MECHANICAL AND ELECTRICAL EXPERIMENTATION

LEARNING OUTCOMES

A. GENERAL LEARNING OBJECTIVE

At the end of the course, the student will be able to design an experiment, analyze its results and communicate them orally and in writing using methods of scientific experimentation, writing techniques and oral presentation.

B. EDUCATIONAL CONTENTS

STUDENT OUTCOMES TO WHICH THE TRAINING SPACE CONTRIBUTES.

Specific student outcomes	1.- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. 2.- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. 6.- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
Student outcomes of emphasis	Does not apply

PERFORMANCE INDICATORS, SKILLS AND SCIENTIFIC-PROFESSIONAL KNOWLEDGE
The professional performance indicators, knowledge and skills promoted by this formation space are:

Learning results that the student will achieve in this training space	
Performance indicators	The student… 1.1 Relates the physical phenomena to the theories and mathematical models that describe them. 1.6 Identifies and calculates the different forms of energy involved in mechanical, electrical, thermal, pneumatic, hydraulic, etc. systems. 1.7 Interprets and produces mechanical, electrical, pneumatic, hydraulic and control diagrams using symbology according to standards. 2.6 Identifies various electromechanical components that can meet the functional requirements of a system or process. 2.7 Identifies and selects the manufacturing processes necessary to build an electromechanical component or system. 6.1 Identifies the need for experiments. 6.2 Selects the materials, devices and methods necessary to design experiments. 6.3 Uses a logical organization of procedures and applies mathematical and graphic analysis to interpret the results of an experiment. 6.4 Identifies in advance the problems that may arise in an experiment. 6.5 Describes the experimental results and their relationship with fundamental concepts and principles.
Knowledge	Reports presentation. Oral presentations of the results of the experiments.

	Study of the standard NOM-008-SCFI-2002 General System of Measurement Units (or the current version). Experimental scientific method.
Skills	Experiments development Report writing. Teamwork. Effective presentations. Synthesis capacity. Handling of tools to assemble electromechanical components. Management to obtain the resources. Collaborative work. Management of measuring instruments for experimental tests English language reading..

C. UASLP GRADUATE: PERFORMANCE INDICATORS AND TRANSVERSAL SKILLS

Graduate profile UASLP	Performance indicators and transversal skills promoted by this training space
Professional autonomy for learning (an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.**)**	The student… 7.1 Recognizes the importance of learning and using sources different of information to prepare projects and reports. 7.4 Has information of engineering state-of-the-art.
Collaborative work skills (an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives**)**	The student… 5.1 Contributes positively and widely to the work team. 5.2 Assumes responsibilities as a team member. 5.3 Expresses his/her ideas and concerns without fear. 5.4 Assumes leadership responsibilities.
Communication skills in spanish and other languages (an ability to communicate effectively with a range of audiences**)**	The student… 3.1 Has organized oral communication, being consistent with the central message and using appropriate body language to express one's ideas. 3.2 Has organized written communication, which is consistent with the central message identified in the introduction, where the main points are linked to transitions and a conclusion. 3.3 Uses modern presentation tools, such as audio, video, etc. effectively. 3.4 Uses extensive and appropriate vocabulary, as well as correct grammar.
Scientific, professional, and/or social creative project development	This student outcomes in engineering is considered as specific professional, the performance indicators are already integrated within this training space.
Social responsibility and ethical reflection (an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts)	The student… 4.1 Identifies the facts and work methods considering ethical principles. 4.9 Is aware of a variety of current events in a national and global context. 4.10 Selects the techniques and tools to give modern engineering solutions and makes judgments comparing the results with the alternative tools or techniques.

GENERAL STRUCTURE AND SUMMATIVE EVALUATION

D. General didactic planning

The student will learn the scientific method to carry out experiments and the characteristics of a written report to present the results, as well as an oral presentation of the same. The experiment will be developed throughout the semester and in each partial exam the progress will be reported in written and oral form. The teacher will explain the experimental scientific method in each part, as well as the characteristics of the written report and the oral presentation. Students are expected to use SharePoint to write reports collaboratively.

