WASC Program Review
Mechatronics Academy

Table of Contents

1. Introduction.

This paper presents the results generated by the Mechatronics Academy for the revision of the Mechatronics Engineering program. The Mechatronics Academy consists of the following members:

- Ing. Christopher Capiz Gomez
- Ing. Arturo Mendez Escoto
- Ing. Adolfo Esquivel
- Ing. Yamel Ungson

The Mechatronics Engineering program was launched in Mexicali and Ensenada in 2005 and in Tijuana in 2006. The program is currently undergoing its first major revision. Five generations have graduated from Mexicali and four from Tijuana. In 2010, the Mechatronics Engineering program initiated a program review process, led by the Mechatronics Academy, following the guidelines established by the CETYS's Academic Programs Periodic Review Process. This work has been done mainly by taking advantage of technology, such as e-mail and video conferencing, to be able to have interaction between members of the different campuses.

In addition, a program review work team was created in the first half of 2011, composed by the leaders of the Academy and the group involved in the review and evaluation processes of the program as well as the University's staff. The purpose of the group was to provide a peer review team for the program's review processes and provide timely and multidisciplinary feedback for the academies. In addition to the feedback provided by the group, the academy's professors have participated in various program review and evaluation workshops conducted by external consultants, and the program review documents as well as the evaluation plans were reviewed by external consultants and experts who provided comments and feedback.

The components of the review presented in this document reflect the methodology followed by the Academy to undergo the review process, which begins with an analysis of the mission and vision of the program and its educational objectives and learning outcomes, along with the curricular mapping and assessment processes, identifying indicators for student achievement and analysis of students, faculty resources and support. It also includes the information obtained in the comparative analysis with other reviewers from external programs. The areas of opportunity and recommendations defined by the Academy during the process and reflected in this document are presented to the College of Engineering, which in turn will be submitted to the Academic Vice-Presidency to be considered for implementation in the next version of the academic programs.

An improvement plan is presented in the final section of this paper. It includes the main activities proposed to make the necessary changes according to the results of the analysis.

2. Revision of the mission, vision and educational objectives

For the analysis of the mission and vision of the computer engineering program, we begin by identifying some important historical and contextual information, as well as some important achievements of the program:

- The first professional in the area of mechatronics graduated from the program in 2008 in the Mexicali campus.
- Students have participated in the design, integration and deployment of systems technology for several companies in the region such as Kenworth, Honeywell, Skyworks, Sun Power, and CETYS, to name a few.
- Students have contributed for more than five years with expertise to several companies in the region.
- The program received its first accreditation in 2012 by CACEI.

The total number of graduates of the program for the Mexicali Campus is about 75 and about 60 for the Tijuana Campus. In the Ensenada campus only the first four semesters of the program are offered, so in order for students to continue their studies they must travel to Mexicali or Tijuana.

Three aspects have been considered in the analysis of the mission and vision of the Mechatronics Engineering program: alignment with the institutional mission and vision, impact on the regional and national development, the level of alignment of the program with current educational goals.

The Bachelor in Mechatronics Engineering focuses on the following main areas of knowledge, also called vocational lines:

a) Mechanical Design.
b) Manufacturing.
c) Electronics.
d) Control.

In addition to the items listed above, CETYS University's educational model promotes the comprehensive development of its professionals, including critical thinking, global and international mindset, information literacy, values and contribution to the social, economic and technological development and sustainability.

The mission and vision for the Mechatronics Engineering program, established as part of the review process is:

The mission of the Mechatronics Engineering Program is to generate highly qualified professionals with a thorough knowledge in fundamentals of materials, manufacturing processes, automation and industrial robotics, enabling them to develop successful careers within the manufacturing industry as an employee or freelancer.

The vision of the Mechatronics Engineering program is to be the main source in the region of professionals that provide solutions that require the use of knowledge of materials and manufacturing processes and robotics and industrial automation.

When analyzing the institutional mission and the mission of the academic program, we found that the second complements the first one. CETYS University's mission and the mission of the Bachelor in Mechatronics Engineering point to the importance of the development of the "intellectual capacity". However, the program's mission does not explicitly specifies the importance of the development of "moral capacity" in students, but by "professional" they mean a "high level of professional ethics, behavior and work activities, and practice of the profession" and thus implicitly refer to "moral power" as mentioned in the institutional mission.

Below is CETYS mission, as adopted by the IENAC in 1977:

It is the purpose of Centro de Enseñanza Técnica y Superior to contribute in the education of persons with the moral and intellectual capacity required to participate in an important way in the economic, social, and cultural improvement of the country. CETYS University seeks, as a result, to make indestructible those values that have traditionally been considered as basic so man can live in society in a peaceful way, and satisfy the needs that his capacity to do work allows him.

The institutional mission states the following in regards to students:

- Moral and intellectual capacity for the economic, social and cultural development of the country.
- Basic values to live peacefully in society.

We understand as moral capacity that students are decent, respectful and noble people; regardless of the profession they choose this would allow them to live a successful life despite their socioeconomic status. The institutional mission indicates the intellectual capacity of suitable students to weigh out the work required by their profession. In other words, the value of students as individuals and as professionals should be guided towards the "economic, social, and cultural development."

The second part of the institutional mission states that students must be able to meet their needs through their work and live in peace with other people. Again, we can detect the existence of students' ability in their profession as well as respect for others.

Taking the components and elements as guidelines and with the institutional mission and vision as building blocks of the Foundation, the Mechatronics Academy, through a process of review and analysis, has maintained the mission and vision of the Mechatronics Engineering program as they were specified previously.

While the institutional mission focuses on the country's development, the vision of the program takes a more local perspective. This represents an opportunity to develop a good learning outcomes program and an assessment program that responds to the challenge proposed in the vision.

The program's vision clearly states, that the program should move towards the areas of materials, manufacturing processes, robotics and industrial automation. This would be reflected in curricular and co-curricular courses, departments and infrastructure and support centers in one way or the other and impact in the academic program.

The educational objectives the Mechatronics Academy has set for the Mechatronics Engineering program are:

- Graduates of this program will make at least one proposal for an industry for the automation of a production system.
- Graduates of this program will improve an existing manufacturing process through the integration of electronics, tires, etc..
- Graduates of this program will integrate, install, test and ensure the operating means of electronic and / or mechanical systems.
- Graduates of this program will be able to pursue graduate studies successfully.
- Graduates of this program will be able to find professional jobs within six months of their graduation.
- Graduates of this program will be able to start their own business,
- Graduates of this program will be able to reach first or second level management positions within three years following graduation.

These educational objectives are the primary target of the under graduate follow-up studies, to be used for various purposes during the evaluation cycle and program review.

3. Review of the program's capacity

3.1 Structure of the program.

The Mechatronics Engineering academic program of CETYS University has the following requirements for obtaining structure and degree:

- Accreditation of 42 subjects
- Completion of 400 hours of professional practice.
- Completion of 500 hours of community service.
- Completion of the relevant EGEL Test administered by CENEVAL (Mexico's organization that offers several exam services).

The curriculum for the Mechatronics Engineering program includes the following subjects in the field of engineering and specifically in Mechatronics (the 10 general education subjects are not shown):

CODE	SUBJECT	SEMESTER
MA400	Mathematics	1
CC400	Programming Methods I	1
CE058	Introduction to Mechatronics	1
MC400	Computer Drawing	2
MA401	Differential Calculus	2
CC402	Programming Methods II	2
FI400	Physics I	2
MF400	Material Properties	2
MA402	Integral Calculus	3
FI401	Physics II	3
MA403	Numeric Methods	3
MF401	Materials Manufacturing	3
MA404	Probability	4
MA407	Differential equations	4
FI402	Physics III	4
MF402	Computer Manufacturing	4
MC402	Mechanics of Materials	4
MA406	Multivariable Calculus	5
MC410	Mechanisms dynamics	5
CE059	Electronic Systems I	5
MC415	Introduction to Design	5
CE061	Industrial Automation and Robotics	6
MC407	Electroneumatics and hydraulics	6
CE060	Electronic Systems II	6
CE062	Programmable Controllers	7
CE414	Power electronics	7
CE063	Sensors and actuators	7

CE401	Computer Networks	7
CE402	Applications of computer networks	8
CE065	Design with microcontrollers	8
CE064	Modeling mechatronic prototypes	8
MC414	Heat Transfer	8

3.2 Program and Institutional Learning Outcomes

The Student Learning Outcomes for an academic program are comprised by two main blocks: Institutional Learning Outcomes and Program Learning Outcomes. The Institutional Learning Outcomes are defined and reviewed by the Academy of Institutional Learning Outcomes. The Program Level Learning Outcomes are defined and reviewed by the Academies.

