3h	- *Explain the basics of vibration mechanics. Understand the origins, causes and consequences of mechanical vibrations.* *Identify areas of application of vibrations in various contexts.* - *Describe the fundamental models of vibration (mass, spring and damper). Mastery of Fundamental Concepts:* - *Explain the concept of degrees of freedom in the context of vibrational systems.* - *Identify and understand the basic elements of vibration systems.*
3-4	***Ch.2: Mathematical Modeling of Vibration Systems*** *Mathematical modeling of mechanical systems in vibratory motion.* *Lagrange equations, Differential equations that describe the dynamic behavior of systems, with emphasis on solving these*	*3h*	- *Master the concept of Lagrange equations for modeling vibrational systems.* - *Understand how Lagrange equations simplify the description of complex movements in mechanical systems.* - *Develop an in-depth understanding of mechanical systems in vibratory motion.* - *Identify the characteristics of vibrations ; amplitude, frequency and phase.*

	equations to determine vibrational characteristics.		
5-6	***Ch.3: Study of free vibrational systems at one dof.*** *Definition of the one-dof system:* *Explanation of the concept of degree of freedom.* *Examples of one-dof systems. Case of the simple harmonic oscillator (Case of the simple pendulum).* *Equation of motion:* *Development of the differential equation of motion.* *Initial conditions.* *Solutions of the equation of motion:* *General solution of the equation of motion.* *Special cases and examples.* *Natural frequency:* *Definition of natural frequency.* *Influence of system parameters on natural frequency.* *Amortization :* *Introduction to the concept of depreciation.* *Types of damping (viscous, dry, etc.).*	3h	- *Understand the nature of vibrational systems with one degree of freedom.* - *Understand the physical meaning of each term in the equation of motion.* - *Introduce analytical solutions to the equations of motion, particularly simple harmonic solutions.* - *Apply initial conditions to solve for integration constants.* - *Understand the effects of damping on the vibration behavior of systems, and know how to model and quantify damping.*
	Ch.4: Response of forced vibrational systems to a dof. *Definition of the system forced to a dof:* *Examples of systems forced to a dof.* *Forced response:*		- *Define harmonic forcing and explain its role in forced vibration systems.* - *Identify the characteristics of a harmonic force, such as amplitude and frequency.* - *Write the equation of motion for a vibrational system with one degree of freedom subject*

7-10	*Explanation of the concepts of forced response and free response.* *Analysis of the two types of responses.* *Response to a sinusoidal force:* *Analysis of the response of a system to a sinusoidal force.* *Magnitude and phase of the response.* *Response to an unbalance force:* *Analysis of the response of a system to an unbalance force* *Magnitude and phase of the response.* *Transmission of vibrations to the foundations; Response to a supporting force:* *Response analysis* *Communicability Report* *Magnitude and phase of the response.* *Vibration isolation* *Exercises to reinforce understanding of concepts.* *Numerical resolution problems.*	*3h* *3h*	*to a harmonic force , unbalance force and support force.* - *Explain the terms resonance, damping and stiffness in the context of the equations of motion.* - *Define the concept of steady-state response of a forced system.* - *Calculate the amplitude of the steady-state response for a vibrational system at one DOF.*
	Ch.5: Study of free and forced DOF vibration systems . *Introduction to systems with "n" degrees of freedom:* *Definition of "n" dof systems.* *Examples of multi-DOF systems in the context of mechanical vibrations.* *Modeling of "n" dof systems:* *Use of differential equations to model the motion of systems.*		- *Master the equations of motion for systems with n degrees of freedom in the case without damping.* - *Know how to analytically solve the equations of motion for systems with n degrees of freedom with damping.* - *Analyze the normal modes and natural frequencies of systems with n degrees of freedom.* - *Understand the concept of coupling between degrees of freedom in vibrational systems.*

11-14	*Concept of mass, stiffness and damping matrices.* *Systems with "n" free dof:* *Reminder of the concepts of natural frequencies and natural modes.* *Analysis of normal vibration modes.* *Numerical methods for solving the equations of motion.* *Systems with "n" forced dof:* *Introduction of external forces and excitations.* *Forced response and amplitude as a function of excitation frequency.* *Resonance and its importance in vibrational systems.* *Analysis methods:* *Frequency response method.* *Spectral analysis of forced responses.* *Use of numerical methods such as the finite element method.*	*3h* *3h*	- *Analyze the forced responses of systems with n degrees of freedom under the effect of periodic forces.* - *Understand resonance phenomena and ways to avoid or mitigate them.* - *Apply the principles of vibration mechanics to concrete cases from engineering.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	***Practical applications:*** *Application examples in fields such as engineering, aerospace, etc.* *Analysis of vibrations in complex structures.* ***TP-1 Modeling of a 1ddl system on Matlab Simulink® & Simscape™.*** *Use of programmable blocks (Mass, spring,* shock absorber, etc.)*, Connection of blocks, Configuration of parameters, Configuration of initial conditions,*	*3h*	- *Understand the basic concepts of modeling systems with multiple degrees of freedom.*

<table>
<tr>
<td></td>
<td>Simulation of the model, Analysis of results and Observation of the system response to the simulation.

Study of the influence of the nature of the excitation on the response.

Study of the influence of parameters on the response.</td>
<td></td>
<td rowspan="2">- Acquire skills in using MATLAB for modeling dynamic systems.

- Analyze the dynamic behavior of a complex system using MATLAB simulations.

- Process numerical examples in the laboratory to illustrate the simulation of vibration behavior and theoretical concepts.

- Acquire practical skills in using modeling and simulation software to characterize vibrational movements.

- Analysis of experimental results

- experimental data .</td>
</tr>
<tr>
<td>3-4</td>
<td>TP-2 Modeling a 2ddl system on Matlab Simulink® & Simscape™

Part I : Modeling in Matlab Simulink®

Creation of a new Simulink model.

Added mass, spring and damping blocks to represent the 2dof system.

Connecting the blocks to form the system model.

Setting the physical properties of the system elements (mass, spring stiffness, damping coefficient).

Configuring initial conditions.

Part 2 : System simulation in Simulink

Definition of simulation parameters (simulation time, time step, etc.).

Running the simulation and observing the temporal response of the system.

Analysis of simulation results, including mass movements and velocities over time.

Part 3 : Modeling in Simscape™

Introduction to Simscape™ and its physical blocks.

Creation of a new Simscape™ model.

Use of physical components to model the 2ddl system.

Configuration of physical parameters of components.</td>
<td>3h</td>
</tr>
</table>

	Part 4 : System simulation in Simscape™ *Setting simulation parameters specific to Simscape™.* *Running the simulation and comparing the results with those obtained in Simulink.* *Analysis of the benefits of using Simscape™ for modeling complex physical systems.* *Summary of the main stages of the practical work.* *Discussion of the advantages and limitations of each modeling approach.*		*- Compare experimental results with theoretical predictions.*
5-6	***TP-4 Modeling of a n dof system Matlab® Script (case study)*** ***Part 1: Theory of n dof systems*** *Introduction to dynamic and multi-degree-of-freedom systems.* *Definition of key terms: degree of freedom, mass-spring system, mass and stiffness matrices.* *Equations of motion for a system with n dof.* ***Part 2: Modeling the system in MATLAB*** *Importing the necessary MATLAB tools.* *Definition of system parameters (mass, stiffness, damping).* *Writing the MATLAB script for modeling the n dof system.* ***Part 3: Simulation and analysis*** *Initialization of initial conditions and simulation parameters.* *Running the MATLAB script to generate the results.* *Analysis of the results: displacement, speed, acceleration, natural frequencies, natural modes.* ***Part 4: Parameter variation and sensitivity analysis*** *Changing system settings in MATLAB script.*	*3h*	

	Running simulations for different configurations. *Sensitivity analysis: how parameters influence system behavior.*		
7	*Practical exam*	1.5	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Del Pedro, Michel, Pahud, Pierre, Vibratory mechanics discrete linear systems, (1989), Edition: Lausanne: Presses polytechniques romandes.*
- *FP Beer , ER Johnston , Mechanics for engineers, Dynamics vol.2 (2009), Edition: De Boeck Supérieur*
- *Marc Thomas, Frédéric Laville, Simulation of mechanical vibrations by Matlab, Simulink and Ansys, (2007), Edition: Presses de l'iversite du Quebec .*

7- Working environment (Facilities necessary for learning)

Course Specification

ERP & GPAO

1. General

Coded	GELM4206	Level/Semester	2/S4	Coefficient	1.5	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	Habib ABDENNEJI					Volume. H. (TP)	*21*
Teaching methods	interactive, direct instructions, Project Based					Self study H.	*54*
Module	*ERP & GPAO*					Version	*09/2023*

Course description (Course objective):
Computer-assisted production management is an IT tool for managing all activities linked to the production of an industrial company; optimize all production processes by controlling various costs.

Prerequisites:	*Keywords :*
OGP	*Technical data, PIC, PDP, Planning, Scheduling, Launch, Declaration, Production*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Optimize entire production processes, from resource planning to inventory management, to increase operational efficiency.* ***OBJ 2 :*** *Planning and anticipation of manufacturing orders for better production traceability.* ***OBJ 3 :*** *Calculation and determination of costs for an in-depth definition of load distribution.*

Necessary material :
Computer Lab, CAPM Software (E-Prelude)

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Management of technical data (Items, Nomenclatures)*	*3*	*Calculation and determination of costs for an in-depth definition of load distribution.*
3-4	*Management of technical data (cost items, ranges) and cost calculation*	*3*	
5-6	*Development of the PIC, breakdown of the PDPs and calculation of net needs*	*3*	*Optimize entire production processes, from resource planning to inventory management, to increase operational efficiency.*
7-8	*Supply Management and Stock Management*	*3*	
9-10	*Staking and Scheduling of Manufacturing Orders*	*3*	
11-12	*Launch and monitoring of production, declaration and measurement of indicators*	*3*	*Planning and anticipation of manufacturing orders for better production traceability.*
13-14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ *Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☒ Yes ☐ No*
- *Authorized search engine : ☐ Yes ☒ No*

- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Brissard, JL and Polizzi, M. Tools for industrial production management, Afnor-gestion;
- Zermati, P. Practice of inventory management. Dunod;
- Vallet, G. Project planning techniques. Dunod, Paris.
- Beranger, P. The new rules of production, Dunod;
- Milan, A. Jouve, M. Communication and business organization. Collection - Breal.
- Engineering Techniques, Safety / prevention of industrial risks, AG 4- April 2004;
- COURTOIS A., MARTIN-BONNEFOUS C., PILLET M. Production management Éditions d'organization – 4th edition – 2006
- GEORGES Javel, Organization and Management of Production, Dunod, Paris, 2004;
- Alain Courtois, Maurice Pillet, Chantal Martin-Bouneffous, Production Management, organizational edition 2003.
- Anne Gratacap, Pierre Médan, Production Management: Concepts- Methods- Cases; Dunod 2009

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Lean Manufacturing

1. General

Coded	GELM4207	Level/Semester	*2/S4*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Abdenneji HABIB*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*30*
Module	*Lean Manufacturing*					Version	*09/2023*

Course description (Course objective):
Lean Manufacturing courses aim to equip students with the skills needed to transform manufacturing or service operations by adopting a Lean approach, thereby improving business competitiveness and profitability.

Prerequisites:	*Keywords :*
OGP	*Waste, Mudas, VA & NVA, customer, Productivity*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Introduce the fundamental principles of Lean*
OBJ 2 : *Identify and eliminate different forms of waste,*
OBJ 3 : *Approach to developing a continuous improvement project*
OBJ 4 : *Application of Lean tools in continuous improvement processes*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Lean Philosophy:*** *Importance of the culture of continuous improvement. creating value, eliminating waste,*	*3*	*Introduce the fundamental principles of Lean*

3	***The hunt for waste (Muda**): overproduction, waiting, unnecessary transport, overproduction, unnecessary movements, excessive stocks, and defects.*	*1.5*	*Identify and eliminate different forms of waste,*
4-5	***Continuous Improvement (Kaizen)** Constant improvement integrated into the company culture. learning to use Kaizen methods to solve problems, improve processes and drive innovation*	*3*	*Approach to developing a continuous improvement project*
6-14	***Lean tools** : JIT, 5S, Jidoka, SMED, Poka-yoke, Kamban, TOC, VSM....*	*13.5*	*Application of lean tools in continuous improvement processes*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- COURTOIS, Alain; PILLET, Maurice; MARTIN-BONNEFOUS, Chantal (2003). Production management, Organization editions.

- DELBALDO, Emmanuele (2009). P-Lean 32 Hours, it's possible! Afnor Editions.
- DURET, Daniel; PILLET, Maurice (2005). Quality in production: from ISO9000 to Six Sigma, EYROLLES Editions d'organization.
- FELD, William M. (2001). Lean Manufacturing: Tools, Technics and How To Use Them, The St. Lucie Press/APICS Series on Resource Management.
- MATSUDA, Kamematsu (1998). The quality guide to production management: Industrial management in lean companies, Dunod.
- SHAH, Rachna; WARD, Peter T. (2003). Lean manufacturing: context, practice bundles, and performance, ELSEVIER/Journal of Operations Management.
- VOLCK, Nicolas (2009). Deploy and operate Lean Six Sigma, EYROLLES Editions organization.

Course Specification

Hydraulic and pneumatic systems

1. General

Coded	*GELM4208*	Level/Semester	*2/S4*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Jamel MELAOUHI*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*21*
Module	Hydraulic and pneumatic systems					Version	*09/2023*

Course description (Course objective):
Help the learner understand the mechanisms of hydraulic and pneumatic power transmission.

Prerequisites:	*Keywords :*
Fluid Mechanics and Heat Transfers.	*Graphic symbol, pump, valves, motors, conditioning unit, cavitation,*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : ***OBJ 1 :*** *Understand the basic concepts, component symbols and coding for a graphical representation*
OBJ 2 : *Know how to choose and study the basic components: pumps, compressors, motors, cylinders and valves for a given hydraulic or pneumatic industrial installation.*
OBJ 3 : *Study the characteristics of hydrostatic transmissions*
OBJ 4 : *Study fluids and conditioning*
OBJ 5 : *Understanding the all-or-nothing command, GRAFCET*
OBJ 6 : *Implemented through applications: electrical logic, programmable automatons and pneumatic logic .*

Necessary material :
Hydraulic Lab

2- Content elements (Course)

Week(s)	*Chapters/Content Items*	*No. HR*	*Goals*

3- Content elements (Practical work)

Week(s)	*Activities/Content Items*	*No. HR*	*Goals*

1.2	*Design a hydraulic circuit based on a case study.* *Perform the simulation on hydraulic software*	*3 hours*	*Interventions on circuits: identification and replacement of components, adjustment of parameters (flow, pressure)*
3-4	*Design a pneumatic circuit from a case study.* *Perform the simulation on pneumatic software*	*3 hours*	*Interventions on circuits: identification and replacement of components, adjustment of parameters (flow, pressure)*
5-6	*Wire the circuits on simulation benches and adjust the parameters (pressure, flow rate)*	*3 hours*	*Understand the operation and role of circuit components.*
7-8	*On the centrifugal pump test bench:* - *Select using isolation valve the circuit where only one pump operates* - *Vary the flow rate using a flow control valve* - *Determine the characteristic curve of the pump Hmt=f(Qv)* *Determine its yield η=f(Qv)*	*3 hours*	*Determine the characteristics (Hmt, Qv, η) of a single pump*
9-10	*On the centrifugal pump test bench:* - *Select the circuit for series pump coupling using an isolation valve* - *Vary the flow rate using a flow control valve* - *Determine the characteristic curve of the coupling Hmt=f(Qv)* *Determine the coupling efficiency η=f(Qv)*	*3 hours*	*Determine the characteristics (Hmt, Qv, η) of a series pump coupling*
11-12	*On the centrifugal pump test bench:* - *Select the circuit for parallel pump coupling using an isolation valve* - *Vary the flow rate using a flow control valve* - *Determine the characteristic curve of the coupling Hmt=f(Qv)* *Determine the coupling efficiency η=f(Qv)*	*3 hours*	*Determine the characteristics (Hmt, Qv, η) of a parallel pump coupling*
13-14	*Practical exam, mini-project defense, etc.*	*3 hours*	*Summative assessment*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒*Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***Material 100% TP : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- CI+TP material : Average = 20% DS + 20% EP + 60% EE

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Patrick Beynet, Product functions – Pneumatic – hydraulic technology for automated production systems. Rouvière High School Toulon.
- J. Perrin, F. Binet, J.-J. Dumery, C. Merlaud, J.-P. Trichard, Automation and Industrial Computing – Theoretical, methodological and technical bases, Éditions Nathan Technique, 2004.
- Guide to Industrial Automation.

7- Working environment (Facilities necessary for learning)

- *None*
- *…*

Course Specification

Modeling and management of electrical networks

1- General information

Coded	*GELM4209*	Level/Semester	*2/S4*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Souha BOUKADIA*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*24*
Module	*Modeling and management of electrical networks*					Version	*06/2025*

Course Description (Course Objective):
- Provide the future engineer with the basic knowledge necessary to understand how an electrical network works (techniques used, dedicated vocabulary, voltage levels) *- Understand the problem of energy supply in the context of market opening.*

Prerequisites:	*Keywords :*
Electrical engineering	*Electrical network, dispatching, load diagram, stability…*

Specific course objectives (OBJ $_i$):
OBJ 1 : *Understand how the electricity network works (production, transport, distribution)* ***OBJ 2 :*** *Understand the electrotechnical constraints that can constrain electrical energy markets.* ***OBJ 3 :*** *Size faults and their causes to properly manage the electrical network.*

Materials needed:
…

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Sinusoidal Regime Basics*	*3*	*Become familiar with the calculation of powers, alternating quantities, voltages, currents, impedances, vector representation and complex representation, powers, power factor compensation.*
3-4	*Reduced Unit System*	*3*	*Reduce the computational load due to*

			real quantities by using reduced units (pu) from a base quantity.
5-8	*Modeling of electrical network elements*	*6*	*Generator modeling, line modeling based on an equivalent PI diagram (Case of a short line/long line), Equivalent transformer diagram, (Kapp approximation and equivalent T diagram), Load modeling. Power flow (Newton Raphson method, Gauss Siedel).*
8-11	*Calculation of short-circuit currents in the electrical network*	*3*	*Know the cause of the fault in the electrical network, size the fault current at any point in the network and choose the means of protecting people and property.*
12-14	*Electrical network management*	*4.5*	*Monitor consumption and production to ensure continuity of supply, voltage plan, load shedding plan, Dispatching, HVDC, Smart-Grid, etc.*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
…	…	…	…
…	…	…	…
			Summative assessment

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* x *No*	

- *100% TP material : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Search engine allowed* : ☐ *Yes* ☒ *No*
  - *Criterion 1: Understanding of the content (4 points)*
  - *Criterion 2: Application of knowledge (10 points)*

- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Arun G. Phadke, "Handbook of Electrical Engineering Calculations," 1999.*
- *BM Weedy, BJ Cory, "Electric Power Systems - Fourth Edition", 1988.*

7- Working environment (Facilities necessary for learning)

- *Title, Version, URL*
- *...*

Mechatronics and Automation MAJOR: S4

Course Specification

General mechatronics

1. General

Coded	*GELM4-A&M 101*	Level/Semester	*2/S4*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Souha BOUKADIDA*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*24*
Module	*General mechatronics*					Version	*06/2025*

Course Description (Course Objective):
Course Description: *Mechatronics is a technology that combines mechanics, electronics, computing, and new information and communication technologies. Combining these different fields allows for a product to be reimagined from its design through to maintenance and recycling. The goal of mechatronics is to create increasingly intelligent components and solutions that communicate with each other, to meet customer demands for excellence and enable the deployment of the factory of the future.*

Prerequisites:	*Keywords :*
Design of mechanical systems, combinational and sequential logic; analysis of automated systems, computer programming.	*Mechatronic system, complex system, energy chain, information chain.*

Specific course objectives (OBJ $_i$):	
OBJ 1 :	*Master the concepts of complex systems;*
OBJ 2 :	*Decompose a complex system using the functional chain approach;*
OBJ 3 :	*Establish the knowledge model in order to study the behavior of a complex system;*

Materials needed:
Table; Video projector.

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Chapter 1: Introduction to Mechatronics*	*3*	*Define mechatronics; the physical fields involved in mechatronics;* *Define the scope of application of mechatronics.*

			The objectives of mechatronic systems.
3-8	*Chapter 2: Structural constitution of a mechatronic system.* *Practical work*	*9*	*Describe in a global way the functioning of a complex system;* *Identify and specify the PE exchange part, the PC control part and the PO operational part;* *Define the interactions between PE-PC-PO.*
9-14	*Chapter 3: Functional chain of a mechatronic system.* *Practical work*	*9*	*Describe the detailed functioning of a complex system; Decompose a complex system into an energy chain and an information chain; Know all the elements constituting the energy chain; constituting the information chain;*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
13-14	*Practical exam*	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*4 0%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	*20%*

- *100% TP material : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes x No*
- *Authorized search engine : ☐ Yes x No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *R. Isermann, "Mechatronic systems: concepts and applications," Transactions of the Institute of Measurement and Control, vol. 22, 2000 , p. 29-55*
- *Abdelwahab MAHDHI, "Mechatronic systems from modeling to simulation", University Publication Center, 2018. 184 p.*

- *Lionel Birglen, Méchatronique, Dunod, 2008. (ISBN 9782100744787,*
- *Mechatronics: monitoring notes and application examples (CETIM)*
- *"SimFonIA Animation Tools" a tool for animating mechatronic systems*

7- Working environment (Facilities necessary for learning)

- *Title, Version, URL*
- *…*

Course Specification

Advanced Automatic

1. General

Coded	GELM4-A&M 102	Level/Semester	2/S4	Coefficient	3	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Wafa BOUKADIDA*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*16*
Module	*Advanced Automatic*					Version	*06/2025*

Course Description (Course Objective):
The control of discrete servo systems is a fundamental objective of any study that aims to impose performance that the controlled system must satisfy. The concept of sampling as well as the stability and regulation of such systems will be the objectives of this module.