The training space will be given five days a week, in a room and on some occasions in a laboratory, where the teacher will present the technique, methodology and experiences to carry out the experiment. The students will form teams of no more than 4 members, to physically carry out the experiment, therefore, in certain sessions the student will be asked for the necessary material to carry out the experiment.

#	Name of the unit or training phase	Unit learning objective	Specific educative contents (performance indicators, skills, knowledge)
1.	1. Method to develop an experiment (first part) (16 h)	At the end of the unit, the student will be able to delimit the approach and hypothesis when carrying out an experimental practice of electrical mechanics through the application of the scientific method.	**Specific educational content:** 1.1 Experimentation as part of the historical development of electromechanical engineering. 1.2 Experimentation as a basis for technological development. 1.3 Choosing an experiment. 1.4 Delimit the investigation. 1.4.1 Delimit the experiment. 1.5 Plan the experiment. 1.6 Propose the hypothesis. 1.7 Structure of the report. 1.7.1 Header, cover, presentation. 1.7.2 Objectives. 1.7.3 Assumptions. 1.7.4 Theoretical Framework. 1.7.5 Materials. 1.7.6 Procedure/method. 1.7.7 Result and analysis of results. 1.7.8 Conclusions and discussion. 1.7.9 Annexes, bibliography and/or mesography. 1.8 Oral expression techniques. 1.8.1 Importance of verbal and non-verbal communication. 1.8.2 Effective communication. 1.8.3 Assertive communication. 1.8.4 Techniques for speaking in public. 1.9 Design of professional audiovisual presentations and teaching material. **Learning activities:** Drafting of the report that includes: 1. Cover page with the following information:

			• Title. • Name of the authors. • Name of the institution (Area, Career). 2. Summary. In this part a brief description of the problem and procedure is given, as well as the general results and conclusions. 3. Introduction. They are the results of the bibliographical research related to the antecedents of the problem that motivated the investigation. 4. Hypothesis. It arises affirming or denying what supposedly solves the problem. Oral exposition of the experiment. Management of citations and references NOM-008-SCFI-2002 General System of Measurement Units
2.	2. Method to develop an experiment (second part) (16 h)	At the end of the unit, the student will be able to determine the variables involved in the design and approach of an electromechanical application experiment by applying the scientific method.	**Specific educational content:** 2.1 Determination of the variables of an experiment 2.2 Design of the experiment. 2.2.1 System in which it will be experimented and the reason why it was selected. 2.2.2 Materials and instruments and measurement procedure. 2.2.3 Detailed description of the measurement procedure. How and when do you intend to measure? 2.6 Feedback on the first report. 2.7 Feedback on the first oral presentation. **Learning activities:** Drafting of the report that includes: 1. Cover page with the following information: • Title. • Name of the authors. • Name of the institution (Area, Career). 2. Summary. In this part a brief description of the problem and procedure is given, as well as the general results and conclusions. 3. Introduction. They are the results of the bibliographical research related to the antecedents of the problem that motivated the research. 4. Hypothesis. It arises affirming or denying what supposedly solves the problem. 5. Determination of variables. 6. Design of the experiment. Oral exposition of the experiment. Management of citations and references
3.	3. Method to develop an experiment (third part) (16 h)	At the end of the unit, the student will be able to carry out and apply an electromechanical application	**Specific educational content:** 3.1 Procedure to carry out the experiment. 3.2 Realization of the experiment. 3.3 Feedback on the second report. 3.4 Feedback on the third oral presentation