The Institutional Learning Outcomes are four and focus on: Verbal and Written Communication Skills, Critical Thinking, Continuous Learning/Information Literacy and Tolerance to Diversity.

The Program Level Learning Outcomes, for the programs offered by the College of Engineering are divided into two blocks: learning outcomes common to all engineering programs (with a strong emphasis on basic sciences and problem solving) and learning outcomes specific to the academic program (with a strong emphasis on the primary and complementary areas of knowledge of the program.

This document will focus on the analysis and review process for the Program of Mechatronics Engineering.

The Program Level Learning Outcomes that apply to all engineering programs, defined in the previous program review process (included in Evidence #35 of the Capacity Report for the WASC Initial Accreditation), were five and were identified as follows:

The student of a CETYS University Bachelor's in Engineering Program will…

- SLO_ENG1: …correctly apply to engineering, the tools provided by the basic sciences, such as physics, calculus, probability, statistics and programming to the solution of diverse problems.
- SLO_ENG2: …design analytic and functional models, quantitatively and qualitatively, for the analysis and improvement of systems for diverse applications.
- SLO_ENG3: … effectively use software tools and technologies to build solutions to engineering problems.
- SLO_ENG4: … effectively design and manage projects.
- SLO_ENG5: … (Clear and effective communication in English) … be able to express his ideas clearly and with an appropriate language, in a verbal, written, and visual way in English.

Review of these learning outcomes took into consideration the following three general guidelines:

1. Since these learning outcomes apply to all engineering programs, all Academies should participate in the review process.

2. As a part of the WASC process, recommendations were made with regards to the amount of learning outcomes regarding assessment implications, thus integration of learning outcomes to reduce the amount is desirable.
3. The learning outcome that has to do with “Clear and effective communication in English” must be included.

The Academies analyzed the five original learning outcomes and re-defined them into the following three Program Level Learning Outcomes that apply to all engineering programs:

The student of a CETYS University Bachelor in Engineering Program will…

- SLO_ENG1: …solve problems relating to the improvement of diverse systems, correctly applying the knowledge and tools provided by the basic sciences and/or software technologies.
- SLO_ENG2: … effectively design and manage projects.
- SLO_ENG3: … (Clear and effective communication in English) … be able to express his ideas clearly and with an appropriate language, in a verbal, written, and visual way in English.

This re-definition allows for a more clear identification of the learning outcomes expected for all engineering programs, and also allows the design of a more manageable program level assessment process and plan (which will be explained in further sections of this document).

As part of the initial accreditation process from WASC, some learning outcomes were defined for the Mechatronics Engineering program. The four learning outcomes for the computer engineering program are set as follows:

The student from the bachelor’s degree in Mechatronics Engineering will be able to ...
• SLO_IMECA1: ... design, implement and maintain control systems and / or automation of a manufacturing system using sensors, programmable logic controllers, and actuators.
• SLO_IMECA2: ... integrate computer systems for monitoring, data acquisition and production control in manufacturing environments.
• SLO_IMECA3: ... design, build, install and program robots for use in manufacturing.
• SLO_IMECA4: ... design, select materials, plan and test mechanisms using a numerical control computer or basic machinery from the workshop of the metalworking industry.

The curricular mapping for the program level learning outcomes, in their redefined versions according to section 3 of this document, considers the following levels:

- DEVELOPMENT (DE): "At the end of the course, the students know, understand, comprehend and are familiar with the course topics". It is expected that students have little or no knowledge of the course topics previous to the course. Knowledge and abilities acquired from previous courses may be used to develop students in the solution of problems of low to medium level complexity. New topics are introduced with a basic application level, sufficient enough for the student to comprehend implications for further applications. It is expected for the student to relate previous concepts and integrate them to his or her new base of knowledge, identifying applications via the identification and solutions of problems and cases at a basic level.

- SATISFACTORY (SA): "At the end of the course the students are able to analyze and apply course topics in various contexts, which present diverse levels of difficulty". Knowledge, skills and abilities acquired from previous courses are used to develop solutions to application problems, of medium to high level of complexity, relating to the area of knowledge of the profession. It is expected that the student develop a higher level of analysis skills and learn to use in a more efficient manner the tools and methodologies relating to the area of knowledge of the profession.

- EXEMPLARY - (EX): "At the end of the course, the students exhibit an integrated understanding of the course topics and their application, knowing when and how to apply them". Knowledge, skills and abilities acquired throughout previous courses are used to identify and solve problems, where the student is expected to design, integrate and evaluate tools and methodologies relating to the area of knowledge of the profession.

It is important to note that the curricular mapping of the Institutional Level Learning Outcomes for all academic programs uses a three level scale that is congruent with the above levels, using different nomenclature (Sufficient, Improvable, Outstanding). This scale is also congruent with the program level scale of Introductory, in Development and Developed.

The following table shows the curricular mapping for Mechatronics Engineering program (learning outcomes of the program):

			ENGINEERING BACHELOR'S PROGRAMS STUDENT LEARNING OUTCOMES			BACHELOR'S IN MECHATRONICS ENGINEERING STUDENT LEARNING OUTCOMES			
CURRICULAR ELEMENTS			SLO_ENG1	SLO_ENG2	SLO_ENG3	SLO_IMEC1	SLO_IMEC2	SLO_IMEC3	SLO_IMEC4
CODE	**COURSE**	**SEMESTER**	**LEVEL**	**LEVEL**	**LEVEL**	**LEVEL**	**LEVEL**	**LEVEL**	**LEVEL**
MA400	Matemáticas	1	DE	DE	DE				
CC400	Métodos de programación I	1	DE	DE	DE		DE	DE	DE
MC400	Dibujo por computadora	2	DE	DE	DE			DE	
MA401	Cálculo diferencial	2	DE	DE	DE				
CC402	Métodos de programación II	2	DE	DE	DE	DE	DE	DE	DE
FI400	Física I	2	DE	DE	DE			DE	DE
MA402	Cálculo integral	3	DE	DE	DE				
FI401	Física II	3	DE	DE	DE			DE	
MA403	Métodos numéricos	3	DE	DE	DE				
MA404	Probabilidad	4	SA	SA	SA				
MA407	Ecuaciones diferenciales	4	SA	SA	SA				
FI402	Física III	4	SA	SA	SA	DE	DE	DE	
MA406	Cálculo multivariable	5	SA	SA	SA				
CE058	Introducción a la mecatronica	1	DE	DE	DE	DE	DE	DE	DE
MF400	Propiedades de los materiales	2	DE	DE	DE	DE		DE	SA
MF401	Manufactura de materiales	3	DE	DE	DE	SA		DE	SA
MF402	Fabricación por computadora	4	SA	SA	SA	SA		SA	EX
MC402	Mecánica de materiales	4	SA	SA	SA	SA		SA	EX
MC410	Dinámica de mecanismos	5	SA	SA	SA	SA		SA	EX
CE059	Sistemas electrónicos I	5	SA	SA	SA	SA	SA	SA	
MC404	Introducción al diseño	5	SA	SA	SA	SA		SA	SA
CE061	Automatización y robótica industrial	6	SA	SA	SA	EX	EX	EX	SA
MC407	Electroneumática e hidraulica	6	SA	SA	SA	EX	SA	SA	
CE060	Sistemas electrónicos II	6	SA	SA	SA	EX	SA	SA	
CE062	Controladores programables	7	EX	EX	EX	EX	EX		
CE414	Electrónica de potencia	7	EX	EX	EX	EX	SA	SA	
CE063	Sensores y actuadores	7	EX	EX	EX	EX	EX	SA	EX
CE401	Redes de computadoras	7	EX	EX	EX		EX		
CE402	Aplicaciones de redes de computadoras	8	EX	EX	EX		EX		
CE065	Diseño con microcontroladores	8	EX	EX	EX	EX	EX	EX	EX
CE064	Modelación de prototipos mecatrónicos	8	EX	EX	EX	EX	EX	EX	EX
MC414	Transferencia de calor	8	EX	EX	EX	EX			EX

It is important to note that, in the case of SLO_ENG3 ("Clear and effective communication in English"), there are curricular elements such as the Advanced Communications in English course (3th semester), and also program level courses offered in English beginning in 5th semester. The development of clear and effective communication in English is developed primarily via the co-curricular ESL program that all students must go through, and which is managed by the English Language Center.