Prerequisites:	*Keywords :*
The Laplace transform, continuous linear systems	*Sampling, discrete system, stability, regulation and control*

Specific course objectives (OBJ $_i$):
OBJ 1 : *Concept of sampling.*
OBJ 2 : *Study of discrete regime systems and calculation of the transfer function in z*
OBJ 3 : *Stability of discrete systems*

Materials needed:
Automations System

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-3	*Concept of sampling*	*4.5*	*-Notion of sampling* *-Sampled fundamental signals* *-Shannon's Theorem*
4-7	Transfer function in z	*6*	*-Concept of the z transform and the inverse z transform* *-Discreet transfer function and Zero-order hold sampler*

			-Closed loop transfer function
8-14	*Stability and precision*	*10.5*	*-Jury criterion and Routh criterion* *-Study of correctors*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Introduction to Simulink*	*3*	*-Introduction to the use of Simulink software.*
3-4	The sampled systems	*3*	*- Study of sampled systems and different discretization methods on Matlab* *-Study of the influence of the sampling period*
5-8	Digital control of discrete systems	*6*	*-Control of systems by P, PI and PID regulators*
9-12	Control of a direct current motor	*6*	*Study of a direct current motor in both the continuous and discrete regime.*
13-14	Assessment by a practical exam	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP subject : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Search engine allowed* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links)

- M. KSOURI and P. BORNE, Industrial Regulation, Technip Edition

- LOUIS MARET, Automatic regulation, Polytechnic Press

- F. DE CARFORT, C. FOULARD, J. C, Continuous linear servocontrols, Dunod University

- T. HAWS, P. GUYETNOT, Regulation and control, Edition Eyrolles

- C. CHAUVEAU, P. CHAUVEAU, Linear servo systems, Edition Educalière

7. Working environment (Facilities necessary for learning)

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Aeronautics Major S4

Course Specification

General avionics

1. General

Coded	GELM4 Aero 101	Level/Semester	3/S5	Coefficient	1.5	Credits	2
Course	*Electromechanical Engineering*					Volume. H. (CI)	21
Responsible	*Trabelsi Mohamed AMINE*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	24
Module	*General avionics*					Version	06/2025

Course description (Course objective):
This course consists of studying: - *Airplane aerodynamics* - *The constitution of avionics* - *The operating structure of the system* - *Integrated modular avionics*

Prerequisites:	*Keywords :*
- *General knowledge of aircraft aerodynamics* - *Aircraft command and control systems, manual and automatic piloting*	*Lift* *Drag strength* *Attack nail* *Automatic pilot* *Control system*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Discover the aeronautical world (planes, structures, systems, principle of volume, etc.)* ***OBJ 2 :*** *Become familiar with the A320 and its constituent systems* ***OBJ 3 :*** *Discover the avionics system*

Necessary material :
Audiovisual supports

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Aerodynamic*	*3*	*Have knowledge of aerodynamic forces and volume controls*
3-4	*Control instruments-1*	*3*	*Role and operation of control systems*
5-6	*Control instruments-2*	*3*	*Role and operation of control systems*
7-8	*Constitution of avionics-1*	*3*	*Knowledge of the human/machine interface and specific computerized systems*
9-10	*Avionics constitution -2*	*3*	*Knowledge of the human/machine interface and specific computerized systems*
11-12	*System security*	*3*	*Main system features*
11-14	*Avionics Management Systems:* - *Electronic Maintenance Systems (EMS)* - *Volume Data Management (FDM) Systems*	*3*	*Monitor the condition of aircraft electronic components and record volume data for post-volume analysis.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
13-14	*Final exam*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*

EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: theoretical knowledge (5 points)*
- *Criterion 2: calculation approach (3 points)*
- *Criterion 3: ability to understand and solve a problem (8 points)*
- *Criterion 4: results obtained (4 points)*

6- Web references (useful links):

- ***Avionics Navigation Systems -** by Myron Kayton, Walter R. Fried (1997)*
- ***Introduction to avionics systems -** by RPG Collinson (2003)*
- ***Avionics: Development and Implementation** - by Cary R. Spitzer (2006)*
- ***Modern Avionics -** by Claudio Bruno, Leonardo Mangeruca (2014)*
- ***Integrated avionics systems -** by George W. Stewart (2000)*
- ***Avionics: elements, software and functions -** by Albert Helfrick (2008)*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

FLUID DYNAMICS AND PRINCIPLES OF AERODYNAMICS

1- General information

Coded	*GELM 4 Aero 102*	Level/Semester	*2/S4*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Melaouhi Jamel*					Volume. H. (TP)	21
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*16*
Module	*Fluid dynamics and principles of aerodynamics*					Version	*06/2025*

Course Description (Course Objective):
Understand the main theories of fluid dynamics allowing the calculation of compressible or non-compressible flows around obstacles encountered in the field of aeronautics. *Understanding the fundamental principles of aerodynamics*

Prerequisites:	*Keywords :*
Fluid mechanics	*Flow; lift; drag; aerodynamics, compressible; incompressible*

Specific course objectives (OBJ $_i$):
OBJ 1 : *Understanding the physics of compressible flows, applied to the field of aerodynamics.* ***OBJ 2 :*** *Determine the equations of flows around the supporting surfaces as well as the forces corresponding aerodynamics, define the balances and stability margins for all aircraft movements and performance.* ***OBJ 3 :*** *Acquire a general knowledge of digital modeling.*

Materials needed:
…

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Fundamental principles* *Equations for a steady-state compressible flow* *One-dimensional compressible flows* *Wave system in a stationary supersonic flow.*	*6 hours.*	*Understanding and modeling flows where* ***compressibility air*** *can no longer be neglected.* *Understanding compressibility effects.* *Understanding shock waves and associated phenomena.*
3	*Reminders on fluid mechanics and aerodynamics* *The lift* *The trail* *Boundary layer* *Effect of Mach number* *Elements on propulsion*	*3 hours*	*Understand the fundamental equations that describe the movement of fluids;* *Analyze the properties of flows;* *Examine the behavior of flows at high speeds* *Generating state;*
4-5	*Classification of EDPs. Ellipticals/ Parabolic/Hyperbolic.* *Presentation of the main discretization methods: Finite Differences, Finite Volumes, Finite Elements. Characterization and control of a numerical algorithm.*	*6 hours*	***predict and optimize the aerodynamic behavior*** *of a system (wing profile, fuselage, etc.)* ***visualize the flow*** *(speeds, pressures, vortices) and calculate the forces (lift, drag)*
6-7	*Introductory concepts and principles in aerodynamics.* *Fundamentals of inviscid incompressible flow* *Kutta-Joukowski theorem.* *Incompressible flow around profiles* *Numerical method of vorticity singularities (aerodynamic characteristics of a profile).* *Incompressible flow around wings Prandtl's "lifting line".* *Linear theory of thin profiles* *The Prandtl-Glauert correction.*	*6 hours*	understand and calculate **the velocity field** and the **pressure field** around wings and profiles study the flows around the wings, and produce explicit results (Bernoulli's law, Kutta–Joukowski formula, thin profile theory) Introduce classical models of incompressible subsonic flow. Describe the modeling techniques derived from these models.

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought

8	*The flow around an airplane wing with Fluent,* *Study of the effect of Mach on a profile (CFD simulation)*	*3 hours*	*Show the impact of compressibility on lift and drag.*
9-10	Applications to representative cases in aerodynamics and structure Applications on a finite element calculation software in fluid and structure.	*6 Hours*	
11	*Numerical analysis of the fluid-structure interaction of a wing profile*	*3 hours*	*Numerical study of a flow and behavior aerodynamics ...*
12	Aerodynamic simulations	*3 hours*	*simulate the flow around a section or a complete wing* *Highlight the theoretical lift (Kutta–Joukowski formula).* *Observe the limits of the perfect fluid model*
13	shock waves	*3 hours*	simulate shocks in supersonic flow.
14	*Practical exam*	*3 hours*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Search engine allowed* : ☐ *Yes* ☒ *No*
  - *Criterion 1: theoretical knowledge (5 points)*
  - *Criterion 2: calculation approach (3 points)*
  - *Criterion 3: ability to understand and solve a problem (8 points)*
  - *Criterion 4: results obtained (4 points)*

6- Web references (useful links):

- *Aerodynamics for Engineering Students, EL Houghton, Fourth edition published in 1993 by Edward Arnold*
- *Aerodynamics and flight mechanics of aircraft performance,* http://pedagogie.ac-limoges.fr/ciras/IMG/pdf/1_-_amv_-_bia_eleve_2016.pdf *(2023).*

7- Working environment (Facilities necessary for learning)

- *SolidWorks (Flow simulation; simulation)*

Industrial Maintenance Major
S4

Course Specification

Industrial maintenance management and strategies

1- General information

Coded	GELM 4 MI 101	Level/Semester	2/S4	Coefficient	1.5	Credits	2
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Kais Bouzrara*					Volume. H. (TP)	00
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*24*
Module	*Industrial maintenance management and strategies*					Version	*06/2025*

Course Description (Course Objective):
Be able to define, organize and optimize industrial maintenance strategies in order to ensure the availability, reliability and sustainability of production equipment.

Prerequisites:	*Keywords :*
Fundamentals of mechanics, electricity and automation	***maintenance*** *(curative, preventive, conditional, predictive) ,* *MTBF, MTTR...* *GANTT, PERT...*

Specific course objectives (OBJ $_i$):
OBJ 1 : Identify the different types of maintenance *(curative, preventive, conditional, predictive).* ***OBJ 2 : Analyze the costs and impacts of maintenance*** *on industrial performance (TRS, MTBF, MTTR, etc.).* ***OBJ 3 : Choose the appropriate maintenance strategy*** *according to the technical and economic context.* ***OBJ 4 :*** *maintenance-related* ***key performance indicators (KPIs) .*** ***OBJ 5 : Develop a budget and plan resources*** *(human, material, spare parts).*

Materials needed:

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	**Introduction to industrial maintenance** Definitions and challenges of maintenance.	*3*	*Familiarize students with the challenges of maintenance*

	Strategic role of maintenance in industry.		
3-4	**Types of maintenance** ◆ **Corrective maintenance** : intervention after failure. ◆ **Preventive maintenance: planned intervention to avoid breakdowns.** ◆ **Predictive maintenance: using data to anticipate failures.** ◆ **Proactive maintenance: continuous improvement to eliminate the causes of failure.**	*3*	***Identify the different types of maintenance*** *(curative, preventive, conditional, predictive).*
5-7	**Maintenance strategies** ◆ Choice **of strategy based on the company's objectives.** ◆ **Assessment of equipment criticality.** ◆ **Optimization of costs and resources .**	*4.5*	***Analyze the costs and impacts of maintenance*** *on industrial performance (TRS, MTBF, MTTR, etc.).*
8-9	Methods department management: Analysis of maintenance times, Analysis of maintenance costs, Preparation of interventions	*3*	***Choose the appropriate maintenance strategy*** *according to the technical and economic context.*
10-11	Equipment life cycle management: Equipment life cycle, Search for optimal economic sustainability, Average annual operating cost	*3*	*maintenance-related* ***key performance indicators (KPIs) .***
12-14	The scheduling function: Mission, scheduling vocabulary, scheduling of intervention requests, scheduling of projects (Pert and Gantt)	*4.5*	***Develop a budget and plan resources*** *(human, material, spare parts).*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, etc.*	*3 hours*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑ *No*	--
DS - Supervised Homework	☑ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*

EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☑ *No*	--

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☑ No*
- *Search engine allowed : ☐ Yes ☑ No*
  - *Criterion 1: theoretical knowledge (5 points)*
  - *Criterion 2: calculation approach (3 points)*
  - *Criterion 3: ability to understand and solve a problem (8 points)*
  - *Criterion 4: results obtained (4 points)*

6- Web references (useful links):

- *https://theses.hal.science/tel-00170432/document*
- *https://www.mcours.net/cours/pdf/hasclic4/hasbnclic971.pdf*
- *https://electrotoile.eu/maintenance.php*
- *http://www.ispm.ac.ma/wp-content/uploads/2020/05/S221-caracteristiques-physico-chimiques.pdf*
- ***Heinz P. Bloch**, Improving Machinery Reliability (3e éd., 1997) et Machinery Failure Analysis and Troubleshooting (4e éd., 2012)*
- ***Juan F. Gómez Fernández & Adolfo Crespo Márquez**, ch. "Techniques and Tools for Maintenance Management" dans Maintenance Management in Network Utilities (Springer, 2012)*

7- Working environment (Facilities necessary for learning)

Course Specification

Diagnostics and predictive maintenance

1- General information

Coded	*GELM 4 MI 102*	Level/Semester	*2/S4*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Kais Bouzrara*					Volume. H. (TP)	21
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*16*
Module	*Diagnostics and predictive maintenance*					Version	*06/2025*

Course Description (Course Objective):
Be able to diagnose the operating status of an industrial system and implement predictive maintenance techniques in order to anticipate breakdowns and optimize equipment availability.

Prerequisites:	*Keywords :*
- *Vibration mechanics* - *Materials and structures* - *Hydraulic*	- *Predictive maintenance* - *Diagnosis* - *failure*

Specific course objectives (OBJ $_i$):
OBJ 1 : Understand the principles and challenges of predictive maintenance.
OBJ 2 : Master diagnostic techniques based on data analysis.
OBJ 3 : Use digital tools to anticipate equipment failures.
OBJ 4 : Integrate predictive maintenance solutions into an industrial environment.

Materials needed:
◆ Thermal camera (FLIR, Testo, Fluke, etc.) ◆ Accelerometric sensors (fixed or portable) ◆ Vibration collector/analyzer ◆ Rapid Oil Analysis Kit (Visual, Magnet, Filter Paper) ◆ Optical Microscope

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought

1-2	**Introduction to predictive maintenance** Definition and comparison with other types of maintenance (reactive, preventive). Advantages and limitations of predictive maintenance.	*3*	
3-6	**Diagnostic techniques** Vibration analysis, infrared thermography, lubricant analysis, ultrasound. Use of sensors for real-time data collection.	*6*	*Know the logistics of preventive maintenance*
7-10	**Data processing and analysis** Use of software for signal analysis and anomaly detection. Introduction to machine learning algorithms for failure prediction.	*4.5*	
11-14	**Integration into the industrial environment** Implementation of a predictive maintenance system in a company. Case study and feedback on industrial projects.	*4.5*	

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
…	*Diagnosis by vibration analysis*	…	*Diagnose an imbalance or bearing fault on a running electric motor using a vibration sensor.*
…	*Diagnosis of electrical anomalies by infrared thermography*	…	*Learn how to use a thermal camera to detect thermal faults on electrical or mechanical equipment, interpret thermographic images and suggest maintenance actions.*
	Machine condition diagnosis by oil analysis		*Learn how to collect, observe and interpret the results of an oil analysis to diagnose the condition of a mechanical or hydraulic system.*

12	*Practical exam, mini-project defense, etc.*	*3 hours*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑ *No*	--
DS - Supervised Homework	☑ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☑ *No*	--

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☑ *No*
- *Search engine allowed* : ☐ *Yes* ☑ *No*
- *Criterion 1: … (… points)*
- *Criterion 2: … (… points)*
- *Criterion 3: … (… points)*
- *Criterion 4: … (… points)*

6- Web references (useful links):

- https://theses.hal.science/tel-00170432/document
- https://www.mcours.net/cours/pdf/hasclic4/hasbnclic971.pdf
- https://electrotoile.eu/maintenance.php
- http://www.ispm.ac.ma/wp-content/uploads/2020/05/S221-caracteristiques-physico-chimiques.pdf

7- Working environment (Facilities necessary for learning)

Major Automatic & Mechatronics: S5

Course Specification

Design and modeling of mechatronic systems

1. General

Coded	*GELMAM5104*	Level/Semester	*3/S5*	Coefficient	3	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Maher ELTAIEF*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*31*
Module	*Design and modeling of mechatronic systems*					Version	*06/2025*

Course Description (Course Objective):
Be able to design, model, simulate and validate a mechatronic system integrating mechanical, electronic and computer elements in an industrial or technological environment.

Prerequisites:	*Keywords :*
General mechatronics ; analysis of automated systems, computer programming.	*Mechatronics, Sensor, Actuate, Complex System*

Specific course objectives (OBJ $_i$):
OBJ 1 : *Establish and simulate the behavior model of a complex system;*
OBJ 2 : *Design complex and multidisciplinary systems;*
OBJ 3 : *Create a virtual prototype of a complex system.*

Materials needed:
Table; Video projector, computer lab.

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1	*Chapter 1: Reminder of general mechatronics*	*1.5*	*Recall mechatronics; the physical fields involved in mechatronics; the scope of application of mechatronics , the objectives of mechatronic systems.*
2-6	*Chapter 2 : Modeling and simulation of mechatronic systems.*	*7.5*	*Define the concept of Energy-Power;* *Define the effort-flow variables;* *Define the basic models associated with mechanics,*

	Practical work		*electrical, hydraulics, etc.* *Define energy resources;* *Modeling mechatronic systems* *Define the general principle for modeling a complex system;* *Define the knowledge model;* *Define the behavior model;*
7-8	*Chapter 3 : Design and simulation tools* *Practical work*	*3*	*Software: MATLAB/Simulink, SolidWorks, CATIA, Automation Studio* *Co-simulation of hybrid systems*
9-10	*Chapter 4 : Control and communication architecture* *Practical work*	*3*	*Integration of sensors/actuators ,* *Communication between components (CAN, SPI, I2C, Profinet, etc.)*
11-14	*Chapter 5 : Design methodology* *Practical work*	*6*	*Functional analysis (FAST, SADT) ,* *System-oriented design (MBSE, V-cycle)*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
1-2	*TP 1: Discover the Simulink environment.*	*3*	*Discover the Simulink interface for designing complex systems.*
3-4	*TP 2: Preparation for mechatronic modeling of a complex system.*	*3*	*Based on a need defined by specifications, design a complex system;* *Apply the PE-PC-PO decomposition;* *Realize the energy chain and the information chain.*
5-6	*TP 3: Modeling and simulation of the behavior of the system created in TP2.*	*3*	*Develop the energy chain knowledge model;* *Carry out the modeling of the energy chain;* *Simulate the system.*
7-8	*TP 4: Creation of a virtual prototype of the system developed in TP2 and TP3.*	*3*	*Create a prototype of a complex system;* *Validate the characteristics of the different components.*
9-12	*TP 5: Modeling and simulation of the behavior of a multiphysical system. (Apply the entire approach of the mechatronics approach).*	*6*	*Implement the energy chain and the information chain;* *Develop the energy chain knowledge model;* *Carry out the modeling of the energy chain;* *Simulate the system.* *Create a prototype of a complex system;* *Validate the characteristics of the different components.*

13-14	*Practical exam*	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP subject : Average = 20% DS + 20% EP + 60% EE***

2- Evaluation criteria

- *Authorized documents : ☐ Yes x No*
- *Authorized search engine : ☐ Yes x No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

3- Web references (useful links):

- *R. Isermann, "Mechatronic systems: concepts and applications," Transactions of the Institute of Measurement and Control, vol. 22,* p. 29-55 , 2000
- *Abdelwahab MAHDHI, "Mechatronic systems from modeling to simulation", University Publication Center, 2018. 184 p.*
- *Lionel Birglen, Méchatronique, Dunod, 2008. (ISBN 9782100744787,*
- *Mechatronics: monitoring notes and application examples (CETIM)*
- *"SimFonIA Animation Tools" a tool for animating mechatronic systems*

4- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Numerical modeling

1. General

Coded	*GELMAM5105*	Level/Semester	*3/S5*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21.*
Responsible	*Sami CHATTI*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*30*
Module	*Numerical modeling*					Version	*09/2023*

Course description (Course objective):
Master simulation techniques in order to solve engineering problems that cannot be solved by analytical methods.