		experiment through applying the scientific method	**Learning activities:** Drafting of the report that includes: 1. Cover page with the following information: • Title. • Name of the authors. • Name of the institution (Area, Career). 2. Summary. In this part a brief description of the problem and procedure is given, as well as the general results and conclusions. 3. Introduction. They are the results of the bibliographical research related to the antecedents of the problem that motivated the research. 4. Hypothesis. It arises affirming or denying what supposedly solves the problem. 5. Determination of variables. 6. Design of the experiment. 7. Procedure to carry out the experiment. 8. Carrying out the experiment. Oral exposition of the experiment. Management of citations and references
4.	4. Method to develop an experiment (fourth part) (16 h)	At the end of the unit, the student will be able to analyze the results of an electrical mechanical application experiment and present the conclusions by writing a report and oral presentation.	**Specific educational content:** 4.1 Analysis of results. 4.2 Representation of the results in graphic form. 4.3 Statistical analysis of the results. 4.4 Acceptance or rejection of the hypothesis. 4.5 Conclusions. **Learning activities:** Drafting of the report that includes: 1. Cover page with the following information: • Title. • Name of the authors. • Name of the institution (Area, Career). 2. Summary. In this part a brief description of the problem and procedure is given, as well as the general results and conclusions. 3. Introduction. They are the results of the bibliographical research related to the antecedents of the problem that motivated the research. 4. Hypothesis. It arises affirming or denying what supposedly solves the problem. 5. Determination of variables. 6. Design of the experiment. 7. Procedure to carry out the experiment. 8. Carrying out the experiment. 9. Experiment results 10. Conclusions Oral exposition of the experiment. Management of citations and references

5.	5. Method to develop an experiment (fifth part) (16 h)	At the end of the unit, the student will be able to analyze and reflect on the work carried out and the opportunities for better that exist in the experimental development to make improvements to the delivered project.	**Specific educational content:** 5.1 Feedback from the teacher on the final report. **Learning activities:** Drafting of the report that includes: 1. Cover page with the following information: • Title. • Name of the authors. • Name of the institution (Area, Career). 2. Summary. In this part a brief description of the problem and procedure is given, as well as the general results and conclusions. 3. Introduction. They are the results of the bibliographical research related to the antecedents of the problem that motivated the research. 4. Hypothesis. It arises affirming or denying what supposedly solves the problem. 5. Determination of variables. 6. Design of the experiment. 7. Procedure to carry out the experiment. 8. Carrying out the experiment. 9. Experiment results 10. Conclusions Oral exposition of the experiment. Management of citations and references

E. ASSESSMENT

The summative evaluation proposal for the training space is shown below. According to it, students will receive an ordinary grade. This subject reports five partial grades before the ordinary final grade, the percentages and weighting are as shown in Table 1. The partial evaluation consists of:

A document written by a team that must be written with at least 750 words, perfectly structured, with correct writing and without spelling mistakes, will have a value of 70% of the partial grade. It must demonstrate the handling of citations and references and the use of cross references.

An oral presentation to their classmates where the work developed during that period will be presented. They must make the presentation a well-structured idea of the work developed, good diction and body language according to their presentation, this will have a value of 30% of the partial qualification.

Table 1.

#	Time of evaluation	Proposal for the summative assessment of learning		Evaluation percentage
1.	Evaluation of the first part according to the College calendar. The first subject of the course is evaluated.	Report on the experiment Oral presentation on the experiment	7 points 3 points	10 %

2.	Evaluation of the second part according to the College calendar. The second subject of the course is evaluated.	Report on the experiment Oral presentation on the experiment	7 points 3 points	15 %
3.	Evaluation of the third part according to the College calendar. The third part of the course is evaluated.	Report on the experiment Oral presentation on the experiment	7 points 3 points	20 %
4	Evaluation of the fourth part according to the College calendar. The fourth part of the course is evaluated.	Report on the experiment Oral presentation on the experiment	7 points 3 points	25 %
5	Evaluation of the fifth part according to the College calendar. The fifth part of the course is evaluated.	Report on the experiment Oral presentation on the experiment	7 points 3 points	30 %

Ordinary final assessment	The ordinary grade will be the sum of all the evaluation points referred to in Table 1 multiplied by the evaluation percentage. The grade will be reported based on 10 and will proceed according to the Examination Regulations to declare the subject accredited or, if appropriate, EE or ET. The evaluation value is 100%.
Extraordinary assessment	It is a written exam worth 100%. 100% of the topics and the result of the learning activities of this training space will be evaluated.
Sufficiency assessment	It is a written exam worth 100%. 100% of the topics and the result of the learning activities of this training space will be evaluated.
Regularization assessment	It is a written exam worth 100%. 100% of the topics and the result of the learning activities of this training space will be evaluated.