The following table shows the courses in the curriculum for Mechatronics Engineering classified by:

General Education. Courses in the area of humanities that give the characteristic signature to a CETYS student.

Common Subjects. Subjects that are common to all engineering students such as mathematics, physics, etc.

Mechatronics Engineering. Subjects that are specific to Mechatronics Engineering.

<table>
<tr><th>General Education</th><th>Common Subjects</th><th colspan="4">Mechatronics Engineering Subjects</th></tr>
<tr><td rowspan="2">10</td><td rowspan="2">13</td><td colspan="4">19</td></tr>
<tr><td colspan="4">45%</td></tr>
<tr><td rowspan="3">24%</td><td rowspan="3">31%</td><td>Mechanical Design</td><td>Manufacture</td><td>Electronics</td><td>Control</td></tr>
<tr><td>5</td><td>4</td><td>6</td><td>4</td></tr>
<tr><td>12%</td><td>10%</td><td>14%</td><td>10%</td></tr>
</table>

It can be seen that 45% of the subjects are in the Mechatronics Engineering area, where the courses in the area of Mechanics are 22% of the total and the Control area is very reduced.

Once the curricular mapping was concluded, the lessons learned during the process are as follows:

- Clarity with which each subject relates to each Learning Outcome.
- There is an important amount of involvement and engagement, as well as ownership by faculty members of the Academy that participated in the process.
- Course content and evaluation criteria were unified.
- Discussion on how students learn and should learn throughout the academic program was achieved among faculty.
- Key moments for the assessment of student learning throughout the academic program were identified.
- Experience was obtained for further program review processes.

3.3 Faculty participating in the program

The program has chairs from Campus, which are full-time professors who are in charge of the program and are involved in the enrollment process and promotion activities, counseling of students and alumni tracking, program reviews, accreditation projects, etc.:

- Cristobal Capiz Gomez - Mexicali Campus.

- Escoto Arturo Mendez - Tijuana Campus.

Professors who are associated with the program, (most members of the Mechatronics Engineering Academy) are:

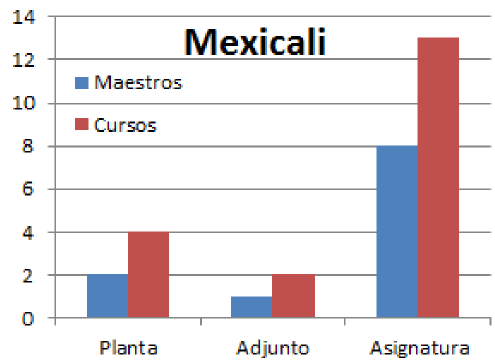
Name	**Academic Degree**	**Area of Knowledge**	**Institution**	**Type**	**Campus**
Cristobal Capiz	Master's in Technology	Digital systems, control systems, analog electronics	ASU	Full-time	Mexicali
Alma Abad	Master's in Science	Materials, mechanical design	CETYS	Part-time	Mexicali
Maribel Lazcano	Master's in Science	Mechanical design, Manufacture	CETYS	Associate* Professors who are part of the administra tive staff	Mexicali
Nestor Orozco	Master's in Science	Control systems, electronics, microcontrollers	UABC	Adjunct	Mexicali
Luis Soto	Engineer	Manufacture	CETYS	Adjunct	Mexicali
José Miguel Ramirez	Master's in Science	Electronics, Semiconductors	CETYS	Adjunct	Mexicali
Yamel Ungson	Master's in progress	Automation systems	UABC	Adjunct	Mexicali
Luis Básaca	Doctorate in progress	Automation systems, sensors	UABC	Adjunct	Mexicali
Hector Barajas	Master's in Science	Computer Networks	CETYS	Adjunct	Mexicali
Arturo Escoto	Master's in Progress	Control Engineering	ITESM		Tijuana
Daniel Moctezuma	Master's in Science	Redes	CETYS		Tijuana
Adolfo Esquivel	Master's in Science	Digital Systems	IPN		Tijuana
Adolfo Esquivel	Master's in Science	Digital Systems	IPN		Tijuana
Moises Sanchez	Doctor's in Engineering	Networks	CETYS		Tijuana
Roberto Salas	Master's in Science	Physics	CETYS		Tijuana

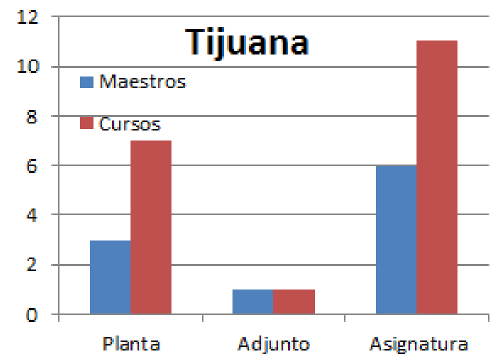
The following table shows the distribution of professors in the subjects taught in the Mechatronics Engineering Program from the previous two semesters:

CODE	SUBJECT	SEMESTER	PROFESSORS		
MA400	Mathematics	1	Ing. Ana Karen Gutiérrez	Ing. Josefina Becerra	Mat. Alfredo Rodriguez
CC400	Programming methods I	1	Ing. Amelia Reséndez	Ing. Guillermo Cheang	
CE058	Introduction to Mechatronics	1	Ing. Cristóbal Capiz		
MC400	Computer Drawing	2	Ing. Maribel Lazcano	Ing. Alma Abad	Ing. Jorge Dones
MA401	Differential calculus	2	Mat. Alfredo Rodriguez		
CC402	Programming methods II	2	Ing. Sukey Nakasima	Ing. Guillermo Cheang	
FI400	Physics I	2	Ing. Diana Navarro	Ing. Salvador Baltazar	
MF400	Material Properties	2	Ing. Alma Abad		
MA402	Integral Calculus	3	Mat. Alfredo Rodriguez	Mtro. Claudio Lopez	
FI401	Physics II	3	Ing. Salvador Baltazar		
MA403	Numerical Methods	3	Ing. Yamel Ungson	Ing. Maribel Lazcano	
MF401	Materials Manufacturing	3	Ing. Maribel Lazcano	Ing. Rubén Yáñez	
MA404	Probability	4	Ing. Salvador Baltazar	Ing. José Manuel Algravez	
MA407	Differential Equations	4	Ing. Susana Guevara		
FI402	Physics III	4	Mtro. Claudio Lopez		
MF402	Computer Manufacturing	4	Ing. Maribel Lazcano		
MC402	Mechanics of Materials	4	Ing. Maribel Lazcano	Ing. Rubén Yáñez	
MA406	Multivariable Calculus	5	Dra. Gabriela Estrada	Ing. Diana Navarro	
MC410	Mechanism dynamics	5	Ing. Ruben Yáñez		
CE059	Electronic Systems I	5	Ing. Cristóbal Capiz		
MC404	Introduction to Design	5	Ing. Maribel Lazcano		