Prerequisites:	*Keywords :*
Analysis and Algebra of preparatory classes; Numerical analysis	*Interpolation functions; finite element methods; stiffness matrix*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the notion of numerical approximation as well as its quantification.*
OBJ 2 : *Master digital simulation techniques.*
OBJ 3 : *Use and master calculation software.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to numerical simulation*	*3*	*Definition of digital simulation b. Applications and importance in solving real problems Master the gaps between the numerical solution and the physical phenomenon to be*

			studied. Presentation of the different numerical errors.
3-4	*partial differential equations ; Presentation of Numerical Methods for Solving Differential Equations*	*3*	*Presentation of physical models in the form of differential equations*
5-8	*Finite element method FEM; Interpolation functions*	*6*	*Principle of FEM and applications in engineering and numerical simulation* *Presentations of interpolation functions in the different cases: 1D; 2D; 3D*
9-11	Application to beam elements (1D case)	*4.5*	*From the mathematical formulation to the equivalent writing of the algebraic (matrix) equation to be solved; determination of the stiffness matrix*
12-14	2D solution method lattice elements	*4.5*	*Numerical resolution of 2D problems*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Bending of a beam*	*3*	*Study of the effect of mesh quality on numerical results*
3-4	*Hole plate in tension*	*3*	*Use adaptive meshing technique to ensure accuracy of numerical results*
5-6	*Thermomechanical study of a heated pipe connection*	*3*	*Master the transfer of results from the thermal study to the static study to obtain the thermomechanical solution*
7-8	*Aerostatic simulation of an airplane wing. Determination of pressure and stress profile*	*3*	*Use the forces from aerodynamic simulation to study the stresses induced in the wing.*
9-12	*Elastoplastic behavior of a sheet subjected to V-shaped bending*	*6*	*Simulation of an assembly with non-linear behavior*
13-14	*Practical exam*	*3*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Hughes, T. J. R. (2001). "The Finite Element Method: Linear Static and Dynamic Finite Element Analysis." Prentice Hall.*
- *Daryl L. Logan, A First Course in Finite Elements Method, CENGAGE Learning, 5th Edition 2012.*
- *Engineering Analysis with SOLID ORKS Simulation 2018, Paul M. Kurowski, Ph.D., P.Eng., SBN-13: 978-1-63057-153-5.*

7- Working environment (Facilities necessary for learning)

- *SolidWorks 2023 (Simulation)*

Course Specification

Mechanism theory

1. General

Coded	*GELMAM5106*	Level/Semester	*3/S5*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Jamel MLAOUHI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*41*
Module	*Mechanism theory*					Version	*09/2023*

Course description (Course objective):
The Theory of Mechanisms course, as a mechanical design tool, aims to provide students with an in-depth understanding of the fundamental principles of the statics and kinematics of mechanisms and articulated mechanisms. The main objective is to develop the skills necessary to analyze and design mechanisms while understanding key concepts such as kinematics, statics, and hyperstatism. At the end of the course, students will be able to solve a hyperstatic/isostatic kinematics or statics/dynamics problem, to criticize the choices of mechanism models, to imagine kinematically equivalent isostatic mechanism models, and to interpret the hyperstatism with its influences on rigidity, assembly, functioning and other aspects such as the mobility of mechanisms .

Prerequisites:	*Keywords :*
- *Statics of non-deformable solids.* - *Kinematics of mechanisms.* - *Notions of torsors (static and kinematic)* - *Mechanical connections (symbol, connection graph, twisters, etc.).* - *Dimensional and geometric tolerances and specifications*	*Hyperstatic/isostatic mechanism, mobility, cyclomatic number, secondary equations, main equations.*

Specific objectives of the course (OBJ $_i$):	
OBJ 1 :	*Gain an in-depth understanding of static balances in mechanisms.*
OBJ 2 :	*Model a mechanism with a schematic model (kinematic diagram)*
OBJ 3 :	*Apply the principles of statics to analyze the equilibrium of mechanisms and determine the equations reflecting static equilibrium.*
OBJ 4 :	*Select appropriate models for solving kinematic or static problems.*
OBJ 5 :	*Determine the degrees of hyperstatism and mobility of the mechanisms.*

OBJ 6 :	*Critically evaluate mechanism model choices based on specific problem requirements.*
OBJ 7 :	*Propose solutions to make the mechanism isostatic.*

Necessary material :

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Ch.1: Introduction to Mechanism Theory*** - *Mechanical connection, degree of freedom* - *Kinematic Torsor* - *Torsor of binding actions* - *Kinematic couple, compound connection, complex connection* - *Degree of mobility* - *Degree of hyperstatism*	4.5	- *Understand the fundamental concept of mechanism theory.* - *Explore the different applications of mechanism theory in engineering.* - *Become familiar with basic terms and concepts related to mechanisms.*
3-4 *5-6*	***Ch.2: Solid chains and equivalent bonds*** ▪ *Problematic, Parallel connections, Series connections, solid chains: open, closed, complex, Cyclomatic number.* ▪ *Law of global mobility, Number of kinematic equations, Mobilities in the mechanism, useful mobility and internal mobility, Consequence on the kinematic equations.* ▪ *Calculation of the degree of hyperstatism, Consequences of hyperstatism.* ▪ *Exercises and tutorials*	*4.5* *4.5*	- *Identify and define solid chains in mechanisms.* - *Master the graphic representation of chains of solids and connections.* - *Analyze the kinematic properties of solid chains.*

7-8	***Ch.3: Analysis of mechanisms***
	▪ *Static analysis*
	  - *External actions*
	  - *Link actions*
	  - *Equation*
	  - *Linear system analysis and results*
	  - *Matrix writing of the linear system*
	▪ *Exercises and tutorials*
	▪ *Kinematic analysis*
		4.5	- *Acquire skills to analyze the kinematics of mechanisms.*
			- *Understand the relative movements of the components of a mechanism.*

9-10 11-12	- *Kinematic torsors associated with connections* - *Equation* - *Linear system analysis and results* - *Matrix writing of the linear system* - *Hyperstatism in the kinematic sense* ▪ *Exercises and tutorials*	*4.5* *4.5*	- *Learn to use mathematical tools to model movements.*
13-14	***Ch.4: Systematic search for isostatic solutions*** ▪ *Obtaining isostatic solutions by direct elimination of hyperstatic forces.* ▪ *Obtaining isostatic solutions by adding new bonds* ▪ *Exercises and tutorials*	*4.5*	- *Understand the concept of isostaticity in mechanisms.* - *Understand the conditions for a mechanism to be isostatic.* - *Acquire skills to determine the degree of isostaticity of a mechanism.* - *Explore systematic methods for solving isostatic design problems.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
...	...	...	...
...	...	...	...

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*

EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *AJ Ballereau, JP Busato, G. Tranier, Mécanique Industrielle Volumes 1 and 2, (1995), Edition: Foucher*
- *Paul Roux, Mechanics of solid material systems, (1995), Edition: Ellipses*
- *D. Spenlé, R. Gourhant, Guide to calculation in mechanics, (1998), Edition: Hachette*
- *JC Bône, J. Morel, M. Bouch, Mécanique Générale, (1985), Edition: Dunod*
- *G. Toutlemonde, Notion of static mechanics, (1973), Edition: technip*

7- Working environment (Facilities necessary for learning)

Course Specification

Robotic Programming

1. General

Coded	*GELMAM 5 107*	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	Wafa BOUKADIDA					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*26*
Module	Robotic Programming					Version	*09/2023*

Course Description (Course Objective):
strengthen the capacity to design, program, test and deploy robotic solutions integrating sensors, actuators and control algorithms

Prerequisites:	*Keywords :*
Robotic system, basics of automation and microcontrollers	*Robot,* Arduino, ROS, VPL

Specific course objectives (OBJ $_i$):
OBJ 4 : Program and control industrial or mobile robots from a software environment.
OBJ 5 : Integrate sensors/actuators into a robotic control loop.
OBJ 6 : Implement trajectory, navigation and obstacle avoidance algorithms.

Materials needed:
…

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
1-2	Introduction to robotic platforms (Arduino, ROS, VPL, etc.)	*3*	Compilation, communication, transfer program
3-4	Basic Programming: Movement and Control of a Mobile Robot	*3*	PID, regulation speed /position
5-8	Integration of sensors (ultrasonic, infrared, encoders), Line tracking / obstacle avoidance	*6*	Analog /digital acquisition , filtering
9-12	.Remote communication and control (Bluetooth, WiFi , MQTT)	*6*	Inter-robot communication, synchronized tasks
13-14	Assessment by a practical exam	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ *Yes* ☐ *No*	*20%*
DS - Supervised Homework	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***100% TP material : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

2- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

3- Web references (useful links):

- *Craig, J. J. (2017). Introduction to Robotics: Mechanics and Control (4e éd.). Pearson. ISBN: 978-0133489798*
- *Lynch, K. M., & Park, F. C. (2017). Modern Robotics: Mechanics, Planning, and Control. Cambridge University Press. ISBN: 978-1107156302*
- *Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2009). Robotics: Modelling, Planning and Control.*

Springer. ISBN: 978-1846286414

- *Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot Modeling and Control (2e éd.). Wiley.*

7.Working environment

Robotics Lab, Arduino Card , …..

Course Specification

Machine control

1. General

Coded	*GELMAM5108*	Level/Semester	*3/S5*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Jannet JEMAII*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*31*
Module	*Machine control*					Version	*09/2023*

Course description (Course objective):
Allow the student to acquire knowledge in the field of intelligent controls of the most used electrical machines: (direct current machine, three-phase asynchronous machine, synchronous machine, etc.) and to manipulate them according to the requirements of the system studied while guaranteeing better performance (speed, precision and stability).

Prerequisites:	*Keywords :*
Electrotechnics and static converters.	*Direct current machines, asynchronous machines, synchronous machines, choppers, rectifiers, inverters, etc.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand how rotating machines work (electromechanical transformation).*
OBJ 2 : *Understand speed variation techniques and choose the suitable converter for each machine (operating quadrant, supply voltage).*
OBJ 3 : *Understand the control techniques that make it possible to influence the performance of the controlled system.*

Necessary material :
Electrical machines: Direct current machine, asynchronous machine, synchronous machine, speed variators, computer.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1-2	*General information on rotating machines*	*3h*	*Understand the principles of electromagnetism, understand the operation of rotating machines and their constitutions, Characteristics of machines under load (Torque, speed and power)*
3-4	*Study and modeling of the direct current machine*	*3h*	*Model and study the operation of a direct current machine*
5-6	*DC machine control*	*3h*	*Study speed variation techniques, study suitable converters depending on the power supply, study the performance of a system driven by an MCC (speed control, current control, etc.)*
7-8	*Study and modeling of the asynchronous machine*	*3h*	*Understand the operating principle of asynchronous machines as motors and generators, model the asynchronous machine, study transformation matrices (Park matrix, Clark matrix, Concordia matrix)*
9-10	*Control of the asynchronous machine*	*3h*	*- Scalar control of the asynchronous machine* *-Vector control of the asynchronous machine*
11-12	*Study and modeling of the synchronous machine*	*3h*	*Understand the operating principle of synchronous machines in alternator, model the synchronous machine.*
13-14	*Synchronous machine control*	*3h*	*- Scalar control of the synchronous machine* *-Vector control of the synchronous machine*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Study and modeling of direct current machines*	*3h*	*Model and study the operation of a direct current motor at variable speed by simulating then interpreting the operating curves.*
3-4	*Separately Excited/Shunt DC Machine Control*	*3h*	*Analyze the operation of direct current machines under load, in open loop and closed loop.*

			-Analyze and interpret the machine's response.
5-6	Study and modeling of the asynchronous machine	3h	Model and study the operation of an asynchronous motor in variable speed by simulating then interpreting the operating curves.
7-8	Vector control of the asynchronous machine	3h	-Design a speed variator -Understand the components of a speed variator - Analyze the performance of the asynchronous machine.
9-10	Study and modeling of the synchronous machine	3h	Model and study the operation of a synchronous machine in variable speed by simulating then interpreting the operating curves. -Study of the alternator under load
11-12	Synchronous machine control	3h	Study of the stability of synchronous machines
13-14	Practical exam, mini-project defense, …	3h	Summative evaluation

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC – Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ Yes ☐ No	
DS – Supervised Duty	☒ Yes ☐ No	20%
EE – Written test (Final exam)	☒ Yes ☐ No	60%
EP – Practical test (TP- TP exam / MP- Mini project)	☒ Yes ☐ No	20%

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes x No*
- *Authorized search engine : ☐ Yes x No*

- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Jean-Paul Hautier , Modeling and control of the asynchronous machine, Edition Technip, 1995.*
- *Michel Pinard , Electronic control of machines, Cahiers Collection techniques , Edition Dunod, 2013.*
- *Ogata, K. (2010). Modern Control Engineering (5th Edition). Prentice Hall.*
- *Nise, N. S. (2011). Control Systems Engineering (6th Edition). Wiley*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Smart sensors and data processing

1. General

Coded	*GELMAM5109*	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Wafa BOUKADIDA*					Volume. H. (TP)	
Teaching methods	interactive, direct instructions, Project Based					Self study H.	*24*
Module	*Smart sensors and data processing*					Version	*06/2025*

Course description (Course objective):
Sensor theory encompasses the fundamental principles, technologies, and concepts related to the design, operation, and use of sensors. A sensor is a device that measures a physical or chemical phenomenon and converts that measurement into an understandable or usable signal.

Prerequisites:	*Keywords :*
Electronics, Signal Processing	*Sensor, sensitivity, response, network, …*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Define the different measurement areas of the sensors and the methods of transduction.* ***OBJ 2 :*** *Present the characteristics of the different types of sensor* ***OBJ 3 :*** *Describe the sensitivities to power supply, electromagnetic interference or other environmental signals and the different ways of powering* ***OBJ 4 :*** *Sensors can provide analog (continuous) or digital (discontinuous) outputs.* ***OBJ 5 :*** *Interconnections to form a network, allowing data collection*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Measurement areas and Transduction*	*3*	*Define the different measurement areas of the sensors and the methods of transduction*
3-6	*Sensitivity, Linearity, Stability, Response Time and Measurement Range*	*6*	*Present the characteristics of the different types of sensor*
7-8	*Power supply and interference*	*3*	*Describe the sensitivities to power supply, electromagnetic interference or other environmental signals and the different ways of powering*
9-10	*Output characteristics*	*3*	*Sensors can provide analog (continuous) or digital (discontinuous) outputs.*
11-14	*Sensor network*	*6*	*Interconnections to form a network, allowing data collection*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*

EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links)

- Sensors and Signal Conditioning- by Ramon Pallas-Areny, John G. Webster (2001)
- Introduction to Sensors- by BBM Tripathi (2015)
- Principles of Measurement Systems - by John P. Bentley (2005)
- Measurement and Instrumentation: Theory and Application - by Alan S. Morris (2001)
- Smart Sensors and Sensing Technology- by Chong-Min Kyung, Shashi P. Karna (2008)
- Sensor and Data Fusion: A Tool for Information Assessment and Decision Making- by Jitendra R. Raol, Da Ruan, George A. Fodor (2017)

7-Working environment (Facilities necessary for learning)

None

Course Specification

Modeling, identification and monitoring of systems

1. General

Coded	*GELMAM5110*	Level/Semester	*3/S5*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Wafa BOUKADIDA*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*43*
Module	*Modeling, identification and monitoring of systems*					Version	*09/2023*

Course description (Course objective):
The objective of this course is to address these different stages. The modeling of linear systems by state representation will be the first objective. In addition, a presentation and critical analysis of the different structures in parametric estimation will be developed. Among the different estimation methods existing in the scientific literature, the so-called ordinary least squares estimation method based on the minimization of a quadratic criterion is discussed.

Prerequisites:	*Keywords :*
Laplace transform, Z transform, constant parameter differential equations, basics of random signals and stochastic processes	*state representation, stability, identification, least squares method.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *State modeling of linear systems* ***OBJ 2 :*** *Controllability and observability of systems* ***OBJ 3 :*** *Identification of industrial processes using the least squares method*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1-4	*State representation of linear systems*	*9am*	*-State modeling of linear systems* *-Study of the stability of linear systems* *-Passing the state representation to the transfer function.*
5-6	*Controllability and observability of linear systems*	*4.5*	*-Controllability and observability of systems* *Study of controllable canonical forms.*
7-8	*Identification of industrial processes*	*4.5*	*-Definition of identification* *-Non-parametric methods*
9-14	*Identification of industrial processes*	*13.5*	*-Model structure in identification: Presentation of structures ARX, ARMA, ARMAX.------ The parametric estimation method of ordinary least squares.* *-Presentation of the problem, quadratic criterion, minimization of the criterion.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links)

- System identification – Theory for the user – Lennart LJUNG – Prentice Hall 1987

- System identification – Second edition – Theory for the user – Lennart LJUNG – Prentice Hall 1999

- Identification of systems – Ioan D. LAUDAU – Educational automation collection – HERMES 1998

- Automatic 2 – Linear servo systems – Michel VILLAIN – Ellipses 1996

- Identification of parametric models from experimental data - Eric WALTER - Luc PRONZATO – Masson 1994

7.Working environment (Facilities necessary for learning)

None

Course Specification

Advanced API Programming

1. General

Coded	*GELMAM5111*	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	
Responsible	*Wafa BOUKADIDA*					Volume. H. (TP)	21
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*24*
Module	*Advanced API Programming*					Version	*06/2025*

Course Description (Course Objective):
API programming presents a fundamental objective of any study which aims to : ▪ Master API programming languages. ▪ Be able to implement industrial automation applications designed around of API.

Prerequisites:	*Keywords :*
Logic systems, Programmable logic controllers	*API, GEMMA, IEC Standard,*

Specific course objectives (OBJ $_i$):
OBJ 1 : Deepen your mastery of industrial programmable automatons
OBJ 2 : Design complex programs in compliance with the IEC 61131-3 standard
OBJ 3 : Mastering advanced API programming languages
OBJ 4 : Implement efficient and reliable automated systems

Materials needed:
…

2- Content elements (Course)

Week(s)	Chapters/ Content Elements	Nbr. HR	Objective(s) sought

3- Content elements (Practical work)

Week(s)	Activities/ Content Elements	Nbr. HR	Objective(s) sought
1-2	Implementation of complex automation using an API.	*3*	**Implement communication** between the API, sensors/actuators, and third-party equipment (HMI, drives, etc.) in compliance with the IEC 61131-3 standard **Test and validate the operation** of the program on a model or real system. **Perform diagnosis and correction of** software or hardware anomalies.
3-4	Study of an elementary field bus (network of two APIs).	*3*	**Identify the different types of industrial buses** (Modbus, Profibus, Profinet, Ethernet/IP, etc.). **Implement a simple network** between two APIs (e.g. master/slave or client/server). **Configure addresses, communication parameters and data exchange functions** in PLC software. **Exchange variables between two APIs** using the protocol of the bus studied. **Check and diagnose** communication (by frame, indicator, supervision, etc.).
5-8	Control of a modular production system with a fieldbus (Profibus, etc.).	*6*	**Analyze the architecture of a modular production system** (e.g. sorting, distribution, assembly, conveying). **Explain the role of the fieldbus** in synchronization and exchange of information between modules. bus **addresses, parameters and topology (Profibus, Profinet, etc.).** **Program a main (master) PLC to control the remote** (slave) modules. **Supervise data exchanges** between equipment via software (TIA Portal, RobotStudio, etc.). **Diagnose communication or operational faults** in the network.

9-12	Automation of two remote systems by a single PLC and by using a remote coupler.	*6*	**Identify the constituent elements of a remote I/O network** (PLC, coupler, I/O modules, network cabling). **Configure a remote coupler** compatible with the bus used (e.g.: Profinet, Profibus, Ethernet/IP). **Program the API to manage both systems** remotely via the coupler's I/O addresses. **Synchronize the actions of both automated systems** from a single master program
13-14	Assessment by a practical exam	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☒ *Yes* ☐ *No*	*20%*
DS - Supervised Homework	☐ *Yes* ☐ *No*	
EE - Written test (Final exam)	☐ *Yes* ☐ *No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*80%*

- ***100% TP material : Average = 20% CC + 80% EP***
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Search engine allowed : ☐ Yes ☒ No*
  - *Criterion 1: Understanding of the content (4 points)*
  - *Criterion 2: Application of knowledge (10 points)*
  - *Criterion 3: Critical analysis (4 points)*
  - *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links)

- JM BLEUX – JL FANCHON, Industrial automation ETAPES collection – NATHON 1996
- JC BOSSY – P. FAUGERE – C. MERLAND, Le GRAFCET (Educational 1995)
- C. ROBINET – A. BIANCIOTTI – P. BOYE? Automation and industrial computing (Delagrave 1997)
- D. BLIN – J. DANIC – R. LE GARREC – F. TORLEZ – JC SEITE, Automation and industrial computing (Educational 1995)
- R. DAVID, H. ALLA, From GRAFCET to the Petri network, Ed Hermes
- G. CHEVALIER, B. GUILLOSSOU, GRAFCET and automation functions, Ed Dunod

7.Working environment (Facilities necessary for learning)

None

Major Aeronautics S5

Course Specification

Vol mechanics

1. General

Coded	GELMAero5104	Level/Semester	*3/S5*	Coefficient	*2.25*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Mortadha GRAA*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*15*
Module	*Vol mechanics*					Version	*09/2023*

Course description (Course objective):
Volume mechanics involves studying the movement of aircraft in the atmosphere and the physical principles that govern it. It encompasses a set of concepts and laws that describe the behavior of airplanes, helicopters, drones and other flying machines.

Prerequisites:	*Keywords :*
Fluid mechanics, Solid mechanics, Aerodynamics	*Lift, drag, thrust, centering, stability, volume control...*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Rapping the main fundamentals of statics and dynamics*
OBJ 2 : *Reminder of the principles of aerodynamics*
OBJ 3 : *Know how to determine and simulate the different forces linked to the aircraft*
OBJ 4 : *Know how to determine and simulate the stability and governance of an aircraft*
OBJ 5 : *determining the position, direction and speed of the aircraft relative to the Earth's surface.*

Necessary material :
...

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1-2	Newton's laws: - Newton's first law (inertia) - Newton's second law (force and acceleration)	*4.5*	*Reminder of static mechanics and dynamic mechanics*
3-4	Principles of aerodynamics	*4.5*	*Reminder of the principles of aerodynamics*
5-8	Lift, Streak, Push, Weight, Centering.	*9*	*Know how to determine and simulate the different forces linked to the aircraft*
9-12	Centering Volume controls Stability	*9*	*Know how to determine and simulate the stability and governance of an aircraft*
13-14	Principle of navigation:	*4.5*	*determining the position, direction and speed of the aircraft relative to the Earth's surface.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting

CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Mechanics of volume *(AC Kermode, Modulo Éditeur, Quebec 1982)*
- The design of the airplane *(Darrol Stinton, Blackwell Science Ltd, Oxford 1997)*
- Fluid Dynamic Drag *(Sighard Hoerner, Hoerner Fluid Dynamics, Bakersfield 1965)*
- Resistance to advancement in fluids *(Sighard Hoerner, Gauthier-Villars, Paris 1965)*
- ony Bingelis on Engines *(Tony Bingelis, EAA Aviation Foundation, Inc., Oshkosh WI. 2000)*
- Principles of Volume Simulation " by David Allerton

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Embedded electrical systems in aeronautics

1- General information

Coded	GELM Aero 5 105	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Mortadha GRAA*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*24*
Module	*Embedded electrical systems in aeronautics*					Version	*06/2025*

Course Description (Course Objective):
Acquire the skills necessary to understand, analyze and intervene on the electrical systems on board an aircraft, by mastering the principles of generation, distribution and electrical consumption in an aeronautical environment.