F. BIBLIOGRAPHIC AND DIGITAL RESOURCES

BASIC TEXTS:

1. Gutiérrez Pulido Humberto y de la Vara Salazar Román, Análisis y diseño de experimentos, Editorial Mc Graw Hill 3era. Edición 2012.

2. Yuin Wu & Alan Wu, Diseño robusto utilizando los métodos de Taguchi, Editorial Díaz de Santos 1997.

3. Uldrich Karl T. & Eppinger Steven D., Diseño y desarrollo de productos, Editorial Mc Graw Hill Quinta edición, 2013.

4. Arana Federico, Método experimental para principiantes, Editorial Joaquín Mortiz 2da. Edición 1992.

5. Navarro Joe, Karlins Marvin, El cuerpo habla. Editorial Sirio, 2010.

6. Allan y Bárbara PEASE, El lenguaje del Cuerpo. Editorial Amat 2012.

INTERESTING LINKS ADDRESSES:

www.scopus.com
www.sciencedirect.com
https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/class-slides/
www. learnEngineering.org
https://ieeexplore.ieee.org/Xplore/home.jsp

CURRICULAR AND SCHOOL DATA

Area	Line	Type of credit	Type of formation space	Language of instruction	Method of delivery
Basic (Math & Basic Sciences)	N/A	Required	Course	Spanish	In person

CREDITS

According to the official curricular proposal, the school data of the formation space are:

Semester	Number of weeks	Classroom hours per week	Contact hours of practice per week	Hours of autonomous student work per week	Credits per agreement 17/11/17(before 279)
1	16	--	5	-	5

.

REQUIREMENTS TO ATTEND THE FORMATION SPACE

The school requirements for the formation space are noted below, if necessary

#	REQUIREMENTS
1.	None

EQUIVALENCIES OF THE FORMATION SPACE

Next, the equivalences of the training space with spaces of previous educational programs are indicated, if necessary.

EQUIVALENCES
None

INTEROPERABILITY

This formation space is shared with other educational programs and/or academic entities: No.

ACADEMIC INSTITUTION AND EDUCATIONAL PROGRAMS
College of Engineering: Electromechanical Engineering

OTHER FORMS OF ACCREDITATION

- This formation space can be accredited through the presentation of a document certifying that the student has already acquired the necessary learning: **No**.

- This formation space can be accredited through an exam that certifies that the student has already acquired the necessary learning: **No**.

FORMATION OPTIONS

This formation space is part of the following options:

Training option	Yes/ No
Bachelor's Degree	Yes
Dual formation program	No
Higher University Technician	No
Executive career	No
Partial accreditation option	No
Residency or internship	No

TEACHER PROFILE

The teacher must know about the student outcomes that are promoted in the students of the electromechanical engineering program.

Formation and academic experience

- Electromechanical Engineer or related career with Master's or Doctorate studies.

Formation and professional and work experience

Must have experience in the course

The teacher's role

- The teacher will have the task of facilitating the student's learning of the topics, as well as providing the necessary theoretical tools for the student to develop the experiment. It will issue a grade in each part according to the percentages established in Table 1

MAXIMUM AND MINIMUM NUMBER OF STUDENTS PER GROUP

- Maximum number of students to guarantee academic, pedagogical, and financial viability: 25
- Minimum number of students to guarantee academic, pedagogical, and financial viability: 5

TYPE OF PROPOSAL

- It is a version of programs that are presented as a curricular adjustment of content within the framework of an existing educational program.

DEVELOPERS AND REVIEWERS

Developers of this programs	Reviewers of this programs
MA. Vérulo Castro López	PhD. Baudel Lara Lara

	PhD. Francisco Oviedo Tolentino.
	LDG. Verónica Contreras Hernández