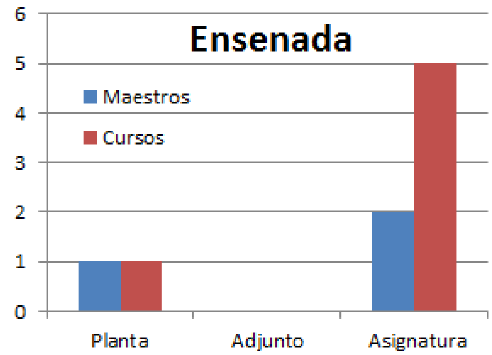
CE061	Industrial Automation and Robotics	6	Ing. Yamel Ungson		
MC407	Electropneumatics and hydraulics	6	Ing. Ruben Yáñez		
CE060	Electronic Systems II	6	Ing. José Miguel Ramirez		
CE062	Programmable Controllers	7	Ing. Néstor Orozco		
CE414	Power electronics	7	Ing. Susana Dominguez	Ing. Néstor Orozco	
CE063	Sensors and actuators	7	Ing. Luis Carlos Básaca		
CE401	Computer Networks	7	Ing. Héctor Barajas		
CE402	Applications of computer networks	8	Ing. Héctor Barajas		
CE065	Design with microcontrollers	8	Ing. Néstor Orozco		
CE064	Modeling mechatronic prototypes	8	Ing. Luis Soto		
MC414	Heat Transfer	8	Ing. Iván Williams	Ing. Jesús Corona	

Analyzing how professors are distributed in the different subjects in each campus, it can be seen that in the three campuses, the majority of the courses are taught by adjoint professors, Mexicali and Ensenada being the most serious cases. In the case of Mexicali, there are two full-time professors that work in the area whom are not dedicated to the program, but are shared with other programs. The same situation happens in Tijuana, but at least they taught more





courses in the program.



3.4 Research lines of the program.

CETYS UNIVERSITY's System, has many years of research in the fields stated on its Mission: Engineering, Administration and Social Sciences and Humanities. The research is primarily of the applied type, and with a focus on solving problems of the region of Baja California. The cases are reported in the documents that have been delivered to CONACYT to endorse the RENIECYT registration. It has also been documented in the applications and endorsements made by the Institution to belong to the National Register of Quality Postgraduate Programs.

The institution's strategic plan towards the year 2020 (CETYS 2020 PLAN) has defined several strategies in order to strengthen its faculty and research in the institution in order to ensure that this activity is an essential part of their academic functions, and in turn, take this ability to assist in the economic, social and cultural development of the region of Baja California. The three strategies are defined as follows:

(1) Strengthening its faculty through support to develop research activities in some cases, and obtaining doctoral degrees in others.
(2) Recruitment of faculty with doctoral degree and with experience in research and publication of results.
(3) Creation of three Centers of Excellence to conduct research and technology development projects that will significantly impact on the productive, social and cultural sectors of Baja California.

To properly align all research efforts, and in turn, coexist in harmony with the teaching activities, the Institution took on the task of defining a research plan which sets out the guidelines and policies that describe the operational framework of this activity. This plan also sets targets and indicators to be achieved in the short, medium and long term. It stands as one of them, for example, that our faculty members are members of the National Researchers System of CONACYT.

Due to the ordering of research and including its graduate programs in the National Register of Quality Graduate Programs (PNPC for its Spanish acronym), and encourage research in their careers, the Institution instructed each of its academic areas (Engineering, Business and Administration, and Social Sciences and Humanities) to define their areas of research, as well as organizing its faculty to form academic bodies in each of them. Thus the following lines were established for the area of Engineering:

(1) **Information and Multimedia Technology.** This research line addresses the problems related to the design and the development of computer systems applied to process automation and information management using the internet platform and associated technologies. It also addresses the problems of designing the electronic systems required in specialized processes, mainly control. Nine full-time professors are working on this LGAC (4 with Doctoral degree, and 4 in doctoral training). In this line are the following academic programs:

1. Electronics Cybernetics Engineering
2. Computer Science Engineering
3. Digital Graphic Design Engineering
4. Software Engineering
5. Master of Science in Engineering with emphasis in Information and Multimedia Technology.

Design and manufacturing processes. This research addresses the problems related to the design and engineering of products, considering the selection of materials, structural analysis, product testing, as well as the processes required for its manufacture. Six full-time professors are working this LGAC (1 Doctor, and 3 in doctoral training). The following academic programs can be found in this line:

1. Mechanical Engineering
2. Mechatronics Engineering
3. Master of Science in Engineering with emphasis in Design and Manufacturing.

Systems and industrial processes. This research addresses the problems related to the analysis and improvement of processes in the field of production of goods and services, using statistical techniques and operations research as well as methods for quality improvement. Nine full-time professors are working this LGAC (5 doctors and 1 in doctoral training). In this line are the following academic programs:

1. Industrial Engineering
2. Master of Science in Engineering with emphasis in Systems and Industrial Processes.

These lines were defined according to the needs found in the different sectors of the region in which the institution desires to impact with the formation of high-level human resources, and the development of research and technological development. According to the Strategic Plan's indicators, significant progress has been made in strengthening its faculty and considering these LGACs and their specific topics for hiring and doctoral training of the faculty.

Academic bodies are created for each line of research at a system-level, so that professors are integrated to develop research and teaching activities with their respective academic group in both undergraduate and graduate studies. In turn, there are collegiate bodies in the institution for reviewing and monitoring each of its academic programs, the purpose of these groups is the learning assessment, student assessment and periodic review of the academic programs.

3.5 Facilities, laboratories and book collection of the program.

All classrooms have projector equipment and wireless Internet connection. Some classrooms have sound equipment. Faculty cubicles have computer and Internet connection.

The library has carried out considerable improvements, especially in the acquisition of electronic books and data bases.

Within the supporting programs we have departments that manage their own resources and strengthen the student's holistic education, such as:

- Student Life is a department that carries out sporting, cultural, and social activities and supports integration and the student body operation.
- Entrepreneurial Development Center promotes the student body participation in the Management and Economic Simulation Exercise program (MESE for its acronym in Spanish) which strengthens the training for business decision making process through simulators. Coupled to this, the Center promotes the visits to companies and seminars in the institution.
- Student Development Center supports students since before the enrollment process through vocational guidance services, and it accompanies them throughout their undergraduate studies with tutorials, workshops, and psychological guidance.
- English Language Center supports students in the accreditation of TOEFL-equivalent test.
- Computer Services is provided by Information Services who manages computer resources in both software and hardware, as well as the necessary multimedia

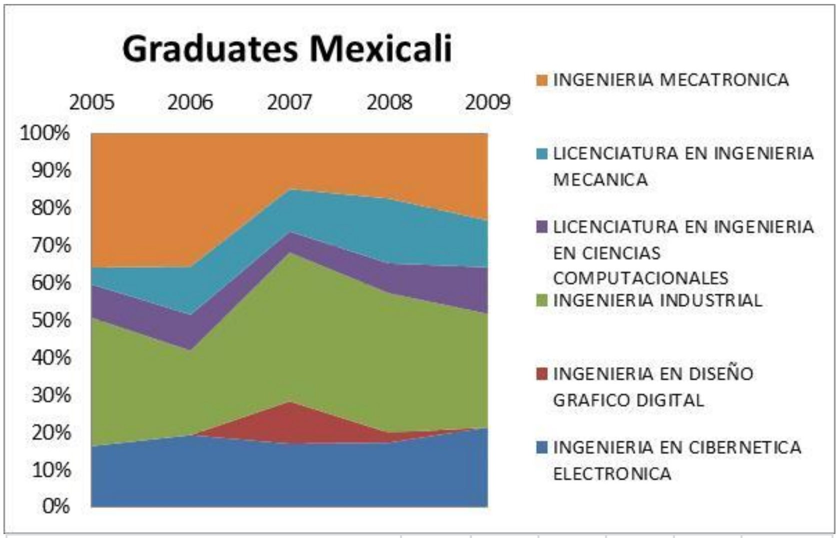
resources for course instruction, Blackboard platform, secure Internet access, local network connections, databases, e-mail and videoconference services.