Prerequisites:	*Keywords :*
Electrical systems .	

Specific course objectives (OBJ $_i$):

- ***OBJ 5 :*** *Identify the electrical sources and networks of an aircraft*
- ***OBJ 6 :*** *Analyze the operation of on-board electrical systems (controls, protections, conversion)*
- ***OBJ 7 :*** *Interpret electrical diagrams and provide diagnosis*
- ***OBJ 8 :*** *Apply safety standards and requirements specific to aeronautics*
- ***OBJ 9 :*** *Understanding the interfaces between embedded electrical, electronic and mechatronic systems*

Materials needed:
Table; Video projector.

2- Content elements (Course)

Week(s)	Chapters/Content Elements	Nbr. HR	Objective(s) sought
1-2	*Introduction to embedded aeronautical systems*	*3*	*oncept of avionics bus, information coding: Principle of maintenance for avionics and on-board systems:*

			Specific constraints: mass, reliability, redundancy, harsh environment *Classification of on-board systems: essential, non-essential, critical*
3-6	*Principle of electrical networks on aircraft and actuators (On-board electrical production and distribution)*	*6*	*Electrical networks on aircraft: Alternating, Continuous.* *Actuators on aircraft: Motors - Power supply, transformer and rectifier.*
7-11	*Monitoring and diagnosis*	*7.5*	*Current/voltage sensors* *Built-In Test Equipment (BITE)* *Conditional and predictive maintenance*
12-14	*Standards and safety*	*4.5*	*ISO 26262 (functional safety) , DO-160, DO-178 (software),* *Grounding, surge and lightning protection* *Certification and traceability*

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
13-14	*Practical exam*	*3*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*4 0%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *100% TP material : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP subject : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* x *No*
- *Authorized search engine* : ☐ *Yes* x *No*
  - *Criterion 1: Understanding of the content (4 points)*
  - *Criterion 2: Application of knowledge (10 points)*

- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Jean Pinet – *Electricity on board aircraft* – Cépaduès Editions
- Pierre Bonnet – *Aeronautical Electricity* – Cépaduès Editions
- Alain Vadez – *Aircraft Technology* (vol. 2) – Nathan Technique
- Mike Tooley – Aircraft Electrical and Electronic Systems – Butterworth-Heinemann (2nd ed.), 2013
- Dale Crane – Aviation Maintenance Technician – Electricity and Electronics – ASA (Aircraft Technical Book Company)

7- Working environment (Facilities necessary for learning)

None

Course Specification

Radar theory

1. General

Coded	*GELMAero5106*	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Trabeli Mohamed Amine*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*27*
Module	*Radar theory*					Version	*09/2023*

Course description (Course objective):
This course consists of studying: - *The different types of radars* - *The principles of radar* - *Radar functions* - *Antennas used in radar*

Prerequisites:	*Keywords :*
- *General knowledge of the different types of radars* - *Acquire basic knowledge and radar concepts which are then applicable to different types of avionics.*	*Transponder; The ILS; VOR; celerity; electromagnetic wave ; speed ; transmission, reception*

Specific objectives of the course (OBJ $_i$):
***OBJ 1 :** Acquire the basics of radar theory and the physics of its environment, as well as the associated vocabulary* ***OBJ 2 :** Know the different types of current radars and the technologies used* ***OBJ 3 :** Identify antenna characteristics and measure speed with Doppler radar.*

Necessary material :
Audiovisual supports

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*The different types of radars -1*	*3*	*Have knowledge of the role of different types of radars*
3-4	*The different types of radars-2*	*3*	*Have knowledge of the role of different types of radars*
5-6	*Principles of operation of radar-1*	*3*	*Have knowledge of the different wave frequencies and how to emit pulses of electromagnetic waves, reception and translations into information*
7-8	*Principles of operation of radar-2*	*3*	*Have knowledge of the different wave frequencies and how to emit pulses of electromagnetic waves, reception and translations into information*
9-10	*Antennas used in radar*	*3*	*Knowledge of the different antennas used in aeronautics*
11-12	***Solid-state** emitters*	*3*	*Have knowledge of the operation of Transmitters such as air traffic control.*
13-14	*Radar signal processing...*	*3*	*Radar operation and operation*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
13-14	*Final exam*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	

DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: theoretical knowledge (5 points)*
- *Criterion 2: calculation approach (3 points)*
- *Criterion 3: ability to understand and solve a problem (8 points)*
- *Criterion 4: results obtained (4 points)*

6- Web references (useful links):

- ***Radar Principles** - by Peyton Z. Peebles Jr. (1998)*
- ***Introduction to Radar Systems-** by Merrill I. Skolnik (2001)*
- ***Principles of Modern Radar: Basics -** by Mark A. Richards, James A. Scheer, William A. Holm (2010)*
- ***Radar Manual -** by Merrill I. Skolnik (2008)*
- ***Advanced radar techniques and systems -** by Gaspare Galati (2017)*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Aeroacoustics

1. General

Coded	GELMAero5107	Level/Semester	3/S5	Coefficient	1.5	Credits	2
Course	*Electromechanical Engineering*					Volume. H. (CI)	21
Responsible	*Mortadha GRAA*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	29
Module	*Aeroacoustics*					Version	09/2023

Course description (Course objective):
Aeroacoustics focuses on the study of sound phenomena generated by the interaction between a fluid (usually air) and moving structures, such as airplanes, vehicles, propellers, turbines, etc. This discipline seeks to understand the production, propagation and reception of sound in aerodynamic environments.

Prerequisites:	*Keywords :*
Fluid mechanics, turbulence, fundamentals of acoustics	Aeroacoustics, *convection, Refraction, Curle's analogy, Lighthill's analogy*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Basic knowledge to gNonep the specific difficulties in solving problems in aeroacoustics; such as sound generation and propagation by and in turbulent flow.* ***OBJ 2 :*** *Characteristics of the acoustic emission of aircraft turbojets for example.* ***OBJ 3 :*** *Physic interpretation of underlying mechanisms and an introduction to the standard estimation models of convection.* ***OBJ 4 :*** *Refraction effects associated with the propagation of acoustic waves in shear and non isothermal flows, and of generation of sound due to turbulent fluctuations (aeroacoustics analogy).*

Necessary material :
…

2- Eléments de contenu (Cours)

Week(s)	Activities/Content Items	No. HR	Goals
1	***Introduction***	*1.5*	*Introduction*

	• *General presentation of some basic aeroacoustics problems* • *Origin of the sources and associated physical henomena*		
2-4	***Chapter 1 - General reminders of fundamental acoustics*** • *Equations of compressible fluid in unsteady flow,* • *Wave equations, sound velocity, general solution, impedance,* • *Acoustic energy, power and intensity - Sound levels.,*	*4.5*	*General reminders of fundamental acoustics*
5-7	***Chapter 2 - Sound propagation in flow*** • *Equations of linear acoustic wave's propagation in flow (Linearized Euler Equations, LEE),* • *Wave convection, Doppler effect,* • *Wave refraction in flow*	*4.5*	*Sound propagation in flow*
8-10	***Chapter 3 - Noise generation from free turbulent flows*** • *Wave equations, Green's function,* • *Lighthill's analogy,* • *Power law and introduction to statistical estimation of jet noise.*	*4.5*	*Noise generation from free turbulent flows*
11-14	***Chapter 4 - Noise from wall-bounded unsteady flows*** • *Curle's analogy,* • *Power law and statistical estimation of the sound of a cylinder in flow.*	*6*	*Noise from wall-bounded unsteady flows*

3- Eléments de contenu (Travaux pratiques)

Semaine(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***<u>100% CI material : Average = 40% DS + 60% EE</u>***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☐ *No*
- *Authorized search engine* : ☐ *Yes* ☐ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- **Fundamentals of Aerodynamics"** by John D. Anderson Jr.
- **Aircraft Noise: Assessment, Prediction and Control"** by David Anderson
- **Aeroacoustics of Low Mach Number Flows: Fundamentals, Analysis, and Measurement"** by Christopher KW Tam

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Aerodynamics

1. General

Coded	GELMAero5108	Level/Semester	3/S5	Coefficient	1.5	Credits	2
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Sami CHATTI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*28*
Module	*Aerodynamic*					Version	*09/2023*

Course description (Course objective):
Understand the fundamentals of aerodynamics

Prerequisites:	*Keywords :*
Fluid mechanics	*Flow; lift; streak*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the fundamentals of aerodynamics*
OBJ 2 : *Study of the impact of aerodynamics on a wing.*
OBJ 3 : *Use and master calculation software.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Introduction to aerodynamics/* *Definition of aerodynamics;* *Basic principles: pressure, temperature, density of air as a function of altitude and speed.*	*3 .*	*Understand the fundamentals of aerodynamics.*

3-6	*The Equations of Aerodynamics/* *Bernouilli equations;* *Saint-Coming equation for compressible fluids*	6	*Understand the fundamental equations that describe the movement of fluids;* *Analyze flow properties;* *Generative state;*
7-8	*Fluid flows/* *Calculation of the boundary layer;* *Mach and Reynolds number* *Shock waves.*	3	*Examine flow behavior at high velocities.* *Understand shock waves and associated phenomena.*
9-12	*Aerodynamic Profiles/* *Symmetrical and asymmetrical profiles;* *Angle of incidence.* *Lift and drag coefficient.*	6	*Study aerodynamic profiles and their characteristics.* *Understand the generation of lift and drag.*
13-14	*Aerodynamic characteristics of objects/* *Establishing the polars and finesse of the wings*	3	*Apply aerodynamic concepts to real cases.* *Study of wing profiles.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
6-7	*Practical exam*	3h	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*

EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Aerodynamics for Engineering Students, EL Houghton, Fourth edition published in 1993 by Edward Arnold*
- *Mechanical aerodynamics of volume performance aircraft,* http://pedagogie.ac-limoges.fr/ciNone/IMG/pdf/1_-_amv_-_bia_eleve_2016.pdf *(2023).*

7- Working environment (Facilities necessary for learning)

- *SolidWorks (Flow simulation; simulation)*

Course Specification

Combustion

1. General

Coded	GELMAero5109	Level/Semester	3/S5	Coefficient	2.25	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Hichem GAZZAH*					Volume. H. (TP)	*10.5*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*45*
Module	*Combustion*					Version	*09/2023*

Course description (Course objective):
The "combustion" course presents the fundamental principles of combustion and thermochemistry. A mathematical description of the different types of flame: pre-mixing and diffusion in different laminar and turbulent flow regimes with an application aspect linked to the field of aeronautics.

Prerequisites:	*Keywords :*
fluid mechanics/thermodynamics/heat transfer	Thermodynamics, combustion, chemical equilibrium, composition, lean/rich combustion, adiabatic temperature, lower calorific value, higher calorific value, laminar premix flames, propagation speeds, flame stabilization, laminar diffusion flames, passive scalar, turbulence, turbojets

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Know the basic concepts and thermochemical quantities used in combustion*
OBJ 2 : *Calculate the adiabatic flame temperature of multicomponent gas mixtures with infinitely fast chemistry, chemical equilibrium, and simplified reactor configurations*
OBJ 3 : *Calculate the structure and characteristics of a premixed flame, including flame speed, thickness, quench distance, and minimum ignition energy.*
OBJ 4 : *Calculate the structure and characteristics of a diffusion flame, including height, takeoff distance, and blowout limits*
OBJ 5 : *Understand the behavior and operation of combustion systems in the field of aeronautics (turbojet engines), including ignition and stabilization problems*
OBJ 6 : *Use cutting-edge software to model combustion systems, simulating detailed flame structures.*

Necessary material :

Ansys-Chemkin, Ansys-Fluent, Comsol

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-4	*Chapter 1: Basic concepts of combustion* • *Fuels* • *Combustion study* • *Characteristic quantities of stoichiometric combustion* • *Different types of combustion* • *Combustion temperature*	*6*	*return to mixtures of chemical species and chemical equilibrium; composition at chemical equilibrium; lean/rich combustion; composition of combustion gases; adiabatic flame temperature; lower and higher calorific value, combustion power, smoke-producing power, combustion in excess of air, combustion in lack of air.*
5-7	*Chapter 2: Laminar diffusion flame* • *Combustion process in diffusion flame* • *Qualitative analysis of laminar diffusion flames* • *Diffusion flame theory* • *Complete solutions of a rapid chemistry flame* • *Stabilization of diffusion flames*	*4.5*	*the structure and characteristics of a diffusion flame, notions of passive scalar, length Lf of the flame adiabatic temperature, stabilization of flames.*
8-10	*Chapter 3: Premix Laminar Flame* • *Flame structure* • *Simplified analysis of a 1d laminar premix flame* • *Factors influencing flame speed* • *Flame stability*	*4.5*	*The structure and characteristics of a premixed flame, one-dimensional equations, propagation speeds; stabilization of flames.*
11-12	*Chapter 4: Turbulent Flames* • *Introduction to Turbulent Flows* • *Structure of turbulent premix flames* • *Structure of turbulent diffusion flames*	*3*	*Turbulent flame speed,* *Length of turbulent flame, Damkohler number, influence of swirls*

	• *Turbulent flame regimes*		
13-14	*Chapter 5: applications using cutting-edge software (Ansys-Fluent, Comsol)*	*3*	*model combustion systems, by simulating the detailed structures of flames.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1.2	*Combustion study*	*3*	*C understand the fundamental principles of combustion n* *E examine the parameters influencing the combustion process n* *E carry out experimental measurements to analyze combustion n*
3-4	*Combustion Simulation*	*3*	*Understand the theoretical principles of combustion.* *Use digital simulation tools to model the combustion process.* *Analyze simulation results and compare them to theoretical expectations.*
5-6	*Digital Combustion Modeling*	*3*	*Understand the basic principles of numerical combustion modeling.* *Use simulation software to model the combustion process.* *Analyze the simulation results and draw conclusions.*
1	*Practical exam, mini-project defense, ...*	*1.5*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒*Yes* ☐ *No*	*20%*

EE - Written test (Final exam)	☒Yes ☐ No	60%
EP - Practical test (TP- TP exam / MP- Mini project)	☒ Yes ☐ No	20%

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒No*
- *Authorized search engine : ☐ Yes ☒No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

Stephen Turns and Daniel C. Haworth *, An Introduction to Combustion: Concepts and Applications, McGraw-Hill, New York, NY, 2021 https://www.mheducation.com/highered/product/introduction-combustion-concepts-applications-turns -haworth/M9781260477696.html*

BORGHI Roland , CHAMPION Michel , MODELING AND THEORY OF FLAMES, 2000, https://www.editionstechnip.com/fr/catalogue-detail/652/modelisation-et-theorie-des-flammes.html

7- Working environment (Facilities necessary for learning)

- *Ansys Chemkin-Pro, https://www.ansys.com/products/fluids/ansys-chemkin-pro*
- *Ansys Fluent https://www.ansys.com/products/fluids/ansys-fluent*
- *The COMSOL Multiphysics® software, https://www.comsol.com/*

Course Specification

Structural mechanics

1. General

Coded	*GELMAero5110*	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	Ibrahim MLAOUHI					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*26*
Module	*Structural mechanics*					Version	*09/2023*

Course description (Course objective):
The Structural Mechanics course aims to provide students with an in-depth understanding of the fundamental principles of aeronautical structural mechanics. The main objective is to develop the skills necessary to analyze, design and evaluate the resistance of structures used in the aerospace industry in particular, hyperstatic structures (Calculation of hyperstatic (statically indeterminate) structures); Three-moment method; Forces method; Travel methods; Hyperstatic lattices. The main topics covered include structural modeling, elasticity theory, aerodynamic loading, stress and strain, material fatigue, and structural repair methods.

Prerequisites:	*Keywords :*
- *Statics of solids* - *Mechanics of deformable solids / Elasticity, Resistance of materials (RDM2)*	aerospace *Structures and Components, Hyperstatic Structures, curvilinear structure, energy method, superposition method.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the main concepts of structural mechanics applied to aeronautics.* ***OBJ 2 :*** *Develop an in-depth knowledge of the loads and constraints specific to aeronautical structures.* ***OBJ 3 :*** *Be able to study and solve a simple, linear or circular hyperstatic structure.* ***OBJ 4 :*** *Acquire skills in modeling aeronautical structures.* ***OBJ 5 :*** *Apply the principles of stress analysis to evaluate the safety and reliability of aeronautical structures.* ***OBJ 6 :*** *Calculate strains and plastic deformations under various loads.*

Necessary material :

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Ch.1: Foundations of Aeronautical Structural Mechanics and Associated Components*** ▪ *Introduction to the mechanics of aeronautical structures* - *Definitions and objectives of structural mechanics applied to aeronautics.* - *Overview of specific challenges in designing structures for aeronautical applications.* ▪ *Loads and stresses in aeronautical structures* - *Types of loads encountered in the aeronautical industry.* - *Understanding of security constraints and criteria.* ▪ *Materials used in aeronautical structures* - *Mechanical characteristics of commonly used aeronautical materials.* - *Thermal and environmental considerations linked to the choice of materials.* ▪ *Principles of Structural Design* - *General design approaches to ensure safety and performance.* - *Integration of lightweight design and aerodynamic considerations.*	3h	- *Understand the main concepts of structural mechanics.* - *Identify specific challenges related to aeronautical structures.*
3-4	***Ch.2: Modeling Approaches for Aeronautical Structures and Components*** ▪ *Geometric modeling of structures* - *Methods for geometric representation of aeronautical components.* - *Use of modeling software to create models.* ▪ *Aerodynamic load modeling* - *Introduction to aerodynamic loads and their modeling.* - *Analysis of the effects of pressure and drag on structures.* ▪ *Modeling of composite materials*	*3h*	- *Acquire skills in modeling aeronautical structures.* - *Use modeling software to represent aeronautical components.* - *Explore the particularities of modeling aeronautical structures.*

	- *Modeling techniques specific to composite materials.* - *Considerations for taking into account anisotropic properties.* ▪ *Exercises and tutorials*		- *Integrate aerodynamic loads into models.*
5-6 *7-8*	***Ch.3: Analysis of Hyperstatic Structures in the Aeronautical Context*** ▪ *Introduction to hyperstatic structures* - *Definition and characteristics of hyperstatic structures.* - *Reminder of the principles of static balance.* - *Hyperstatic rectilinear beams* - *Hyperstatic curvilinear beams and structures.* ▪ *Methods for analyzing hyperstatic structures* - *Analytical methods for solving hyperstatic structures.* - *Superposition method, energy method…etc.* - *Use of structural analysis software for complex cases.* ▪ *Exercises and tutorials*	*3h* *3h*	- *Explore the particularities of modeling aeronautical structures.* - *Integrate aerodynamic loads into models.* - *Analyze stresses and strains resulting from loads on hyperstatic structures.*
9-10 *11-12*	***Ch.4: Hyperstatic Trusses in Aeronautical Structural Designs*** ▪ *Role of hyperstatic lattices* - *Application of hyperstatic lattices in aeronautical structures.* - *Advantages and limitations of trellises compared to other configurations.* ▪ *Design and analysis of hyperstatic trusses* - *Truss design and sizing methods.* - *Analysis of stresses and strains in lattices.* ▪ *Exercises and tutorials*	*3h* *3h*	- *Define hyperstatic trusses and their use in aeronautical structures.* - *Analyze the mechanical properties of the lattices.* - *Apply analysis methods to solve hyperstatic lattices.* - *Consider practical applications in aeronautics.*
13-14	***Ch.5: Application of the Finite Element Method in the Calculation of Aeronautical Structures***		- *Understand the fundamentals of the*

	▪ *Fundamentals of the Finite Element Method (FEM)* - *Mathematical bases of MEF applied to structural mechanics.* - *Principle of discretization and subdivision of structures.* ▪ *Modeling aeronautical structures with FEM* - *Practical application of FEM to model complex structures.* - *Choice of element types and convergence criteria.* ▪ *Interpretation of MEF results* - *Analysis of MEF results to assess safety and performance.* - *Use of simulation software to interpret results.* ▪ *Exercises and tutorials*	*3h*	*finite element method.* - *Apply this method to the modeling of aeronautical structures.* - *Use the finite element method to solve concrete problems in aeronautics.* - *Evaluate the precision of the results obtained.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*

- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Albiges M. Resistance of applied materials, volume 1, (1969), Editions Eyrolles.

- Dreyfuss E., Lessons on the Resistance of Materials, (1966), Editions Eyrolles.

- Megson TH, Structural and stress analysis, (1996), British library cataloging in publication data.

- Nash WA, Theory and problems of strength of materials 4th Ed. (1998), McGraw-Hill, New York.

- Philippe B., Structural Mechanics, 2008, ENPC.

7- Working environment (Facilities necessary for learning)

Course Specification

Thermal Modeling

1. General

Coded	GELMAero5111	Level/Semester	3/S5	Coefficient	3	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Rihem SARRAJ*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*28*
Module	*Thermal Modeling*					Version	*09/2023*

Course description (Course objective):
Master simulation techniques in order to solve engineering problems that cannot be solved by analytical methods.

Prerequisites:	*Keywords :*
Analysis and Algebra of preparatory classes; Numerical analysis	*Interpolation functions; finite element methods; stiffness matrix*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the notion of numerical approximation as well as its quantification.* ***OBJ 2 :*** *Master digital simulation techniques.* ***OBJ 3 :*** *Use and master calculation software.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals

1-2	*Introduction to numerical simulation*	*3 a.m.*	*Definition of digital simulation b. Applications and importance in solving real problems Master the gaps between the numerical solution and the physical phenomenon to be studied. Presentation of the different numerical errors.*
3-4	*Differential equations and partial differential equations; Presentation of Numerical Methods for Solving Differential Equations*	*3h*	*Presentation of physical models in the form of differential equations*
5-8	*Finite element method FEM; Interpolation functions*	*6 a.m.*	*Principle of FEM and applications in engineering and numerical simulation* *Presentations of interpolation functions in the different cases: 1D; 2D; 3D*
9-11	Application to beam elements (1D case)	*4.5 hours*	*From the mathematical formulation to the equivalent writing of the algebraic (matrix) equation to be solved; determination of the stiffness matrix*
12-14	2D solution method lattice elements	*4.5 hours*	*Numerical resolution of 2D problems*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Bending of a beam*	*3 H*	*Study of the effect of mesh quality on numerical results*
3-4	*Hole plate in tension*	*3 H*	*Use adaptive meshing technique to ensure accuracy of numerical results*
5-6	*Thermomechanical study of a heated pipe connection*	*3 H*	*Master the transfer of results from the thermal study to the static study to obtain the thermomechanical solution*
7-8	*Aerostatic simulation of an airplane wing. Determination of pressure and stress profile*	*3 H*	*Use the forces from aerodynamic simulation to study the stresses induced in the wing.*
9-12	*Elastoplastic behavior of a sheet subjected to V-shaped bending*	*6 a.m.*	*Simulation of an assembly with non-linear behavior*

13-14	*Practical exam*	*3 H*	*Assessment*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Hughes, T. J. R. (2001). "The Finite Element Method: Linear Static and Dynamic Finite Element Analysis." Prentice Hall.*
- *Daryl L. Logan, A First Course in Finite Elements Method, CENGAGE Learning, 5th Edition 2012.*
- *Engineering Analysis with SOLID ORKS Simulation 2018, Paul M. Kurowski, Ph.D., P.Eng., SBN-13: 978-1-63057-153-5.*

7- Working environment (Facilities necessary for learning)

- *SolidWorks 2023 (Simulation)*

Course Specification

Turbomachines and Turbulence

1. General

Coded	*GELMAero5112*	Level/Semester	*3/S5*	Coefficient	*3*	Credits	*3*
Course	*Electromechanics*					Volume. H. (CI)	*21*
Responsible	*Ibrahim MLAOUHI*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*28*
Module	*Turbomachines and turbulence*					Version	*09/2023*

Course description (Course objective):
The application of the laws of fluid mechanics and thermodynamics to energy-producing and mechanical energy-consuming machines using compressible fluids. Control of problems linked to turbomachines during their operations. *As for Turbulence aims to study and model turbulent flows using experimental and numerical methods with emphasis on inhomogeneity and non-stationarity in flows bounded by walls, wakes, jets and other flow configurations.*

Prerequisites:	*Keywords :*
Fluid mechanics, thermodynamics, heat transfer, hydraulic and pneumatic systems	*Turbomachines, compressors, turbines, speed triangle,* *Turbulence, Reynolds equations and tensors, equation model, Kolmogorov theory, energy cascade, turbulent viscosity,*

Specific objectives of the course (OBJ $_i$):	
OBJ 1 :	*Discover the origin and effect of turbulence in industrial and aeronautical environments.*
OBJ 2 :	*Understanding the properties of turbulence*
OBJ 3 :	*Distinguish the types of turbomachines (compressors, turbines).*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. _ HR	Goals
1-4	*Turbulence* - *Importance of turbulence (natural, industrial, aeronautical environments, etc.)* - *Friction force, Cx, energy dissipation, mixing* - *Overview of digital approaches: RANS, LES, DNS*	*6*	*Discover the importance of the phenomenon of turbulence*
5-6	*Properties of turbulence* - *Scale ranges* - *Ensemble averages, Reynolds decomposition* - *Reynolds equations* - *Reynolds tensors*	*3*	*Present and explain the phenomena.* *To understand* *demonstrate the fundamental equations*
7-8	*Turbulence models* - *Eddy viscosity models* • *0-equation models (mixture length)* • *Models with 1 and 2 equations (k-epsilon, k-omega , ...)* - *Notions on 2nd order models (RSM, Reynolds-stress models)* - *Notions on LES (Large Eddy Simulation) models* *Homogeneous turbulence* - *Average flow energy balance - turbulent fluctuations* - *Spectral description* - *Energy cascade, Kolmogorov theory*	*3*	*Study the phenomenon of turbulence using models of different levels.*
9-10	*Introduction to turbomachines* - *Classification.* - *Layout of the organs of a turbomachine.* - *Turbomachines (Axial/Radial)*	*3*	*Distinguish the types of turbomachines.*
11-12	*Turbomachine theory* - *Thermodynamic Study* - *Energy characteristics.* - *Amount of movement,* - *speed triangles*	*3*	*Establish the characteristic laws governing the operation of turbomachines.*
12-14	*Functioning principles,* - *General equations in turbomachines*	*3*	*Study the operation and performance of turbomachines*

	- *Dimensional Analysis and similarity,* - *characteristic curves,*		*using dimensionless parameters.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. _ HR	Goals
1-2	*Turbulent flow profile*	*3*	model and *simulate* fluids in *turbulent flow* through different volumes
3-6	*Turbulence modeling*	*6*	*Create and modify a calculation domain.* *Choose a modeling strategy.* *Use turbulence models.*
7-8	Aerodynamic simulation specific to turbomachines	*3*	Mastery of the operation of the main types of turbomachines - Determination of their main technical characteristics
9-10	Digital fluid simulations Study of fluid flows within centrifugal pumps	*3*	These studies make it possible to validate the sizing and operation of centrifugal pumps.
11-12	Numerical analysis of the fluid-structure interaction of a gas turbine blade profile	*3*	*The numerical study of a flow around a blade of a gas turbine and see the aerodynamic behavior...*
13.14	*Practical exam, mini-project defense, …*	*3*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Turbulence, C. Bailly and G. Comte-Bellot, Ed. CNRS, 2003.
- Turbulent flows, SB Pope, Cambridge University Press, 2000.
- Turbulence, PA Davidson, Oxford University Press, 2004.
- SL Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, Pergamon Press Second Edition, 1975
- B. Lakshminarayana , Fluid Dynamics and Heat Transfer of Turbomachinery, John Wiley and Sons Inc., 1996
- PJ RAPIN et Coll , Refrigeration installations, Ed PYL
- S. ALQUIER, Y. LECOFFRE, Heat pumps and the individual house, Ed Moniteur
- G. LEMASSON, Energy transforming machines, Ed Delagrave
- M. SEDILLE, Hydraulic and thermal turbomachines, volume I and II, Ed Masson
- L. BOREL, thermodynamics and energy, volume I and II, Presse polytech . Romands
- AFNOR, Turbomachines
- Pumps, Ed Afnor
- Fan, Ed Afnor
- Compressor, Ed Afnor

Major Industrial maintenance: S5

Course Specification

Maintenance tools

1. General

Coded	GELMMI5104	Level/Semester	3/S5	Coefficient	2.25	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Mahdi CHEHATA*					Volume. H. (TP)	*00*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*40*
Module	*Maintenance tools*					Version	*09/2023*

Course description (Course objective):
Be able to master the different maintenance tools in order to implement and succeed in an adequate maintenance strategy with the company's work focus while promoting full collaboration with the various stakeholders

Prerequisites:	*Keywords :*
- *Reading flowcharts, grafcets, flowcharts,* - *Non-destructive testing* - *Maintenance methods and times* - *Quality concepts*	*Quality, NDT, organization charts, corrective, preventive maintenance, physico-chemistry of maintenance*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Master the different maintenance strategies* ***OBJ 2 :*** *Know and apply the different concepts and terminologies of corrective maintenance* ***OBJ 3 :*** *Know how to determine the frequency of preventive interventions* ***OBJ 4 :*** *Know and apply maintenance documentation* ***OBJ 5 :*** *Master and apply NDT as well as standard forms of equipment degradation; thus their means of prevention.*

Necessary material :

▪ *UltNoneonic probe,* ▪ *Thickness gauge,* ▪ *Thermal camera,* ▪ *Penetrant product,*

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Corrective maintenance tools*	*4.5*	*Promote the success of a repair*
3-6	*Implementation of preventive maintenance*	*9*	*Succeed in preventative logistics*
7-10	*Maintenance tools*	*9*	*Master the standard preventive maintenance tools*
11-14	*FMEA – role and implementation*	*9*	*Apply and master the FMEA*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑ *No*	--
DS - Supervised Duty	☑ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☑ *No*	--

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☑ *No*
- *Authorized search engine* : ☐ *Yes* ☑ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*

- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *https://theses.hal.science/tel-00170432/document*
- *https://www.mcours.net/cours/pdf/hasclic4/hasbnclic971.pdf*
- *https://electrotoile.eu/maintenance.php*
- *http://www.ispm.ac.ma/wp-content/uploads/2020/05/S221-caracteristiques-physico-chemines.pdf*
- *Jardine, A. K. S., & Tsang, A. H. (2006). Maintenance, Replacement, and Reliability: Theory and Applications. CRC Press.*
- *Boaden, R. (1997). Maintenance Planning and Control (2nd Edition). Longman.*

7- Working environment (Facilities necessary for learning)

Course Specification

Repair techniques

1. General

Coded	*GELMMI5105*	Level/Semester	*3/S5*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*10.5*
Responsible	*Mahdi CHEHATA*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*40*
Module	*Repair techniques*					Version	*09/2023*

Course description (Course objective):
Be able to implement and successfully implement a set of commonly encountered repair techniques and apply them in order to resume production as quickly as possible

Prerequisites:	*Keywords :*
- *Reading standard drawings and illustrations given by suppliers and designers* - *Calculation and sizing of mechanical structures* - *Maintenance strategies and levels*	*Rolling, curative maintenance, reloading of structures, bearing, alignment, assembly and disassembly graphs*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Improve the skills of the maintenance manager*
OBJ 2 : *Master standard maintenance tasks*
OBJ 3 : *Be able to select the approach to follow in a curative intervention.*

Necessary material :
MIG MAG welding station - Steel structure and profile - Alignment bench - double dial indicators - Bearing assembly and disassembly bench - Sets of standard mechanical tools - Sets of thin shims for alignment - camera thermographic -

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Maintenance repair position*	*1.5*	*Master standard maintenance tasks*
2-3	*The order of assembly and disassembly*	*3*	

4	*Bearing assembly*	*1.5*	*Be able to select the approach to follow in a curative intervention.*
5	*Aligning rotating machines*	*1.5*	
6.7	*Arc reloading technique*	*3*	

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1	*View and familiarize yourself with the available tools*	*1.5*	*Identify available tools*
2	*Handle and understand tools correctly*	*1.5*	*Avoid bodily accidents*
3-4	*Read an overall drawing of a mechanism and understand its mode(s) of operation*	*3*	*Know the performance of a mechanism*
5-6	*Carry out the disassembly and disassembly of a mechanism*	*3*	*Carefully carry out disassembly and assembly operations*
7	*Install a rigid bearing*	*1.5*	*Master the assembly of a bearing*
8	*Dismantle a rigid bearing*	*1.5*	*Master the disassembly of a bearing*
9	*Assembling and dismounting a separable ring tapered bearing*	*1.5*	*Master the handling of a tapered bearing*
10	*Visually examine a tree line*	*1.5*	*Thermo graphically read a tree line*
11	*Align two rotating machines by sight*	*1.5*	*Use feeler gauges and a ruler to align 2 rotating machines*
12	*Use the method – inverted comparators – to align two rotating machines*	*1.5*	*Use the graphical method for alignment*
13	*Reloading a metal structure by welding*	*1.5*	*Use MIG-MAG welding for surfacing.*
14	*practical exam,*	*1.5*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting

CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☑ *No*	---
DS - Supervised Duty	☑ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☑ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☑ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☑ No*
- *Authorized search engine : ☐ Yes ☑ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *https://www.technologuepro.com/*
- *Mahan, D. P., & Bechhoefer, E. (1992). Repair and Maintenance of Machines (2nd Edition). Prentice Hall.*
- *Schilling, E. G. (2006). Fundamentals of Machine Component Design (5th Edition). Wiley.*
- *Personal lesson*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Safety of industrial installations

1. General

Coded	GELMMI5106	Level/Semester	3/S5	Coefficient	2.25	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	*Kais TELILI*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*39*
Module	*Safety of industrial installations*					Version	*09/2023*

Course description (Course objective):
The security of industrial installations is a crucial aspect to ensure the safety of people, property and the environment in the context of industrial activities. It encompasses a wide range of measures aimed at preventing accidents, incidents and failures which could lead to adverse consequences. Here are some key principles and areas of importance in industrial facility security:

Prerequisites:	*Keywords :*
Reliability, Electric circuit, Electrotechnics	*Safety, fire, risk…*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Identification of potential hazards, quantification of risks and implementation of measures to mitigate them.* ***OBJ 2 :*** *Implement an effective security management strategy (Design, management, monitoring and intervention)* ***OBJ 3 :*** *Apply continuous improvement approaches to implement corrective measures*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Risk Assessment:*** *In-depth assessments of facility risks. (FMEA Security)*	*3*	*Identification of potential hazards, quantification of risks and implementation of measures to mitigate them.*
3-4	***Safety management:*** *the establishment of appropriate policies, procedures and management systems.* - *Staff training,* - *Security awareness and effective communication of security-related information.*	*3*	*Implement an effective security management strategy*
5-6	***Safe design:*** *Industrial installations must be designed to minimize risks:* - *Use of safe technologies,* - *Implementation of integrated security systems and compliance with current standards and regulations.*	*3*	*Integrate security into design thinking*
7-8	***Monitoring and maintenance:*** - *Continuous monitoring to detect any sign of failure or potential problem (exploitation of indicators such as MTBF, MTTR.)* - *Planning a regular maintenance program is essential to ensure the proper functioning of equipment and reduce the risk of failure.*	*3*	*Plan to set up a permanent monitoring system*
9-10	***Detection and alarm systems:*** *Implementation of detection and alarm systems is crucial to warn personnel in the event of an imminent incident (gas detectors, automatic fire extinguishing systems, etc.).*	*3*	*installation of fire detection systems*
11-12	***Emergency Response Plan*** - *Detailed emergency response plans to deal with any critical situation such as the staff evacuation plan,*	*3*	*Anticipate critical situations and intervention plans*

	- *incident management, coordination with local authorities, etc.*		
13-14	***Incident analysis:*** *In the event of an incident, it is essential to conduct an in-depth analysis to understand the underlying causes and implement corrective measures to avoid a recurrence (cause and effect, 5P, etc.)*	*3*	*an in-depth analysis of incidents for the implementation of corrective measures*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Kletz, T. A. (2003). Hazop and Hazard Analysis (4th Edition). Gulf Professional Publishing.*
- *Chirdan, L. O., & Yaw, B. S. (2009). Industrial Safety and Hazard Management (2nd Edition). Wiley....*

7- Working environment (Facilities necessary for learning)

- *None*
- ...

Course Specification

Optimization of production systems

1. General

Coded	*GEMMMI5107*	Level/Semester	*3/S5*	Coefficient	*2.25*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*31.5*
Responsible	Habib ABDENNEJI					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*42*
Module	*Optimization production systems*					Version	*09/2023*

Course description (Course objective):
Optimization of production systems is a process aimed at improving the efficiency, productivity and profitability of a company.

Prerequisites:	*Keywords :*
OGP, CAPM, Lean	*TOC, VSM, SCM, Lean, …*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Identify current production processes, from the supply chain to delivery.* ***OBJ 2 :*** *Optimize supply chain management to minimize costs, reduce delays and improve visibility.* ***OBJ 3 :*** *Implement changes in a gradual and well-planned manner. Use project management methodologies to ensure effective implementation.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-4	*Process Analysis:* - *Roll-down analysis and process graph* - *Implementation typology and ergonomic analysis of positions* - *OCD* - *VSM*	*6*	*Identify current production processes, from supply chain to delivery*

5-10	*Supply Chain Management* - *Stock management* - *SCM* - *Distribution Management (Transportation Issues)*	*9*	*Optimize supply chain management to minimize costs, reduce lead times and improve visibility*
11-14	*Lean Manufacturing:* - *Lean principle* - *Measuring Lean indicators* - *Approach to developing a Lean project*	*6*	*Adopt Lean Manufacturing principles to eliminate waste, reduce inventory and improve the overall efficiency of the production process*
15-21	*Project management, The development phases of a project (APQP: Advanced Product Quality Planning)* - *Project Definition and Planning: (Gantt Chart, Activity Network Diagram, etc.)* - *Product design and development (Product FMEA)* - *Design and development of the product manufacturing process (FMEA Process, MSA, R&R):* - *Process and product validation (PPAP: Production Part Approval Process)* - *Launch, Evaluation and Continuous Improvement (LEAN SIX SIGMA)*	*10.5*	*Implement changes in a gradual and well-planned manner. Use project management methodologies to ensure effective implementation.*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting

CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*40%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- Brissard, JL and Polizzi, M. Tools for industrial production management. Afnor-management.
- Zermati, P. Practice of inventory management. Dunod.
- Vallet, G. Project planning techniques. Dunod, Paris.
- Beranger, P. The new rules of production. Dunod.
- Darbelet, M. Izard, L. Scaramuzza, M. Fundamental notions of business management. Foucher.
- Milan, A. Jouve, M. Communication and business organization. Collection - Breal.

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Machine control

1. General

Coded	GELMMI5108	Level/Semester	3/S5	Coefficient	3	Credits	3
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Jannet JEMAII*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*33*
Module	*Machine control*					Version	*09/2023*

Course description (Course objective):
Allow the student to acquire knowledge in the field of intelligent controls of the most used electrical machines: (direct current machine, three-phase asynchronous machine, synchronous machine, etc.) and to manipulate them according to the requirements of the system studied while guaranteeing best performance (speed, precision and stability).

Prerequisites:	*Keywords :*
Electrotechnics and static converters.	*Direct current machines, asynchronous machines, synchronous machines, choppers, rectifiers, inverters, etc.*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand how rotating machines work (electromechanical transformation).* ***OBJ 2 :*** *Understand speed variation techniques and choose the suitable converter for each machine (operating quadrant, supply voltage).* ***OBJ 3 :*** *Understand the control techniques that make it possible to influence the performance of the controlled system.*

Necessary material :
Electrical machines: Direct current machine, asynchronous machine, synchronous machine, speed variators, computer.

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*General information on rotating machines*	*3h*	*Understand the principles of electromagnetism, understand the operation of rotating machines and their constitutions, Characteristics of machines under load (Torque, speed and power)*
3-4	*Study and modeling of the direct current machine*	*3h*	*Model and study the operation of a direct current machine*
5-6	*DC machine control*	*3h*	*Study speed variation techniques, study suitable converters depending on the power supply, study the performance of a system driven by an MCC (speed control, current control, etc.)*
7-8	*Study and modeling of the asynchronous machine*	*3h*	*Understand the operating principle of asynchronous machines as motors and generators, model the asynchronous machine, study transformation matrices (Park matrix, Clark matrix, Concordia matrix)*
9-10	*Control of the asynchronous machine*	*3h*	*- Scalar control of the asynchronous machine* *-Vector control of the asynchronous machine*
11-12	*Study and modeling of the synchronous machine*	*3h*	*Understand the operating principle of synchronous machines in alternator, model the synchronous machine.*
13-14	*Synchronous machine control*	*3h*	*- Scalar control of the synchronous machine* *-Vector control of the synchronous machine*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
1-2	*Study and modeling of direct current machines*	*3h*	*Model and study the operation of a direct current motor at variable speed by*

			simulating then interpreting the operating curves.
3-4	*Separately Excited/Shunt DC Machine Control*	*3h*	*Analyze the operation of direct current machines under load, in open loop and closed loop.* *-Analyze and interpret the machine's response.*
5-6	*Study and modeling of the asynchronous machine*	*3h*	*Model and study the operation of an asynchronous motor in variable speed by simulating then interpreting the operating curves.*
7-8	*Vector control of the asynchronous machine*	*3h*	*-Design a speed variator* *-Understand the components of a speed variator* *- Analyze the performance of the asynchronous machine.*
9-10	*Study and modeling of the synchronous machine*	*3h*	*Model and study the operation of a synchronous machine in variable speed by simulating then interpreting the operating curves.* *-Study of the alternator under load*
11-12	*Synchronous machine control*	*3h*	*Study of the stability of synchronous machines*
13-14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC – Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS – Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE – Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*

EP – Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

6- Web references (useful links):

- *Jean-Paul Hautier , Modeling and control of the asynchronous machine, Edition Technip, 1995.*
- *Michel Pinard , Electronic control of machines, Cahiers Collection techniques , Edition Dunod, 2013.*
- *Ogata, K. (2010). Modern Control Engineering (5th Edition). Prentice Hall.*
- *Kuo, B. C., & Golnaraghi, F. (2017). Automatic Control Systems (9th Edition). Wiley.*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Advanced Automation and Robotics

1. General

Coded	*GELMMI5109*	Level/Semester	*3/S5*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Anouer BEN AMOR*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*30*
Module	*Advanced Automation and Robotics*					Version	*06/2025*

Course Description (Course Objective):
Train learners in advanced automation technologies and the implementation of industrial robotic systems, from design to integration and maintenance.