- General Computer Laboratories provide computer resources for general hardware and software use,
    - 6 laboratories in the Mexicali campus.
    - 5 laboratories in the Tijuana campus.
    - 5 laboratories in the Ensenada campus.

- In addition, the engineering programs offered by the College of Engineering have the following laboratories:
    - Mexicali campus: Physics, General Electronics, Chemistry, Production Systems, Mechatronics, Manufacturing, Materials, and Thermic Process.
    - Tijuana campus: Physics, General Electronics, Chemistry, Production Systems, Mechatronics, Manufacturing, and Computer Networks.
    - Ensenada campus: Physics, General Electronics, Chemistry, and Production Systems.

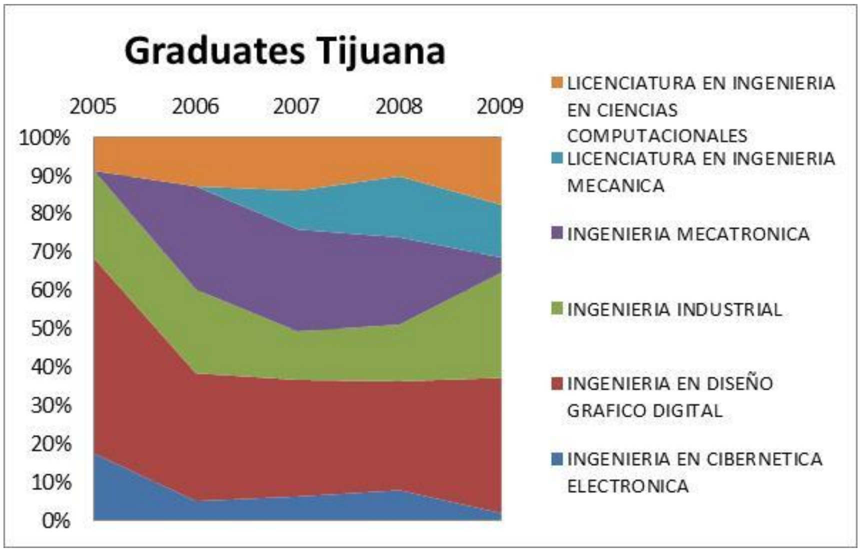
4. Revision of the program’s educational effectiveness

4.1 Graduates of the Program



	2005	2006	2007	2008	2009	TOTAL
INGENIERIA EN CIBERNETICA ELECTRONICA	11	12	15	13	12	63
INGENIERIA EN DISEÑO GRAFICO DIGITAL			10	2		12
INGENIERIA INDUSTRIAL	23	14	35	28	17	117
INGENIERIA MECATRONICA	24	22	13	13	13	85
LICENCIATURA EN INGENIERIA EN CIENCIAS COMPUTACIONALES	6	6	5	6	7	30
LICENCIATURA EN INGENIERIA MECANICA	3	8	10	13	7	41
Escuela	67	62	88	75	56	

Graduation from the Bachelor of Mechatronics in the Mexicali campus is shown in the table above. It can be seen that from 2005, when the program was open, until 2009 the number of graduates is 85. However, it is important to note that the first two generations had twice as many graduates than the following three.

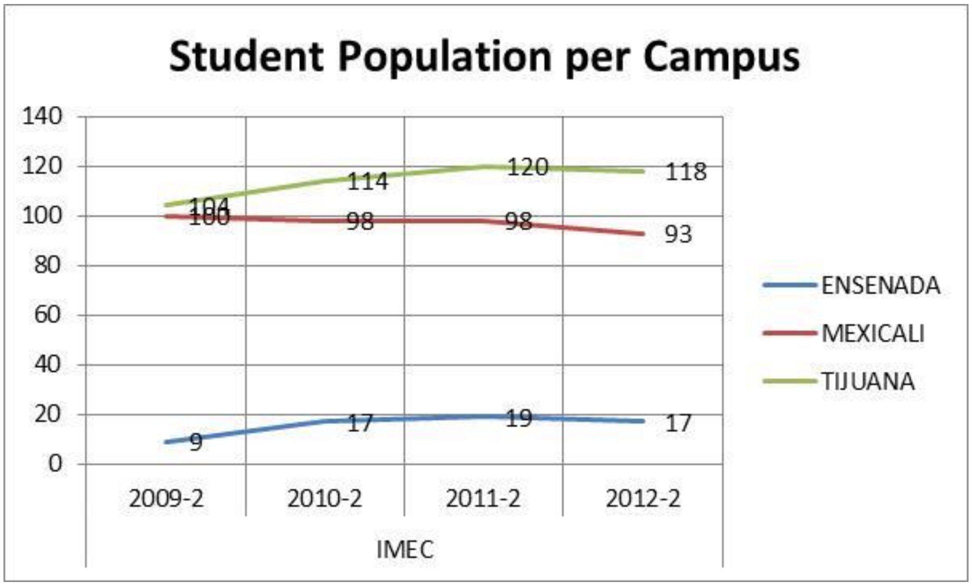


	2005	2006	2007	2008	2009	TOTAL
INGENIERIA EN CIBERNETICA ELECTRONICA	10	4	5	7	1	27
INGENIERIA EN DISEÑO GRAFICO DIGITAL	29	26	24	25	18	122
INGENIERIA INDUSTRIAL	13	17	10	13	14	67
INGENIERIA MECATRONICA	0	21	21	20	2	64
LICENCIATURA EN INGENIERIA EN CIENCIAS COMPUTACIONALES	5	10	11	9	9	44
LICENCIATURA EN INGENIERIA MECANICA	0	0	8	14	7	29
Escuela	57	78	79	88	51	

Graduation rate of the Bachelor in Mechatronics in the Tijuana campus is shown in the table above. It can be seen that in 2006 when the program was open, until 2009 the number of graduates is 64. However, in the same table, we can see that the first three generations show around 20 graduates and the last one only shows 2. This tremendous decrease could be due to the fact that students chose to be part of the Dual Degree with City University of Seattle, where it may be necessary to take more time to graduate (at least one more semester).

4.2 Student Population

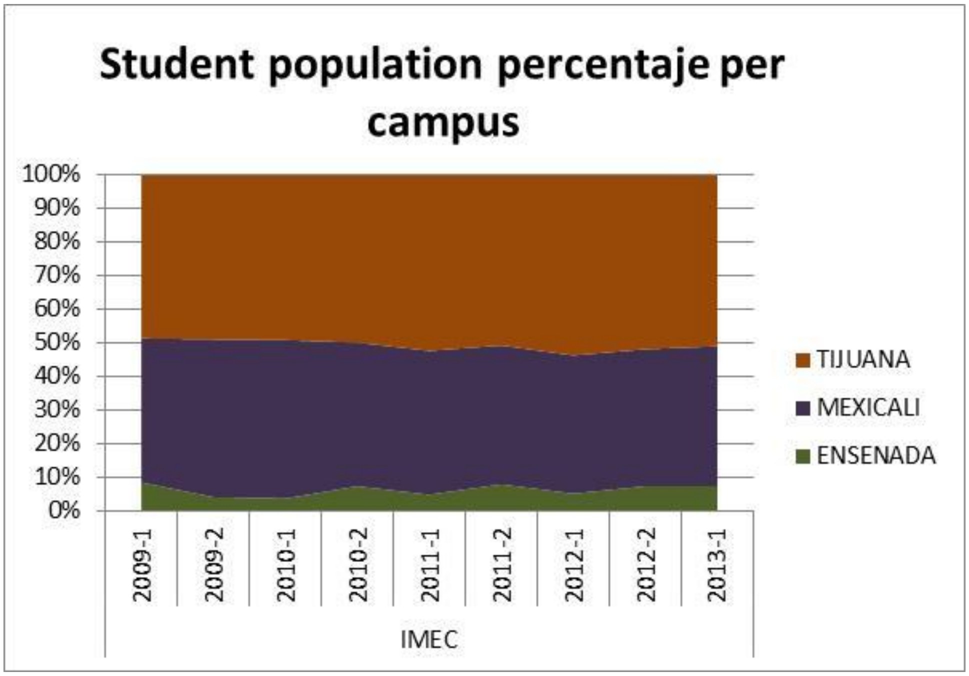
The student population trend of the Mechatronics Engineering program for the three campuses is shown in the following chart:



Sum of textbox2	Column Labels			
Row Labels	ENSENADA	MEXICALI	TIJUANA	Grand Total
IMEC				
2009-2	9	100	104	213
2010-2	17	98	114	229
2011-2	19	98	120	237
2012-2	17	93	118	228

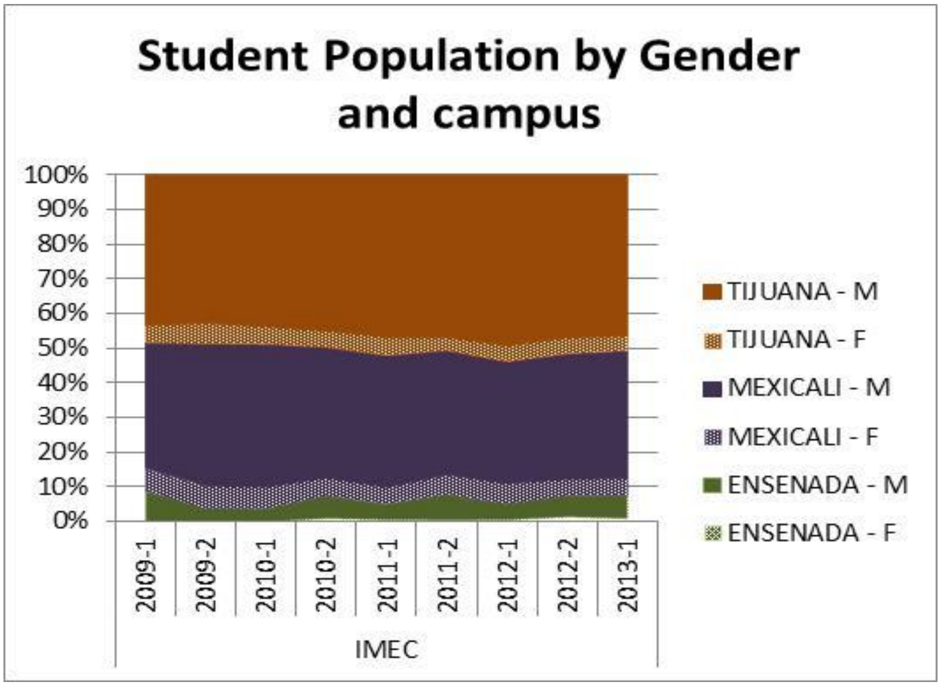
As shown in the chart for the three campuses, population decreased slightly after having an upward trend.

It should be noted that in the Ensenada Campus, the mechatronics engineering program does not offer all semesters and students have to switch to Mexicali or Tijuana campus in order to finish the program.



Sum of textbox2	Column Labels			
Row Labels	**ENSENADA**	**MEXICALI**	**TIJUANA**	**Grand Total**
IMEC				
2009-1	15	75	85	175
2009-2	9	100	104	213
2010-1	8	99	103	210
2010-2	17	98	114	229
2011-1	10	86	105	201
2011-2	19	98	120	237
2012-1	11	86	112	209
2012-2	17	93	118	228
2013-1	17	94	115	226

As shown in the graph above the largest population of Mechatronics Engineering students is in the Tijuana Campus with 50% of the students. Mexicali Campus has 42% of the entire student population and the Ensenada Campus the remaining 8%.



Sum of textbox2	Column Labels					
	ENSENADA		MEXICALI		TIJUANA	
Row Labels	F	M	F	M	F	M
IMEC						
2009-1		15	12	63	9	76
2009-2		9	13	87	13	91
2010-1		8	13	86	11	92
2010-2	2	15	12	86	11	103
2011-1	1	9	10	76	11	94
2011-2	1	18	13	85	9	111
2012-1	1	10	12	74	9	103
2012-2	3	14	11	82	11	107
2013-1	2	15	11	83	10	105

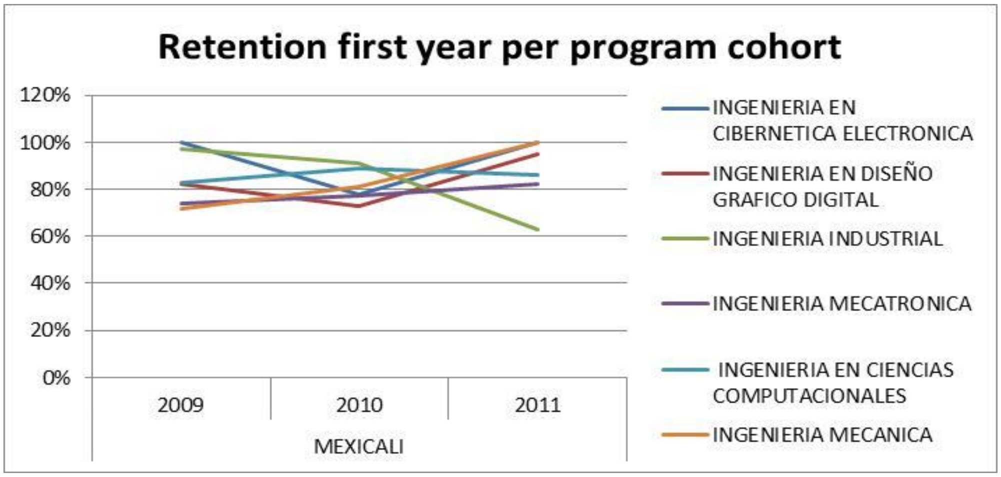
The gender behavior over time in the Mexicali and Tijuana campuses has been stable. The female population represents about 10% of all students in both campuses.

In the Ensenada Campus the gender behavior over time has remained stable at around 10% with a slight increase in 2012.

4.3 Analysis of retention and graduation rate

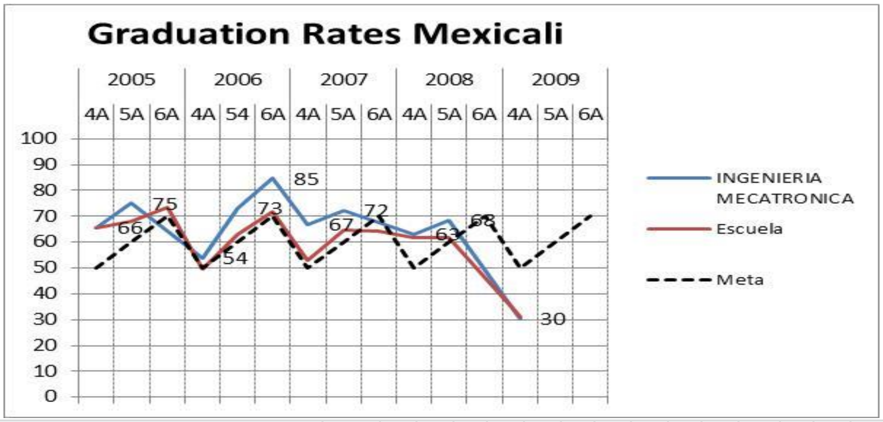
The retention analysis shown below is only for the Mexicali and Tijuana campuses since only these campuses offer the complete program.

Students enrolled in the Ensenada Campus must move to any of the two campuses (Mexicali or Tijuana) to complete the program from the fifth semester.