Prerequisites:	*Keywords :*
◆ *Programmable logic controller* ◆ Basics of automation (Grafcet, wired logic, programmable logic) ◆ Knowledge of electricity, electrical engineering and sensors ◆ Notions in algorithms or programming	*API, GRAFCET, HMI, SCADA, robot, cobots...*

Specific course objectives (OBJ $_i$):	
OBJ 1 :	*Design and program complex automated systems.*
OBJ 2 :	*Integrate and configure industrial robots (robotic arms, AGVs, etc.).*
OBJ 3 :	*Master industrial communication protocols (Ethernet/IP, Modbus, Profinet, etc.).*
OBJ 4 :	*Apply servoing, vision and embedded intelligence techniques.*
OBJ 5 :	*Diagnose and maintain a robotic system.*

Materials needed:
- Siemens, Schneide r, ... Robot - Software: TIA Portal, RobotStudio, LabVIEW, etc.

2- Content elements (Course)

Week(s)	*Chapters/Content Elements*	*Nbr. HR*	*Objective(s) sought*

1-4	Advanced Automation : Reminders on industrial automation , Advanced API programming (advanced Grafcet, IEC 61131-3 languages) , Industrial communication networks , Human-machine interfaces (HMI / SCADA) , Supervision and remote monitoring	*6*	Master the design, programming and integration of complex automated systems using advanced automation technologies (API, industrial networks, supervision, robotics).
4-8	Industrial robotics Robot architecture: manipulators, kinematics, degrees of freedom , Robot control: programming by learning or offline , Introduction to machine vision and embedded sensors , Collaborative robots (cobots): safety standards, human-robot interaction , Robotic simulation .	*6*	Understand the basic kinematics of an industrial robot (axes, degrees of freedom, trajectories). Identify the components of a robotic system (manipulator, controller, sensors, gripper, etc.). Program an industrial robot in point-to-point or continuous path mode. Synchronize the robot with other equipment
9-14	Integration and maintenance Integration of a robot into an automated cell , Alarm and fault management , Predictive maintenance and remote diagnosis , Industrial cybersecurity	*9*	Analyze the requirements of a robotic cell (safety, communication, positioning, cadence). Install and connect an industrial robot in a production environment. Carry out preventive maintenance of the robot , Diagnose operating faults (mechanical, electrical or software). Use the monitoring or analysis tools integrated into the robot (error logs, test interfaces, monitoring software).

3- Content elements (Practical work)

Week(s)	Activities/Content Elements	Nbr. HR	Objective(s) sought
1-2	PLC programming with analog and PID modules	*3*	*Design and program complex automated systems.*
3-6	Implementation of a robotic cell (palletizing, sorting, welding, etc.)	*6*	*Integrate and configure industrial robots (robotic arms, AGVs, etc.).*

7-8	Simulation of automated lines with supervision	*3*	*Master industrial communication protocols (Ethernet/IP, Modbus, Profinet, etc.).*
9-12	Fault diagnosis on industrial model	*6*	*Diagnose and maintain a robotic system*
13-14	*Practical exam*	*3 hours*	*Summative assessment*

4- Evaluation methods & Distribution of marks

Type of assessment	Yes/No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☐ *No*	
DS - Supervised Homework	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *100% TP material : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP subject : Average = 20% DS + 20% EP + 60% EE***

2- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Understanding of the content (4 points)*
- *Criterion 2: Application of knowledge (10 points)*
- *Criterion 3: Critical analysis (4 points)*
- *Criterion 4: Clarity and organization (2 points)*

3- Web references (useful links):

- JM BLEUX – JL FANCHON, Industrial automation ETAPES collection – NATHON 1996
JC BOSSY – P. FAUGERE – C. MERLAND, Le GRAFCET (Educative 1995)
- C. ROBINET – A. BIANCIOTTI – P. BOYE Industrial automation and computing (Delagrave 1997)
- D. BLIN – J. DANIC – R. LE GARREC – F. TORLEZ – JC SEITE, Automation and industrial computing (Educative 1995)
- R. DAVID, H. ALLA, From GRAFCET to Petri nets, Ed Hermes
- G. CHEVALIER, B. GUILLOSSOU, GRAFCET and automation functions, Ed Dunod

7- Working environment (Facilities necessary for learning)

- *None*

Course Specification

Control non-destructive (CND)

1. General

Coded	*GELMMI5110*	Level/Semester	*3/S5*	Coefficient	*3*	Credits	*3*
Course	*Electromechanical Engineering*					Volume. H. (CI)	*21*
Responsible	*Safa Hraoiech*					Volume. H. (TP)	*21*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*33*
Module	*Non-Destructive Testing*					Version	*09/2023*

Course description (Course objective):
Nondestructive testing (NDT), also known as nondestructive evaluation (NDE) and nondestructive inspection (NDI), is a multidisciplinary evaluation that blends quality assurance and materials science. NDT is used to inspect and evaluate materials, components, or assemblies without destroying their serviceability. Non-destructive evaluation (NDE) methods Commonly used are: Visual Inspection, Penetrant Testing , Radiography, UltNoneonic, Magnetic Particle, Eddy Current…

Prérequis :	*Mots clés :*
Materials science	*Evaluate,* properties of a material, surface discontinuities, methods

Objectifs spécifiques du cours (OBJ_i) :
OBJ 1 : *Definition of NDT, uses of NDT, objectives*
OBJ 2 : *Presentation of the most frequently used test methods*
OBJ 3 : *Advantages and limitations of each method*

Matériel nécessaire :
Flash lamp, Penetrant, Developer.

2- Eléments de contenu (Cours)

Semaine(s)	Chapitres/Eléments de contenu	Nbr. HR	Objectif(s) visés
1-2	*Introduction of Nondestructive testing*	*3h*	*Definition of the process*

			Presentation of different types of flaws such as a crack or porosity
3-6	*Practical work on Visual inspection and penetrant testing*	*3h*	*Haw to use the flash lamp to find the cracks* *Description of results of a penetrant testing*
6	*Presentation (project)*	*3h*	*Presentation of a method of the NDT as a project*
7	*Eddy current testing*	*3h*	*Principle of the proposed method* *Uses* *Advantages and limitations* *Interpretation of the results*
8	*UltNoneonic testing*	*3h*	
9	*Exercises + Radiography testing*	*1.5h*	
10	*Computerized tomography CT scan*	*1.5h*	
11	*Infrared (IR) thermography*	*1.5h*	
12	*Revision for the final exam*	*1.5h*	*Exercises*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
2	*Visual inspection*	*3h*	*Description of the method, tools* *Limitations*
3	*Penetrant testing and revision*	*3h*	*Principle* *Uses and limitations Application examples*
5	*Magnetic particle inspection*	*6am*	*Principle of the MT method* *Advantages, uses, tools and limitations*
4	*Practical work on Visual inspection and penetrant testing*	*6am*	*Haw to use the flash lamp to find the cracks* *Description of results of a penetrant testing*
	Practical exam	*3*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☒ *No*	
DS - Supervised Duty	☒ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	☒ *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*20%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- ***CI+TP material : Average = 20% DS + 20% EP + 60% EE***

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☒ No*
- *Authorized search engine : ☐ Yes ☒ No*
- *Criterion 1: Preparation of the project (PPT, speech) (8 points)*
- *Criterion 2: Presentation of the proposed method (Description of the principle, examples, uses, limitations) (8 points)*
- *Criterion 3: Use of descriptive figures and videos (4 points)*

6- Web references (useful links):

[1] NON-DESTRUCTIVE TESTING (NDT) AND SHIP SURVEILLANCE (ISTLS), Ms. HENTATI EP. FKI Taissir, 2022-2023.

[2] Non-destructive testing: penetrant testing, magnetic scanning, radiography, eddy current and ultNoneound,
Ministry of Higher Education and Scientific Research, People's Democratic Republic of Algeria, 2017-2018
https://www.univ-usto.dz/images/coursenligne/CND_RA.pdf

[3] Non-destructive testing, kada karim and gharabi tayab, 2018
https://dspace.univ-adrar.edu.dz/jspui/bitstream/123456789/146/1/Contr%C3%B4le%20non%20destructif%20CND%20.pdf

[4] https://www.skillscommons.org/bitstream/handle/taaccct/8674/1%20Introduction%20to%20Nondestructive%20Testing.pdf?sequence=2&isAllowed=y

[5] https://ncr.indianrailways.gov.in/cris/uploads/files/1348828761350-NDT.pdf

[6] http://wcours.gel.ulaval.ca/2017/h/GEL1001/default/5chronologie/2017-01%20GEL-1001%20CND.pdf

7- Working environment (Facilities necessary for learning)

NONE

language module sheets

Process of test of placement LANGUAGES (English & French)

New students :

- ✓ **Registration & Admission**

All the new students has their admission has the PI register in line via a platform dedicated to the passage of tests level of languages "MyEPIADMISSION"

They provide of the information personal such that their name, their address E-mail And their number of CIN ..

- ✓ **Planning & Passage of Test of level :**

A times registered, THE students receive a confirmation registration And are scheduled For pass the tests in English And in French

THE tests are planned In THE labs of LANGUAGES .They pass THE test of language on PC (MCQ) Who evaluate their SKILLS linguistics

- ✓ **Fix of the Testing of level :**

THE tests are corrected automatically by the software And the results are generated instantly once that THE test East finished.

THE results are analyzes For determine the level of language of each student .

- ✓ **Attribution of the levels of language :**

THE levels are based on of the standards international such that THE frame European common of reference For the LANGUAGES (CEFR)

- ✓ **Ranking In the groups of LANGUAGES & Notification of the results :**

In function of their level of language, THE students are assigned has of the groups of language appropriate.

These groups can be constituted in function of level :

1- Beginner =A
2- Intermediate =B
3- Advanced = C

- ✓ **Notification of the results ;**

THE students receive their results via the app And Who understand their level of language And their assignment has A band specific

THE students are Next affected In their groups of language according to THE jobs of LANGUAGES displayed on the app

Follow up And assessment :

THE progress of the students are followed All At long of their course learning

Of the assessment periodicals are carried out such that (projects PPT , tests oral, exercises ..) For adjust their progression in function of their needs .

These process guarantee a assessment precise of level of language of the students And their assignment has of the course appropriate For to favor their learning linguistic

Former students:

Transition of former students from one level to another:

For language levels (former 23.24 => 24.25)

Initial level = A & Average 23.24 <13 → Level A (24.25)
Initial level = A & Average 23.24 >13 → Level B (24.25)
** Initial level = B & Average 23.24 <13 →Level B (24.25)
** Initial level = B & Average 23.24 >13 →Level C (24.25)
**Level C =>15 →Level C (24/25)

Course Specification

French (Level A)

1. General

Coded	*EN-ABC*	Level/Semester	*3-4*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21*
Responsible	*Sami MZOUGHI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*20*
Module	*Languages & Communication*					Version	*09/2023*

Course description (Course objective):
A -level French courses aim to develop the student's ability to understand the essential points of a message written in clear, standard language. The course materials are taken from Inspire 3, a DELF manual. They also aim to prepare the student to produce simple and coherent speeches on familiar subjects. Oral is preferred in all sessions.

Prerequisites:	*Keywords :*
Understand simple, decontextualized sentences. *Communicate in a simple way.*	*Understand, listen, communicate, react*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Understand the materials and respond to instructions.* ***OBJ 2 :*** *Participate orally in debates around the proposed subject.* ***OBJ 3 :*** *Form a personal opinion.*

Necessary material :
Sound recording / JBL

2- Content elements (Course)

Week(s)	Chapters/Content Items	#HR	Goals
1-2	*1st unit: Is it possible to be different and live together ?*	*3 hours*	*- talking about oneself* *- understand others.* *- explain cultural differences.*

3-4	*2nd Unit: Are we all journalists?*	*3 hours*	*- talk about information professions. - transmit information. - question the information.*
5-6	*3rd Unit: Why do we travel?*	*3 hours*	*Tell about an experience. - talk about tourism - think about the trip.*
7-8	*4th Unit: Describing a profession*	*3 hours*	*- collect information about a profession. - talk about responsibilities. - the skills required for each profession.*
9-11	5th Unit: Organize a remote activity	4.5 hours	- discuss teleworking. - understand the advantages and challenges of managing remote activities.
12-14	6th Unit: Can we fight inequalities?	4.5 hours	- tell about a commitment. - to give his opinion. - talk about inequalities.

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No		Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	*☐ Yes*	*☒No*	-
DS - Supervised Duty	*☒Yes*	*☐No*	*40%*
EE - Written test (Final exam)	*☒Yes*	*☐No*	*60%*
EP - Practical test (TP- TP/MP exam- Mini project)	*☐ Yes*	*☒No*	-

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria (of written production)

- *Authorized documents : ☐Yes☐ No*
- *Search engine allowed : ☐Yes☐ No*
- *Criterion 1: Understanding of the instructions : (8 points)*
- *Criterion 2: Relevance of ideas: (4 points)*
- *Criterion 3: Linguistic correction: (6 points)*
- *Criterion 4: Originality: (2 points)*

5- WebReferences (useful links):

- Learn.TV5Monde

6- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

French (Level B)

1. General

Coded	*EN-ABC*	Level/Semester	*3-4*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21*
Responsible	*Sami MZOUGHI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*20*
Module	*Languages & Communication*					Version	*09/2023*

Course description (Course objective):
Level B courses set the objectives of understanding audio documents, understanding press articles and other authentic texts. Written production sessions are also on the program to introduce the student to the code of writing by inviting them to write various texts. The course materials are taken from Inspire 4, a DELF manual.

Prerequisites:	*Keywords :*
The student can understand isolated sentences and frequently used expressions. He can also communicate orally and describe his training using simple means , and address some subjects that concern him closely.	*Understand, communicate, describe, discuss subjects.*

Specific objectives of the course (OBJ $_i$):
OBJ 4 : *Understand the educational documents specific to each lesson.* ***OBJ 5 :*** *Take a position on the subjects or problems raised by the materials.* ***OBJ 6 :*** *Imagine other ways of acting.*

Necessary material :
Paper version documents / Sound recordings / JBL

2- Content elements (Course)

Week(s)	Chapters/Content Items	#HR	Goals
1-2	*Does work have the same meaning today?*	*3 hours*	*. explain professional trends*

			. analyze the workplace. *.reveal professional taboos.*
3-4	*How is technology transforming our lives?*	*3 hours*	*- improve a living space.* *- take a position on virtual meetings.* *- imagine new worlds.*
5-6	*Can we still save the planet?*	*3 hours*	*- make an inventory of pollution.* *-alert the public to a risk.* *-propose solutions*
7-8	*Is politics everyone's business?*	*3 hours*	*- define rights and duties.* *- defend a commitment.* *- question the right to vote.*
9-11	*Are we prisoners of our appearance?*	*4.5 hours*	- tell of discrimination. -imagine the human of the future. - talk about your appearance.
12-14	Is happiness utopian?	4.5 hours	- give a definition of happiness. - analyze preconceived ideas. - envision happiness.

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No		Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes*	☒*No*	-
DS - Supervised Duty	☒*Yes*	☐*No*	*40%*
EE - Written test (Final exam)	☒*Yes*	☐*No*	*60%*
EP - Practical test (TP- TP/MP exam- Mini project)	☐ *Yes*	☒*No*	-

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria (of written production)

- *Authorized documents : ☐Yes☐ No*
- *Search engine allowed : ☐Yes☐ No*
- *Criterion 1: Understanding of the subject and organization of the text: (8 points)*
- *Criterion 2: Care given to expression (6 points)*
- *Criterion 3: Knowledge of the subject : (4 points)*
- *Criterion 4: Originality of ideas : (2 points)*

5- WebReferences (useful links):

- *Learn.TV5Monde*

6- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

French (Level C)

1. General

Coded	*EN-ABC*	Level/Semester	*3-4*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21*
Responsible	*Sami MZOUGHI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*20*
Module	*Languages & Communication*					Version	*09/2023*

Course description (Course objective):
The French Communication Techniques course, at level C , aims to develop three skills in the student: Comprehension of writing (CE), Oral production (PO) and Written production (PE), with a view to preparing them for the DELF exam. The course material is generally a paper version document which offers various educational activities, relating to the materials. The role of the teacher is to provide the student with a certain autonomy in the search for answers. The supports are those of DELF B 2, 2nd Edition - 100% SUCCESS.

Prerequisites:	*Keywords :*
In principle, the student should have the following abilities: understand the essential points of a discussion, a text, a press article when the language used is clear and standard and when it concerns familiar subjects having relates to the daily life of the student.	*Understand, listen well, interact*

Specific objectives of the course (OBJ $_i$):
OBJ 7 : *Make reading hypotheses and generally understand the content of a document.* ***OBJ 8 :*** Enter message scopes. ***OBJ 9 :*** React to messages. ***OBJ 10 :*** For PE, acquire a methodology allowing successful written productions.

Necessary material :
Paper version documents - Sound recordings - JBL

2- Content elements (Course)

Week(s)	Chapters/Content Items	#HR	Goals
1-2	*CE: How to read a text? / A set of short texts.* *PE: Analysis of the instructions / Different statements of written production*	*3 hours*	*Help the student understand various texts.* *Understand what is required by the instructions.*
3-4	*CE: Analysis of positions/testimonies* *PE: Learn to present a situation, facts / Various texts.*	*3 hours*	*Identification of tone, point of view.* *Learn to identify a situation, facts*
5-6	*CE: Search for relevant information / Various texts.* *PE: Expression of personal opinion / PE topics.*	*3 hours*	*Identification of the content of a text.* *Help to formulate ideas, to qualify your comments, to formulate proposals*
7-8	*informative text : its content, its characteristics.* *PE: Text production / Writing workshop.*	*3 hours*	*Enter the content of a text and report it in writing.* *PE: Master the structure of the text to be produced.*
9-11	*CE: The argumentative text / Various texts* *PE: Writing a formal letter. / Written production instructions.*	*4.5 hours*	*CE: Learn to recognize an argumentative text and gNonep its specific features.* *PE: Learn the formal characteristics of the letter.*
12-14	*CE: Analysis of points of view / Written testimonies*	*4.5 hours*	*Recognize the different positions and their nuances.*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No		Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes*	☒*No*	-
DS - Supervised Duty	☒*Yes*	☐*No*	*40%*
EE - Written test (Final exam)	☒*Yes*	☐*No*	*60%*
EP - Practical test (TP- TP/MP exam- Mini project)	☐ *Yes*	☒*No*	-

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria (of written production)

- *Authorized documents : ☐Yes☐ No*
- *Search engine allowed : ☐Yes☐ No*
- *Criterion 1: Understanding of the subject structuring of the text: (8 points)*
- *Criterion 2: Relevance of the argument: (6 points)*
- *Criterion 3: Linguistic correction: (4 points)*
- *Criterion 4: Originality of ideas: (2 points)*

5- WebReferences (useful links):

- Learn.TV5Monde

6- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

English (A level)

1. General

Coded	*ENG-ABC*	Level/Semester	*3-4*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21*
Responsible	*Sawcen LAAMIRI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*24*
Module	*Languages & Communication*					Version	*09/2023*

Course description (Course objective):
Whether you already have some basic English or are completely new to it, our English program is divided into three levels (A, B and C). At the start of the academic year, your teacher will define your objectives with you and test your level during an initial assessment in order to help you integrate one of the three levels. - *You will be able to acquire or strengthen your basics in business English as well as your self-confidence.* - *You will review and learn the grammatical, oral and written basics.* - *You will learn to communicate orally and in writing and you will enrich your vocabulary.* - *You will be able to respond orally and follow a conversation.*

Prerequisites:	*Keywords :*
***Level A** : No specific knowledge necessary*	*Business English*

Specific course objectives (OBJ):
OBJ 11 : *Oral expression : acquisition of vocabulary relating to working English (Business English)* ***OBJ 12 :*** *Written expression : writing letters, messages, formats, references, abbreviations, etc.* ***OBJ 13 :*** *The fundamentals : tense, auxiliaries, adjectives, comparatives, pronouns*

Necessary material :
The printed course purchased from the printing, data show and baffles service

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*The working day*	*3h*	*Vocab: Company departments(ex: HR, PR, finance) and job titles(ex: production manager)* *Gr: present simple and present continuous*
3-4	*Corporate culture*	*3h*	*Vocab: corporate culture vocabulary and asking for information* *Gr: collocations*
5-6	*Developing contacts*	*3h*	*Networking vocabulary, present perfect and past simple tenses*
7-8	*Cultural issues*	*3h*	*Cultural awareness, marketing in china and business in Finland vocabulary*
9-10	*Teamwork*	*3h*	*Describing a team, slogans, team-building and verbs with their corresponding nouns and adjectives*
11-12	*Job applications*	*3h*	*How to write a CV, a letter of application and wait for an interview*
13-14	*Revision*	*3h*	*Tenses and vocabulary of all chapters*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No		Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes*	☒*No*	
DS - Supervised Duty	☒*Yes*	☐*No*	*40%*
EE - Written test (Final exam)	☒*Yes*	☐*No*	*60%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria (of written production)

- *Authorized documents : ☐Yes☐ No*
- *Search engine allowed : ☐Yes☐ No*
- *Criterion 1: Understanding of the subject structuring of the text: (8 points)*
- *Criterion 2: Relevance of the argument: (6 points)*
- *Criterion 3: Linguistic correction: (4 points)*

- *Criterion 4: Originality of ideas: (2 points)*

5- WebReferences (useful links):

- *TOIC; TOFEL*

6- Working environment (Facilities necessary for learning)

- *None*
- *…*

Course Specification

English (level B)

1. General

Coded	*ENG-ABC*	Level/Semester	*3-4*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21h*
Responsible	*Sawcen LAAMIRI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*24*
Module	*Languages & Communication*					Version	*09/2023*

Course description (Course objective):
Whether you already have some basic English or are completely new to it, our English program is divided into three levels (A, B and C). At the start of the academic year, your teacher will define your objectives with you and test your level during an initial assessment in order to help you integrate one of the three levels. *You will be able* ***to acquire or strengthen your basics in business English*** *as well as your self-confidence. You will review and learn the grammatical, oral and written basics. You will learn to communicate orally and in writing and you will enrich your vocabulary. You will be able to respond orally and follow a conversation.*

Prerequisites:	*Keywords :*
Level B *: No specific knowledge necessary*	*Business English*

Specific course objectives (OBJ):
OBJ 14 : *Oral expression : acquisition of vocabulary relating to working English (Business English)* ***OBJ 15 :*** *Written expression : writing letters, messages, formats, references, abbreviations, etc.* ***OBJ 16 :*** *The fundamentals : tense, auxiliaries, adjectives, comparatives, pronouns*

Necessary material :
The printed course purchased from the printing, data show and baffles service

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Job description and job satisfaction*	*3h*	*Vocab: Company departments, corporate culture vocabulary* *Gr: asking questions at a job interview*
3-4	*Letters of enquiry and applications*	*3h*	*Vocab : How to write a letter of enquiry and an email of application* *Gr: complex questions*
5-6	*Promotional activities and branding*	*3h*	*The 15 different promotional activies, the power of brands, supermarkets' own brands*
7-8	*Presenting your business idea*	*3h*	*Vocab : Structuring a presentation, signalling the parts of a presentation, making the most presentations* *Gr: modal verbs*
9	*Business meetings*	*1h30*	*Vocab: Why have meetings? purpose, benefits, importance of team discussions* *Gr: use of "too" and "enough"*
10-11	*Customer loyalty*	*3h*	*Vocab: the factors which make customers loyal to a company, words and definitions* *Gr: relative pronouns*
12-13-14	*Révision*	*4h30*	*Revision of the tenses and vocabulary of all chapters*

3- Methods evaluation & marks Distribution

Type of assessment	Yes No		Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes*	☐*No*	
DS - Supervised Duty	☒*Yes*	☒*No*	*40%*
EE - Written test (Final exam)	☒*Yes*	☐*No*	*60%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria (of written production)

- *Authorized documents : ☐Yes☐ No*
- *Search engine allowed : ☐Yes☐ No*
- *Criterion 1: Understanding of the subject structuring of the text: (8 points)*
- *Criterion 2: Relevance of the argument: (6 points)*
- *Criterion 3: Linguistic correction: (4 points)*
- *Criterion 4: Originality of ideas: (2 points)*

5- WebReferences (useful links):

- *TOIC; TOFEL*

6- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

English (level C)

1. General

Coded	*ENG-ABC*	Level/Semester	*3-4*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21h*
Responsible	*Sawcen LAAMIRI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions, Project Based					Self study H.	*24*
Module	*Languages & Communication*					Version	*09/2023*

Course description (Course objective):
Improve your English to communicate in writing and orally in a professional classroom context, and prepare for the TOEIC test (Test of English for International Communication). Prepare to improve your TOEIC score in 18 hours of lessons. ***TOEIC teaching resources and methods:*** *Table, internet access. Interactivity with the teacher. Refresher, time management strategy, practical exercises, mini tests targeted to student needs, detailed corrections. Review of progress made. Tips and revision strategy before the exam.* ***Composition:*** *200 multiple choice questions (MCQ)* • *100 oral comprehension questions with audio support (4 exercises, duration 45 minutes)* • *100 written comprehension questions (3 exercises, duration 75 minutes)* ⇨ *The TOEIC is based on authentic examples taken from international professional situations (meetings, travel, telephone, etc.)* ***Results:*** *a distinct assessment of oral comprehension and written comprehension* • *a score of 5 to 495 points for each* • *a total score between 10 and 990 points*

Prerequisites:	*Keywords :*
Level C *: This course is intended for all students registered at level C in order to take the TOEIC exam*	*TOEIC , time management, oral and written*

Specific course objectives (OBJ):

OBJ 17 :	*Prepare in the best conditions for taking the TOEIC*
OBJ 18 :	*Master the essential points of grammar and conjugation*
OBJ 19 :	*Enrich your vocabulary*
OBJ 20 :	*Improve your oral and written comprehension*

Necessary material :
The printed course purchased from the printing, data show and baffles service

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	***Detailed overview of the exam***	*3h*	• *General presentation of the test and its objectives.* • *Detailed breakdown of the test: written part/oral part.* ⇨ *Complete mock test in real time, complete and detailed correction*
3-4	***Assessment of student level and revisions***	*3h*	• *Review of current knowledge, strengths and areas for improvement.* • *Consolidation at the level of fundamental grammatical structures* ⇨ *Fill-in-the-blank exercises, multiple choice questions, reformulation exercises*
5-6-7	***Preparation for the oral comprehension part***	*4h30*	• *Listening and reconstitution of professional dialogues.* • *Improved oral comprehension.* • *Vocabulary recognition* • *Understand the story of a current event or a news item: know how to distinguish the main elements (date, place, actions, etc.).*
8-9-10	***Improvement of written comprehension***	*4h30*	• *Work on enriching everyday vocabulary* • *Work to enrich professional and commercial vocabulary.* • *Know how to read and analyze documents used in professional*

			situations: e-mails, summaries, reports, notices, etc.
11-12-13-14	***Final mock test***	*6h*	• *Real exam situation to evaluate and validate your progress. Detailed correction*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No		Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes*	☒*No*	
DS – Supervised duty	☒*Yes*	☐*No*	*40%*
EE - Written test (Final exam)	☒*Yes*	☐*No*	*60%*

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

4- Evaluation criteria (of written production)

- *Authorized documents : ☐Yes☐ No*
- *Search engine allowed : ☐Yes☐ No*
- *Criterion 1: Understanding of the subject structuring of the text: (8 points)*
- *Criterion 2: Relevance of the argument: (6 points)*
- *Criterion 3: Linguistic correction: (4 points)*
- *Criterion 4: Originality of ideas: (2 points)*

5- WebReferences (useful links):

- *TOIC; TOFEL*

6- Working environment (Facilities necessary for learning)

- *None*
- *...*

Transversal module sheets

Course Specification

PFA (end of year project)

1. General

Coded	*TV-402*	Level/Semester	*4/08*	Coefficient	*3*	Credits	*3*
Course	*engineer*					Flight. H. (CI)	
Responsibl e	*educational manager*					Flight. H. (TP)	*42h*
Teaching methods	direct instructions, Project Based, Field Work					Self study H.	*56*
Module	*PFA (end of year project)*					Version	*09/2023*

Course description (Course objective):
• The PFA (End of Year Project) is a project which lasts one semester, which resolves a problem and which must be defended in front of a jury. • This project is an opportunity for the student to prepare themselves to know how to write a report, present their work, to highlight it and to improve their skills • PFAs start from the second semester and will end on the exam week of the second semester. • Each student is expected to contact one of these teachers for supervision • All 4th year engineering students must be called to a meeting with their educational supervisors and the head of the internship service so that they are properly oriented respectively: Pedagogically and administratively. • PFA internships must be validated at the end of a defense which is carried out following the submission of a report and an internship certificate duly completed by the company supervisor. • The teacher (school tutor) helps the student to refine the end-of-year project. He provides educational support to the student (working methodology, definition of the problem or mission, establishment of the plan, writing of the report, etc.)

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Discover the industrial world*
OBJ 2 : *Solve a problem*
OBJ 3 : *Writing of the report*
OBJ 4 :

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Discover society (observation and learning)*	*6h*	Read all documents relevant to the internship related to the company and the project Learn the tools and software used in the business. Meeting with the team and supervisor Introduction to projects and internship objectives
2-4	*Define the problem and objectives*	*9h*	identification of the tasks to be accomplished. Taking inventory of all the missions to be carried out is necessary to be sure of achieving your objective on time. Observe operations in the field Make a project schedule
5-8	*The realization of the project*	*9h*	all tasks will be accomplished and the project will come to life. You have to ensure that everything goes as planned and that the objectives are achieved.
	Autonomy and responsibility		Take more responsibility in the project Work more independently Regularly take into account the progress of tasks Work collaboratively with other team members
9-11	*Evaluation of the achievement and proposal of improvement actions*	*9h*	*Study of the effectiveness of the achievement and compare with the objective* *Check the work accomplished with the supervisor*
12-14	*Close the work and propose forecasts*	*9h*	*Prepare an internship report*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
14	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

- *The student must submit a PFA report with a monitoring sheet signed by their educational supervisor in order to validate authorization for submission on time.*
- *In the absence of an internship certificate on the day of the defense, the jury will not accept the student and consequently the student will have a zero (unless the student brings back an authorization signed by the internship service)*
- *The evaluation is carried out by at least two members of the jury (supervisor, jury 1)*
-
- *The evaluation is also done by assigning grades on a well-detailed report which is validated by the department head and the director.*
- *Among the evaluation criteria: Oral Expression, Rigor of the approach, content of the presentation, Discussion, Behavior and attendance, structure and content of the report, etc.*

5- Evaluation criteria

Written report (5pts)
Oral Presentation (5pts)
Mastery of the subject (5pts)
Project objective (5pts)

6- Web references (useful links):

- *NONE*
- *…*

7- Working environment (Facilities necessary for learning)

- *NONE*
- *…*

Course Specification

Preparing for MOS certification

1. General

Coded	**TV-401**	Level/Semester	4	Coefficient	1.5	Credits	2
Course	engineering					Volume. H. (CI)	21
Responsible	Moez ZOUARI					Volume. H. (TP)	
Teaching methods	interactive, direct instructions, Project Based					Self study H.	25
Module	Preparing for MOS certification					Version	09/2023

Course description (Course objective):
Acquire the basic notions necessary to create simple tables and graphs.

Prerequisites:	*Keywords :*
Know the Windows environment, excel I	*If nested, date function, text, filter database, subtotals, TCD*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Manage complex formulas*
OBJ 2 : *Filter and conditional formatting*
OBJ 3 : *Subtotals*
OBJ 4 : *Create a pivot table*

Necessary material :
PC, Excel software (2013,2016,2019)

2- Content elements (Practical work)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	Inserting complex functions • *If nested, logical (AND, OR)*	*3*	*Mastering logical IS*
3-4	Database and complex functions	*3*	*Database function*

	• Searchv , SearchH , • index , equiv		
5-6	Functions • Date, dateif , end.month , dayweek , month, year • No., no.if, no.if.together , sum.if, sum.if.together , reduced.average , average.if	*3*	*Statistical function and date*
7-8	Filters • Automatic • Advance	*3*	*Query a database*
9-10	• Simple sort, combined sort • Subtotals	*3*	*Sort a database*
11-12	Pivot table	*3*	*Synthesize a database*
13-14	Practical Project and Synthesize	*3*	*Global evaluation*

3- Content elements (Course)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
…	…	…	…

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting

CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☒*No*	
DS - Supervised Duty	☐ *Yes* ☒*No*	
EE - Written test (Final exam)	☐ *Yes* ☒*No*	
EP - Practical test (TP- TP exam / MP- Mini project)	☒ *Yes* ☐ *No*	*100%*

- *Material 100% TP : Average = 100% EP*

5- Evaluation criteria

- *Authorized documents : ☐ Yes ☐ No*
- *Authorized search engine : ☐ Yes ☐ No*
  - *Criterion 1: Clarity of ideas (5 points)*
  - *Criterion 2: methodological approach (5 points)*
  - *Criterion 3: innovation (5 points)*
  - *Criterion 4: presentation and mastery (5 points)*

6- Web references (useful links):

- *https://excel.developpez.com/*

7- Working environment (Facilities necessary for learning)

- *None*
- *...*

Course Specification

Human Resource Management

1. General

Coded	TV-501	Level/Semester	*5/8*	Coefficient	*1.5*	Credits	*3*
Course						Volume. H. (CI)	*21*
Responsible	*Ati Abderraouf*					Volume. H. (TP)	
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*40*
Module	*HRM*					Version	*09/2023*

Course description (Course objective):
At the end of this module, the engineering student must be introduced to the main concepts, methods and most common practices of HRM. Know the practices – which vary depending on the company – by which an engineer employee is recruited, evaluated, paid, etc .; Identify the "shared" role of human resources manager that an engineer who supervises a few employees quickly has; Develop critical thinking skills in relation to themes and discussions relating to the human resources function.

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Identify key human resources activities and decision-making*
OBJ 2 : *Identify key human resources activities and decision-making*
OBJ 3 : *Identify the information needed to resolve certain problems.*

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Chapter I: Rise of HRM*	*3 hours*	*Identify the transition from personnel management to HRM as well as the objectives of the latter*
3-4	*Chapter II: Study and analysis of positions within the company*	*3 hours*	*Role and importance of job analysis and its link with other HRM activities, describe the methods for collecting information on positions, write a description of the required profile*
5-6	*Chapter III: Recruitment and integration*	*3 hours*	*Presentation of the recruitment process, selection and integration*
7-8	*Chapter IV: Forecast Management of Jobs and Skills*	*3 hours*	*Understand the importance and purpose of GPEC, distinguish it from workforce management, successfully manage workforce and skills*
9-10	*Chapter V: Training*	*3 hours*	*Know the links between training and other HRM activities, know the different training methods, evaluate the effectiveness of a training program*
11-12	*Chapter VI: Remuneration*	*3 hours*	*Definition and importance for employees and for the company, present remuneration systems*
13-14	*Study of practical cases*	*3 hours*	*Evaluate students' level of learning with practical cases*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
13-14	*Mini-project support, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	x *Yes* ☐ *No*	*20%*
DS - Supervised Duty	☐ *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	x *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- *100% CI material : Average = 40% DS + 60% EE*
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : x No*
- *Authorized search engine : ☐ Yes x No*
- *Criterion 1: Clarity of ideas (5 points)*
- *Criterion 2: methodological approach (5 points)*
- *Criterion 3: innovation (5 points)*
- *Criterion 4: presentation and mastery (5 points)*

6- Web references (useful links):

- *HR's role in turning around a company - Daniel Cohen and Ivan Maltcheff*
- *Henri De Camagro : General and industrial administration (1917)*
- *François Stankiewicz and François Geuze , HR Manager. Concepts for action, 2007*
- *Dave Ulrich, Human Resource Champions. The Next Agenda for Adding Value and Delivering Results, 1999*
- *Tania Saba, Simon L. Dolan, Susan E. Jackson and Randall S. Schuler, Human Resource Management, Compagon Web, edition 4, 2008, p. 71-72*

7- Working environment (Facilities necessary for learning)

NONE

Course Specification

labor law

1. General

Coded	*TV-502*	Level/Semester	*3/S5*	Coefficient	*1.5*	Credits	*2*
Course						Volume. H. (CI)	*21h*
Responsible	*Walid Chriaa*					Volume. H. (TP)	
Teaching	Lecture, interactive, direct instructions					Self study H.	*24*
Module	*labor law*					Version	*09/2023*

Course description (Course objective):
Acquisition of knowledge in Labor Law (Social Law), in relation to the engineering profession and the functioning of the company. The labor contract: legal environment; hiring, working time; execution, conclusion, breach of contract; salary representation in the company

Prerequisites:	*Keywords:*
Management, business, organizational chart	*Termination, contract…*

Specific objectives of the course (OBJ):
OBJ 1 : Sources of labor law OBJ 2 : Labor inspection OBJ 3 : Determination of the employment contract OBJ 4 : Conclusion of the employment contract OBJ 5 : End of employment contract OBJ 6 : Understand the principles of international construction law. OBJ 7 : Analyze FIDIC standards and their application in construction projects. OBJ 8: Develop skills in drafting and managing international construction contracts. OBJ 9: Learn the mechanisms of arbitration and dispute resolution in an international context. OBJ 10: Apply knowledge through practical case studies and simulations.
Necessary material :
NONE

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1	*Chapter I: 1. General* *Definition* *The historical development of labor law in Tunisia* *Civil Code* *Labor Code* *Collective agreements* *Characteristics of labor law*	*1h30*	*The different official sources of Tunisian labor law*
2-3	*Chapter II: 2. Sources of labor law* *Common Sources* *International Sources* *Universal conventions* *Regional sources* *National sources* *The Constitution* *The law (labor code)* *Decrees and orders* *Doctrine* *Jurisprudence* *Clean Sources* *Spontaneous clean sources* *Own voluntary sources:* *Collective agreements* *The internal regulations* *The contract*	*3 hours*	*How to establish an employment contract that complies with different official sources*

4-5	*Chapter III: 3. LABOR INSPECTION* *Definition* *Missions* *Control* *Power of decision* *Advice* *Conciliation* *Powers of intervention of the labor inspector* *The finding of the labor inspector and its consequences* *The observations* *The notice* *The verbal procedure* *Temporary cessation of activity*	*3 hours*	*Understand the role of the work inspection as well as the types of findings and discrepancies*
6-7	*Chapter IV: 4. Determination of an employment contract* *Definition* *The distinctive criteria of the employment contract* *Work performance* *The link of subordination* *Compensation* *Distinction of employment contract from other contracts* *The mandate contract* *The company contract* *The business contract* *Types of employment contract* *The fixed-term contract (CDD)* *The permanent contract (CDI)*	*3 hours*	*The different types of employment contracts as well as the specific clauses*

8-9	*Chapter V: 5. Conclusion of the employment contract* *Obligations of the parties* *Employee obligations* *Employer obligations* *Conditions of validity of employment contract* *The basic conditions* *The defects of consent* *The capacity* *The object* *The cause* *Formal conditions* *Mandatory information* *Sanction of the rules for forming contracts* *Negotiable elements* *End of the employment contract*	*3 hours*	*Know the obligations of a contract and the elements of negotiation* *Understand the different types of end of an employment contract, the obligations and the sanctions*
10-12	**FIDIC Standards:** nalysis of key clauses in FIDIC contracts: general conditions, parties' obligations, and risk management **International Contracts**: Characteristics of contracts in the context of international construction **Arbitration and Dispute Resolution**: Introduction to international arbitration: principles, benefits, and procedures.	*4h30*	*Understand the principles of international construction law.* *Analyze FIDIC standards and their application in construction projects.* *Develop skills in drafting and managing international construction contracts.* *Learn the mechanisms of arbitration and dispute resolution in an international context.*

13-14	*Study of practical cases and presentation of personal projects*	*3 hours*	*Evaluate students' level of learning with practical cases*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals
…	…	…	…
…	…	…	…
13-14	*Mini-project support, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	x *Yes* ☐ *No*	*20%*
DS - Supervised Duty	x *Yes* ☐ *No*	*20%*
EE - Written test (Final exam)	x *Yes* ☐ *No*	*60%*
EP - Practical test (TP- TP exam / MP- Mini project)	☐ *Yes* ☐ *No*	

- *Material 100% TP : Average = 20% CC + 80% EP*
- ***100% CI material : Average = 40% DS + 60% EE***
- *CI+TP material : Average = 20% DS + 20% EP + 60% EE*

5- Evaluation criteria

- *Authorized documents : x No*
- *Authorized search engine : ☐ Yes x No*
- *Criterion 1: Clarity of ideas (5 points)*
- *Criterion 2: methodological approach (5 points)*
- *Criterion 3: innovation (5 points)*
- *Criterion 4: presentation and mastery (5 points)*

6- Web references (useful links):

Civil Code
Labor Code

Collective agreements

FIDIC Contracts: Law and Practice"

Auteur : Ellis Baker, Ben Mellors, Scott Chalmers, Anthony Lavers

Description : Une analyse approfondie des contrats FIDIC et de leur application dans les projets de construction internationaux.

"International Construction Contracts: A Handbook"

Auteur : William Godwin

Description : Ce guide pratique explique comment rédiger et négocier des contrats de construction internationaux, y compris les aspects juridiques et les normes FIDIC.

"The Guide to Construction Arbitration"

Éditeur : Global Arbitration Review

Description : Ce livre fournit des informations sur l'arbitrage international dans le domaine de la construction, avec des études de cas et des conseils pratiques.