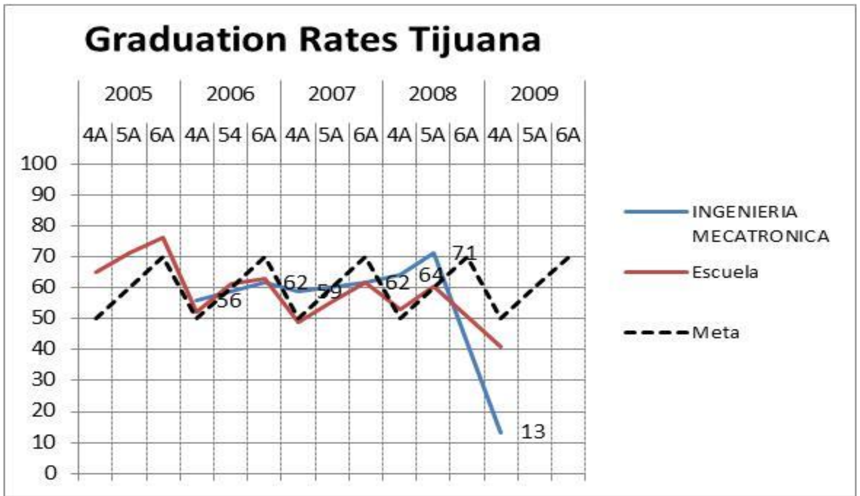


Nivel	LICENCIATURA						
Nombre_Colegio	COLEGIO DE INGENIERIA						
Average of Textbox16	Column Labels						
Row Labels	INGENIERIA EN CIBERNETICA ELECTRONICA	INGENIERIA EN DISEÑO GRAFICO DIGITAL	INGENIERIA INDUSTRIAL	INGENIERIA MECATRONICA	INGENIERIA EN CIENCIAS COMPUTACIONALES	INGENIERIA MECANICA	AVG
MEXICALI	93%	83%	84%	78%	86%	84%	85%
2009	100%	82%	97%	74%	83%	72%	85%
2010	78%	73%	91%	77%	89%	81%	82%
2011	100%	95%	63%	82%	86%	100%	88%
AVG	93%	83%	84%	78%	86%	84%	85%

As it can be seen in the graph of the Mexicali Campus, mechatronics engineering program presented a graduation rate in line with the general behavior target of the engineering school for generations 2005 through 2008. However, the class of 2009 decreased in relation to the expectations; this is due to the fact that there was a cohort with few students.
Regarding the Tijuana campus, for the last generation 2009 has been a significant drop in the rate for both the school and for the mechatronics engineering program. This last fact should lead to a deeper analysis regarding the causes that led to such a fall.



	2005			2006			2007			2008			2009		
	4A	5A	6A	4A	54	6A	4A	5A	6A	4A	5A	6A	4A	5A	6A
INGENIERIA EN CIBERNETICA ELECTRONICA	60	67	73	50	61	67	72	83		88			40		
INGENIERIA EN DISEÑO GRAFICO DIGITAL										35	50		18		
INGENIERIA INDUSTRIAL	70	85		44	48	52	63	71	73	62	67		55		
INGENIERIA MECATRONICA	66	75		54	73	85	67	72		63	68		30		
LICENCIATURA EN INGENIERIA EN CIENCIAS COMPUTACIONALES	31	46		33	56	67	22	44	56	60			25		
LICENCIATURA EN INGENIERIA MECANICA	100			67	78	89	42	53		62			19		
Escuela	65	68	73	50	63	72	53	65	64	62	62	###	31	##	##
Meta	50	60	70	50	60	70	50	60	70	50	60	70	50	60	70



	2005			2006			2007			2008			2009		
	4A	5A	6A	4A	54	6A	4A	5A	6A	4A	5A	6A	4A	5A	6A
INGENIERIA EN CIBERNETICA ELECTRONICA	75	83		44		56				31	54		17		
INGENIERIA EN DISEÑO GRAFICO DIGITAL	71	74	76	54	62	67	57	69		63			72		
INGENIERIA INDUSTRIAL	80	87		60	64	68	50	56		62			61		
INGENIERIA MECATRONICA				56		62	59		62	64	71		13		
LICENCIATURA EN INGENIERIA EN CIENCIAS COMPUTACIONALES	33	42		47	59		48	52		50	56		40		
LICENCIATURA EN INGENIERIA MECANICA							31	46	62	48			44		
Escuela	**65**	**71**	**76**	**52**	**61**	**63**	**49**	**56**	**62**	**53**	**61**	**###**	**41**	**##**	**##**
Meta	**50**	**60**	**70**	**50**	**60**	**70**	**50**	**60**	**70**	**50**	**60**	**70**	**50**	**60**	**70**

4.4 Learning Assessment Process

Assessment at the program level is something new, due to the fact that the focus has been on developing an infrastructure of knowledge and resources, as well as culture, to support assessment at the institutional level. The result of these efforts, as well as the information that has been generated is just now being used to obtain indicators for program review.

At the program level, the College of Engineering decided to designate an Assessment Officer to design a pilot assessment plan and program for the August-December 2010 semester for all Engineering Programs offered by the College. The responsible for this process was M.S. Jorge Sosa López, with the collaboration of the Deans of the Schools of Engineering and Chairs of each Academy.

This pilot project is divided in two stages, the first was deployed during the second semester of 2010 and focuses on program level learning outcomes common to all engineering programs. The second stage focuses on program level outcomes specific to the academic program, in this case the Bachelor in Mechatronics Engineering, as well as external assessment data relating to the EGEL exit test administered by CENEVAL.

This assessment plan has the goal to not only define a structure and methodology for assessment at the program level for the College of Engineering, that can be integrated as seamlessly as possible to the academic dynamic of the courses offered by the College of Engineering, but also with a strong faculty participation in the design of the assessment plan and process, providing a case study that not only integrates what has been achieved by the institutional process, but builds upon it. The complete documentation regarding the Assessment Plan for the College of Engineering may be found in the corresponding document, separate from this program review document

To assess the program level specific outcomes the following stages were defined:

1. <u>Definition of rubrics.</u>
   Faculty for each campus defines a proposal of the type and format for the rubrics to be applied during the semester. These proposals are analyzed by the Academy as a group and validated for use.

2. <u>Definition of period for assessment.</u>
   At the beginning of each semester, the Academy will define which rubrics will be applied during the semester.

3. <u>Identification of courses where assessment will be applied.</u>
   Based upon the curricular mapping for the academic program, subjects are selected for assessment.

4. <u>Notification to faculty involved in assessment activities.</u>
   Faculty is notified and trained in the use of the rubric if necessary.

5. <u>Definition of learning activities and evidence.</u> Faculty select learning activities and evidence for assessment, according to the selected course and curricular mapping.

6. <u>Students upload their work to the electronic portfolio during the semester.</u>

Students do the assigned learning activity and upload their work to the electronic portfolio.

7. Faculty evaluates and provides feedback to students.
Faculty evaluates student work using the previously designed rubrics and provides feedback to the students, as well as a general summary of assessment results.

8. Faculty generate a summary of assessment results.
Each faculty member generates a summary of assessment results for student learning based upon the selected course and rubric.

9. The Academy analyzes the summary of assessment results.
The Academy analyzes assessment results as a group, identifying areas of opportunity and improvement. If expected learning is not achieved, then an action plan is defined. The analysis of assessment results seeks to answer the question: what does this data mean with regards to student learning?

The College of Engineering began implementing the program review process in 2010 with all its academic programs, starting with the institutional learning outcomes that were applied to all the offered programs. In the first half of 2012 the SLO_IMEC2 was evaluated, in the second half of 2012 the SLO_EN1 being common for all engineering programs and in the first half of 2013 the SLO_EN2 SLO_IMEC3 are being evaluated.

For the first half of 2013 (January-June 2013):

1) Learning Outcomes Selection: The Academy decided that, for this cycle, learning assessment SLO_IMEC3 will be applied.