7- Working environment (Facilities necessary for learning)

- *NONE*

Course Specification

ESB Entrepreneurship and Small Business

1. General

Coded	TV-503	Level	*5/S1*	Coefficient	*1.5*	Credits	*2*
Course	*Engineering*					Volume. H. (CI)	*21*
Responsible	*Moez ZOUARI*					Volume. H. (TP)	*0*
Teaching methods	Lecture, interactive, direct instructions					Self study H.	*28*
Module	*ESB*					Version	*09/2023*

Course description (Course objective):
The objective of the course is to master small business entrepreneurial skills and understand its different functions. *The ESB certification is designed to test and validate fundamental concepts and knowledge in entrepreneurship and small business management. These fundamental concepts include* - *Entrepreneurship;* - *Recognize and evaluate opportunities;* - *Plan, start and operate a business;* - *Marketing and sales;* - *and finance and business financing.*

Prerequisites:	*Keywords :*
None	*Entrepreneurship, management, business environment, accounting, commerce, finance*

Specific objectives of the course (OBJ $_i$):
OBJ 1 : *Identify the characteristics of entrepreneurs and as well as the risks, benefits, opportunities and disadvantages of being an entrepreneur*
OBJ 2 : *Identify the advantages and disadvantages of different types of opportunities*
OBJ 3 : *Identify the objectives, value of a business plan and the appropriate legal structure*

OBJ 4 : *Identify the advantages and disadvantages of various sources of startup financing* ***OBJ 5 :*** *Identify business operations: human capital needs, intellectual property issues, standard operating procedures, etc.* ***OBJ 6 :*** *Develop a sales strategy, identify and analyze the costs/benefits of finding customers, identify how to retain customers, and determine the value and methods of communication.* ***OBJ 7 :*** *Interpret basic financial statements, identify and analyze cash flows, and identify the company's break-even point.*

Necessary material :
None

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1.2	***The entrepreneur:*** - *Identify the characteristics of entrepreneurs* - *Given a scenario including a self-assessment result, identify the strengths, weaknesses, and risk tolerance the self-assessment identifies and how to compensate with services* - *Given a scenario, recognize a business opportunity* - *Identify the risks, benefits, opportunities and disadvantages of being an entrepreneur*	*3h*	*OBJ 1*
3.4	***Opportunity recognition :*** - *Identify the advantages and disadvantages of different types of opportunities (for example, starting a new business, purchasing an existing business, and purchasing a franchise)* - *Given a scenario, analyze the demand for the good or service and opportunities in an environment* - *Given a scenario, identify customers or potential customers for a business* - *Given a scenario, recognize a value proposition*	*3h*	*OBJ 2*

5.6	***Start a business :*** - *Identify the objectives and value of a business plan* - *Identify the appropriate legal structure, advantages and disadvantages for different legal structures for a business* - *Given a scenario, identify different types of licenses and regulations needed* - *Identify the pros and cons of various sources of startup funding: equity (friends/family, angel investors, venture capital), debt (bank, credit cards, personal loans), and grants (government, foundation, business)* - *In a given scenario, identify the support available to the business at the local, state, and federal levels* - *Identify ethical practices and social responsibilities of a company* - *Identify potential exit strategies for a business*	*3h*	*OBJ 3* *OBJ 4*
7.8	***Commercial operations :*** - *Based on a scenario, identify key positions and human capital needs (including compensation and benefits)* - *Given a scenario, determine if the work can be done by the owner or if employees or service providers are needed* - *In a given scenario, identify the required taxes* - *Using a scenario, identify intellectual property issues related to trademarks, copyrights and patents.* - *In a given scenario, identify standard operating procedures (e.g., setup, conduct, internal controls, segregation of duties)* - *Based on a scenario, identify the factors that led to sustainability*	*3h*	*OBJ 5*
9.10	***Marketing and sales:*** - *Based on a scenario, develop a sales strategy and identify the characteristics of a successful sale* - *Given a scenario, identify and analyze the costs/benefits of finding customers* - *Based on a scenario, identify how to retain customers and develop a relationship with loyal customers* - *Based on a scenario, determine the value and methods of communication, including: websites, brochures, social media and advertising.*	*3h*	*OBJ 6*

11-14	***Financial management :*** - *Given a scenario, interpret basic financial statements such as income statements and balance sheets* - *Using a scenario, identify the factors that influence credit ratings and the importance of a positive credit rating* - *From a list of expenses, identify which ones are fixed or variable* - *Given a scenario, identify the factors that impact the price for the customer* - *Given a scenario, identify and analyze cash flows, including accounts receivable, accounts payable, inventory and debt.* - *Given a scenario, create a cash budget* - *Given a scenario, identify the company's break-even point*	*6h*	*OBJ 7*

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☐ *Yes* ☒ *No*	-
DS - Supervised Duty	☐ *Yes* ☒ *No*	-
EE - Written test	☒ *Yes* ☐ *No*	*50%*
EC – Certification Exam	☒ *Yes* ☐ *No*	*50%*

4- Evaluation criteria

- *Authorized documents* : ☐ *Yes* ☒ *No*
- *Authorized search engine* : ☐ *Yes* ☒ *No*

- *Criterion 1: The entrepreneur (4 points)*
- *Criterion 2: Recognition of opportunities (3 points)*
- *Criterion 3: Start a business (4 points)*
- *Criterion 4: Commercial operations (3 points)*
- *Criterion 5: Marketing and sales (3 points)*
- *Criterion 6: Financial management (3 points)*

5- Web references (useful links):

- *ESB overview, https://certiport.pearsonvue.com/Certifications/ESB/Certification/Overview*
- *Exam Objectives for ESB, C:\Users\LENOVO\Downloads\ESB OD Original 0221.pdf*

6- Working environment (Facilities necessary for learning)

- *None*

Course Specification

Connected objects (IOT)

1. General

Coded	TV-504	Level/Semester	3/5	Coefficient	1.5	Credits	2
Course	Electromrcanical engineer					Volume. H. (CI)	0
Responsible	Mouhedine BELGHITH					Volume. H. (TP)	21
Teaching methods	Lecture, interactive, direct instructions					Self study H.	29
Module	Connected objects (IOT)					Version	09/2023

Course description (Course objective):
This course introduces students to the world of the Internet of Things (IoT) by providing a hands-on introduction to the design and programming of IoT systems. Through the study of different programmable boards, sensors and actuators, learners gain a fundamental understanding of IoT technology and basic programming skills to create simple applications and interact with connected devices

Prerequisites:	Keywords :
• Basic Computer Knowledge: A general understanding of computer science and programming concepts is beneficial in tackling the fundamentals of programming in IoT. • Electronics: Basic knowledge of electronics and circuits can be helpful in understanding the hardware components used in IoT systems. • Interest in emerging technologies: A curiosity and interest in new technologies, particularly in the area of Internet of Things, is essential to gNonep the concepts and practical applications of the course	IoT, Embedded Programming, Sensors, Actuators, IoT Cards, Wireless Connectivity, IoT Protocols, Embedded Systems, Interfacing

Specific course objectives (OBJ):

OBJ 4 : Understanding of IoT: Gain an in-depth understanding of the fundamental concepts of the Internet of Things, including its applications, challenges and opportunities.

OBJ 5 : Mastery of IoT components: Learn to identify, use and integrate different sensors, actuators and hardware boards to create simple IoT systems.

OBJ 6 : IoT Application Programming: Develop basic programming skills to create simple applications and interact with connected devices.

OBJ 7 : IoT System Design: Design and plan simple IoT systems using hardware and software components tailored to meet specific needs.

Necessary material :
• IoT development boards: Arduino Uno , Nonepberry Pi, ESP8266, ESP32, etc., to experiment with different microcontrollers and hardware platforms. • Various sensors and actuators: Temperature, humidity, movement, light sensors, actuators such as LEDs, motors, relays, to understand their operation and integration. • Breadboards and electronic components: Starter kits with breadboards , resistors, capacitors, connection wires, to create prototypes and simple circuits. • Wireless Communication Modules: Wi-Fi, Bluetooth, Zigbee , LoRa, etc. modules, to experiment with different wireless communication technologies used in IoT systems. • Laptop or Desktop: For software development, programming, and interacting with IoT devices. • Basic accessories and tools: Connection cables, soldering tools (if applicable), multimeter, and other basic tools for electronic manipulations. • IoT Starter Kits: Ready-to-use kits providing a variety of sensors, actuators, and components to quickly experiment and understand basic concepts.

2- Content elements (Practical work)

Week(s)	Activities/Content elements	No. HR	Goals
01	**Introduction to IoT and basic concepts** ▪ Understanding of IoT fundamentals. ▪ Exploring IoT applications and use case examples.	1h30	Getting to know the fundamentals of IoT, exploring real-world applications and use case examples
02-03	**Exploring microcontrollers and IoT boards** ▪ Presentation and handling of various microcontrollers (Arduino, etc.). ▪ Practical implementation with hardware platforms.	3h	Overview of different hardware platforms, handling and practical implementation with microcontrollers such as Arduino or Nonepberry Pi
04	**Introduction to embedded programming** ▪ Learning the basics of programming for embedded devices. ▪ Creation of simple programs to control hardware components.	1h30	Learning the basics of programming for embedded devices, creating simple programs to control hardware components
05	**Using IoT sensors** ▪ Identification and manipulation of various types of IoT sensors .	1h30	Discovering sensors used in IoT systems , experimenting with different types of sensors to collect data.

	▪ Experimentation to collect data with different sensors.		
0 6-07	**Interfacing with actuators** ▪ Practice controlling actuators in response to sensor data. ▪ Manipulation and control of actuators to perform actions.	3h	Practice controlling actuators to perform actions in response to data captured by sensors.
08	**Wireless Connectivity for IoT** ▪ Exploring and configuring wireless technologies for IoT. ▪ Data transmission using wireless communication protocols.	1h30	Exploration of wireless communication technologies used in IoT, configuration and use of these protocols for data transmission.
09	**Advanced programming of IoT devices** ▪ Deepening IoT programming skills. ▪ Integration of advanced functionalities into IoT applications.	1h30	Deepening programming skills to create more complex IoT applications, integrating advanced features.
10	**Power and energy management** ▪ Understanding of energy management strategies for IoT devices. ▪ Optimization of energy consumption to improve system efficiency.	1h30	Understanding of energy management strategies to extend the life of devices and improve their energy efficiency.
11-12	**Design of simple IoT projects** ▪ Application of knowledge to design and implement IoT projects. ▪ Integration of sensors, actuators and connectivity for simple projects.	3h	Exploring the basics of IoT security, identifying vulnerabilities, and methods for protecting systems.
13	**Testing and debugging IoT systems** ▪ Use of testing methods to verify the operation of systems. ▪ Identification and resolution of potential problems.	1h30	Application of testing methods to verify the operation of IoT devices, identification and resolution of potential problems.
14	**Evaluation of the final IoT project** ▪ Presentation, demonstration and evaluation of final IoT projects. ▪ Putting into practice the skills and knowledge acquired in the course.	1h30	Evaluation, presentation and demonstration of the final project, putting into practice all the skills acquired during the course

3- Evaluation methods & Marks Distribution

Type of assessment	Yes No	Tx Weighting
CC - Continuous assessment (Test/Quiz, Presentation, Report, etc.)	☑ Yes ☐ No	
DS - Duty to Monitor	☐ Yes ☑ No	
EE - Written test (Final exam)	☐ Yes ☑ No	
EP - Practical test (TP- TP exam / MP- Mini project)	☑ Yes ☐ No	

- Material 100% TP : Average = 20% CC + 80% EP
- 100% CI material : Average = 40% DS + 60% EE
- CI+TP material : Average = 20% DS + 20% EP + 60% EE

4- Evaluation criteria

- Authorized documents : ☑ Yes ☐ No
- Authorized search engine : ☑ Yes ☐ No
- *Criterion 1: Clarity of ideas (5 points)*
- *Criterion 2: methodological approach (5 points)*
- *Criterion 3: innovation (5 points)*
- *Criterion 4: presentation and mastery (5 points)*

6- Web references (useful links):

- The Things Network: https://www.thethingsnetwork.org/ - Community platform for IoT, offering resources, tutorials and tools for building and connecting LoRaWAN networks .
- IoT For All: https://www.iotforall.com/ - Platform dedicated to IoT, offering articles, use cases, guides and resources for IoT professionals.
- Embedded Artistry : https://embeddedartistry.com/ - Blog and resources focused on embedded and IoT, covering topics such as software development, hardware design, and best practices.
- IoT Security Foundation : https://www.iotsecurityfoundation.org/ - Organization focused on IoT security, providing best practices, guidelines and resources for securing IoT systems.

7- Working environment (Facilities necessary for learning)

- Material :
  - Microcontrollers like Arduino, Nonepberry Pi, ESP32/ESP8266.
  - Various sensors (temperature, humidity, movement sensors, etc.).
  - Actuators (motors, relays, LEDs, etc.).
  - Breadboards , connection wires, electronic components.
- Software:
  - Integrated development environment (IDE) adapted to the microcontroller used (Arduino IDE, PlatformIO , Thonny , etc.).

- Software for modeling and simulation of IoT systems (like Fritzing , Tinkercad , or simulators specific to certain sensors or microcontrollers).

subject Sheets Projects and internships

Course of Internships at EPI

Importance of Internships:

Internships in companies are an integral part of the EPI Group's training.

These internships in companies are mandatory for obtaining the diploma.

Also, the EPI Group pays particular attention to their progress.

During these internships, students develop their personal qualities, learn to work in a team and carry out projects.

Professional internships must be validated at the end of a defense.

Types of Internships:

Internships in companies are of three types:

- **Introductory Internship**: they concern 3rd year students
  - ✓ Objective: To give students the opportunity to discover the professional world and join the company.
  - ✓ Minimum duration: 1 month
- **Professional internships** (design and/or implementation of projects linked to the specialty): they concern 4th year students
  - ✓ Objective: The student is expected to carry out the design and/or implementation of projects related to his specialty
  - ✓ Minimum duration: 1 month
- **PFE internships**: they concern 5th year students
  - ✓ Objective: Implementation of all the skills acquired during schooling to carry out a project allowing one to project oneself into the professional world
  - ✓ Minimum duration: 16 weeks

The EPI Group supports its students during these internships and provides them with the Internship Service for coordination with the different departments and host companies (choice, validation, etc.).

Evaluation of the Internships:

The internship results in the writing of a report, which must be presented before a jury. This jury must be composed of at least two members:

- A president who must be a teacher from the EPI Group.
- An examiner: who must be a teacher from the EPI Group.
- The university supervisor who must be a teacher from the EPI Group.
- An internship tutor who must represent the host structure.

All internships must be validated at the end of a defense.

For this, each student is required to submit to the internship service:

- A connection form (to download from the “Internship forms” menu on our website episup.com)
- An internship certificate obtained from the company and duly completed and signed.
- Supervision monitoring sheet duly completed by the educational supervisor
- Company appreciation form: duly completed by the professional supervisor
- The internship report bearing the EPI Group cover page (to be downloaded from the “Internship forms” menu) in at least two copies (depending on the number of jury members) and one scanned copy.

Course Specification

Projects and internships (PFE, Professional internships, Introductory Internship)

* PFE

1. General

Coded	Pro- 5 2 03	Level/Semester	*3/S6*	Coefficient	*10*	Credits	*24*
Course	*Engineering course*					Flight. H. (CI)	
responsible	Internships department					Flight. H. (TP)	
Teaching methods	direct instructions, Project Based, Field Work					Self study H.	*700*
Module	*PFE*					Version	*09/2023*

Course description (Course objective):
This involves the implementation of all the skills acquired during schooling to carry out a project, generally proposed by a company, allowing one to project oneself into the professional world. The student works full-time within the company and is supervised by a teacher. During an End of Study Project (PFE), the student is led to develop a problem based on a specific professional situation. The main objective of this last internship is to affirm the skills of our future engineers and to prepare them effectively for their entry into professional life. The subject of the PFE internship generally leads the future engineer to encounter challenges and allows him to learn to act accordingly.

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ):
OBJ 1 : The PFE ideally allows the intern to carry out a project from A to Z… **OBJ 2 :** Go through all the stages necessary for its realization, from the study of specifications to final delivery **OBJ 3 :** Participate in technical studies: definition of problems, acquisition, compilation and analysis of data, formulation of hypotheses and recommendations; **OBJ 4 :** Put the student in the position of an engineer, **OBJ 5 :** Refine their first career orientations, **OBJ 6 :** Measure the role of the company's different engineers, **OBJ 7 :** Discover the different functions and their relationships, **OBJ 8 :** Write an end-of-studies report.

Necessary material :
…

2- Content elements (Course)

Week(s)	Chapters/Content Items	No. HR	Goals
1-2	*Discover society (observation and learning)*		Read all documents relevant to the internship related to the company and the project Learn the tools and software used in the business. Meeting with the team and supervisor Introduction to projects and internship objectives
3-4	Establishing project objectives	…	Clearly define the objectives to be achieved with the project. Observe operations in the field Make a project schedule Establish a Problem
4-5	Project planning and design	…	project delivery , including specific steps to follow and resources required. Design potential solutions to meet project objectives
5-7	Data collection and situation analysis		Collect relevant data necessary to carry out the project. Analyze data to understand the causes of the problem using analytics tools
7-8	Project implementation		Implement the solutions designed within the project framework .
8-9	*Autonomy and responsibility*		Take more responsibility in the project Work more independently Regularly take into account the progress of tasks Work collaboratively with other team members
9-12	Testing and validation		Test the developed solutions and ensure that they meet the specifications and needs of the project. Validate the results obtained with the internship supervisor or the team responsible for the project in the company.
12-14	*Close the work and propose forecasts*		*Prepare an internship report*

3- Content elements (Practical work)

Week(s)	Activities/Content Items	No. HR	Goals

…	…	…	…
…	…	…	…
12	*Practical exam, mini-project defense, …*	*3h*	*Summative evaluation*

4- Evaluation methods & Marks Distribution

- *The student must submit a PFE report with a monitoring sheet signed by their educational supervisor in order to validate authorization for submission on time.*
- *In the absence of an internship certificate on the day of the defense, the jury will not accept the student and consequently the student will have a zero (unless the student brings back an authorization signed by the internship service)*
- *The evaluation is carried out by at least three members of the jury (supervisor, president of the jury and rapporteur)*
- *The evaluation is also done by assigning grades on a well-detailed report which is validated by the department head and the director.*
- *Among the evaluation criteria: Oral Expression, Rigor of the approach, content of the presentation, Discussion, Behavior and attendance, structure and content of the report, etc.*

5- Evaluation criteria

Criteria	
Oral Expression: - Ability to keep the audience attentive - Judicious use and quality of transparencies. - Vocabulary, use of appropriate technical terms - Respect the planned time.	/04
Steps : - Rigor of the approach: choice, tools, method and synthesis	/04
Content of the presentation: - Level of know-how, technicality… - Personal work carried out. - Presentation of objectives achieved	/08
Discussion : - Mastery of aspects related to the subject, justifications, etc.	/04
Behavior, Attendance, Punctuality and Motivation	.. /04
Personal contribution and initiative	.. /06
Scientific and technological knowledge	.. /05
Level of know-how , technicality, creativity and functionality	.. /05
Report Structure -Acknowledgements, summary, introduction, presentation of the company, specifications, technical content, conclusion - Balanced ratio (Volume) - Clear and progressive presentation of information - Reasonable use and definition of technical terms, standardization	.. /06
Content of the Report - Presentation of the work requested (specifications) then of the entire made work. - Technical content - Meets standards -Importance of personal work (volume and level) - Justification for the choice of solutions adopted. - Comparison of the objectives achieved with the content of the specifications - Appendices, Bibliographies	.. /08
Presentation of the report -Pagination, layout -Spelling, grammar, style. - Clarity and quality of figures, diagrams, etc.	.. /06

6- Web references (useful links):

- *Author, Title, URL, Year*
- *…*

7- Working environment (Facilities necessary for learning)

- *None*
- *…*

* Professional internships

Coded	Pro- 5 2 02	Level/Semester	*3/S6*	Coefficient	*10*	Credits	*3*
Course	*Engineering course*					Flight. H. (CI)	
responsible	Internships department					Flight. H. (TP)	
Teaching methods	direct instructions, Project Based, Field Work					Self study H.	*75*
Module	Professional internships					Version	*09/2023*

Course description (Course objective):
During his professional internship, the student, who has achieved his 4th year succesfully, must complete a practical case whose theme depends on his specialization The student works full-time within the company but is not supervised by a teacher. It's a period of practical training or work experience undertaken by a student in a professional setting relevant to his field of study and career goals. It provides the intern with the opportunity to apply theoretical knowledge gained in academic settings to real-world scenarios, gaining practical skills and insights into their chosen profession. Interns may also have the opportunity to network with professionals in their field, build valuable connections, and sometimes even secure PFE opportunities upon completion of the internship.

Prerequisites:	*Keywords :*
…	…

Specific objectives of the course (OBJ):
OBJ 1 : Providing students with practical, real-world experience in their field of study or desired career path. **OBJ 2 :** Develop and refine technical skills, soft skills, and industry-specific competencies necessary for future success in the profession. **OBJ 3 :** Receive constructive feedback from supervisors and mentors to identify strengths, areas for improvement, and opportunities for further growth. **OBJ 4 :** Gain insights into the expectations and realities of the workforce, facilitating a smoother transition from student life to professional employment post-graduation.

OBJ 5 :	Write a professional internship report.

Evaluation methods & Marks Distribution

- *The student must submit a professional internship report with a Internship certificate and Company appreciation form duly completed and signed in order to validate authorization for submission on time.*
- *In the absence of an internship certificate on the day of the defense, the jury will not accept the student and consequently the student will have a zero (unless the student brings back an authorization signed by the internship service)*
- *The evaluation is carried out by at two members of the jury.*
- *The evaluation is also done by assigning grades on a well-detailed report which is validated by the department head and the director.*
- *Among the evaluation criteria: Oral Expression, Rigor of the approach, content of the presentation, Discussion, Behavior and attendance, structure and content of the report, etc.*

* Introductory Internship

Coded	Pro- 5 2 01	Level/Semester	*3/S6*	Coefficient	*10*	Credits	*3*
Course	*Engineering course*					Flight. H. (CI)	
responsible	Internships department					Flight. H. (TP)	
Teaching methods	direct instructions, Project Based, Field Work					Self study H.	*75*
Module	*Introductory Internship*					Version	*09/2023*

Course description (Course objective):
It is an internship for discovering the company the student spend time observing and shadowing experienced professionals within various departments or teams. This allows them to gain insights into different aspects of the organization's operations and understand the roles and responsibilities of various team members. As the internship progresses, the student is gradually given more opportunities to participate in hands-on tasks and projects under the guidance and supervision of mentors or supervisors. These tasks may be relatively simple or routine at first but gradually increase in complexity as the student gains confidence and demonstrates competence.

Prerequisites:	*Keywords :*
...	...

Specific objectives of the course (OBJ):
OBJ 1 : Help students explore different career paths within their field of study or industry by exposing them to various departments, roles, and responsibilities

OBJ 2 : Provide students with opportunities to develop fundamental skills relevant to their field, such as communication, teamwork, problem-solving, and time management

OBJ 3 : Offer students practical, hands-on experience through tasks, projects, and assignments that contribute to the organization's goals and objectives.

OBJ 4 : Facilitate networking opportunities for students to connect with professionals in their field,

OBJ 5 : Prepare students for future internships or employment opportunities by equipping them with essential skills, experiences, and insights into the professional world.