2) Selection of subjects for evaluation: Based on the range of courses for the semester from January to June 2013, 3 courses were selected from the Mechatronics Engineering program for their evaluation.

CODE	SUBJECT	SEMESTER	PROFESSOR
MF402-02	Computer Manufacturing	4	Ing. Maribel Lazcano
CE061-01	Industrial Automation and Robotics	6	Ing. Yamel Ungson
CE064-01	Modeling mechatronic prototypes	8	Ing. Luis Soto Zamorano
MF402-K4	Computer Manufacturing	4	Ing. Juan Pablo Geraldo
MF402-4K	Computer Manufacturing	4	Ing. Juan Pablo Geraldo
CE061-K6	Industrial Automation and Robotics	6	ISE Arturo Javier Escoto Méndez
CE064-K8	Modeling mechatronic prototypes	8	ISE Arturo Javier Escoto Méndez

1) Training of faculty: We trained the group of professors who teach the subjects to participate in the evaluation cycle.

2) The assessment during the semester: The assessment cycle was deployed during the semester August-December 2012 and the results, including evidence of learning, were collected by each program coordinator.

3) Analysis of results: The results were analyzed by each school during the first half of 2013 and have been integrated into the documentation of the program review.

4.5 Learning Assessment Outcomes

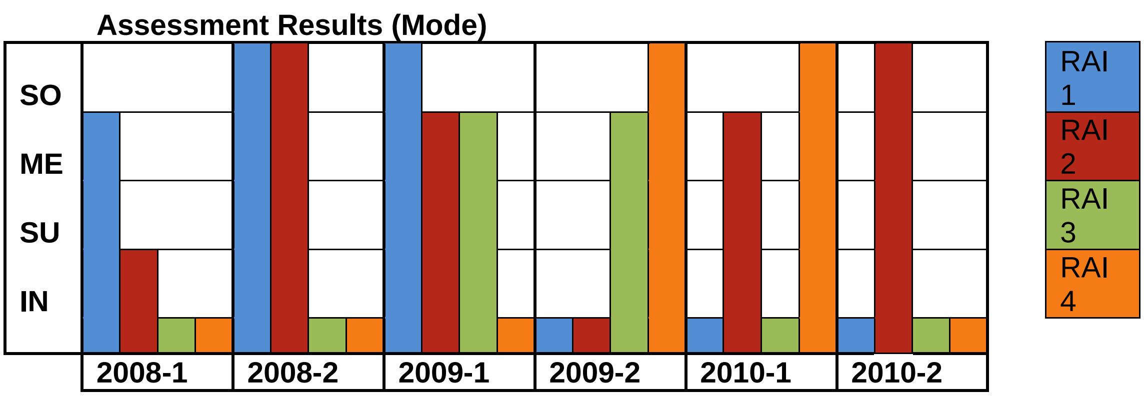
Much work has been done at the institutional level with regards to Assessment. An assessment plan and program began in 2008 with a focus on the gradual and systematic assessment of all institutional level learning outcomes for all academic programs. This has been a work in progress, in which areas of improvement have been identified and addressed, such as faculty participation and the integration and use of the electronic portfolio.

The institutional assessment process now gathers and stores information via the electronic portfolio, which is a custom design, developed by the Information Technologies Department of CETYS University.

The results of the assessment of institutional learning outcomes are delivered to the Deans of the Schools of Engineering at the end of each assessment cycle, which are by semester. The academies use this information as general input for the program review process.

INSTITUTIONAL ASSESSMENT RESULTS.

The results presented to the Academy by the CDMA (Center for Academic Development and Improvement) in the "Institutional Assessment Report Summary" are as follows:



Where: IN = Insufficient
SU = Sufficient
ME = Improvable
SO = Outstanding

RAI1 = Clear and effective communication in Spanish
RAI2 = Continuous learning
RAI3 = Critical thinking
RAI4 = Cultural diversity.

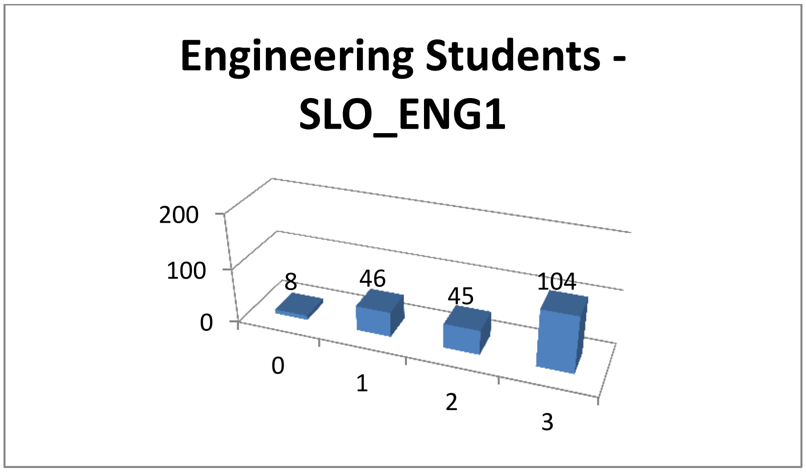
In general terms, the assessment results show a variation in learning achievement levels in each of the four institutional learning outcomes, without achieving outstanding or improvable levels consistently. This may be due to various factors that should be analyzed in conjunction with the Centers for Student Development (CEDEs) of each Campus.

Work has been done to support student development through the CEDEs of each Campus, due to the diverse academic achievement profiles of our students. This is done via workshops and student monitoring in conjunction with the academic coordinators. However, the academy identifies the importance of the course offering and content for fundamental areas relating to the four institutional learning outcomes.

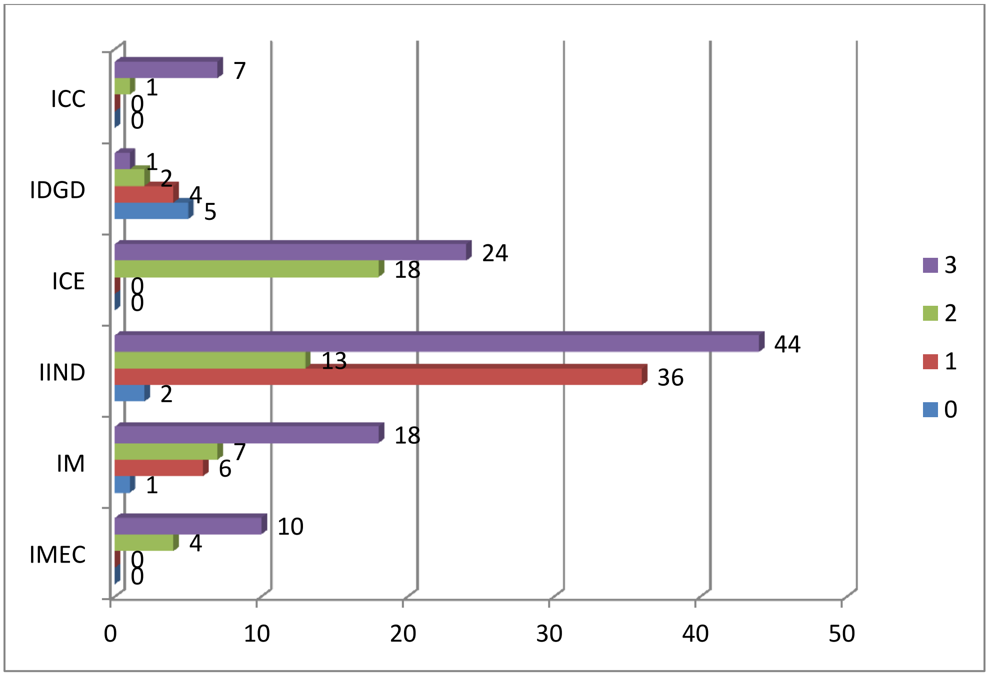
Also, the Academy identifies a need to disaggregate data for each academic program to provide program specific information regarding institutional assessment for program review purposes.

PROGRAM ASSESSMENT RESULTS.

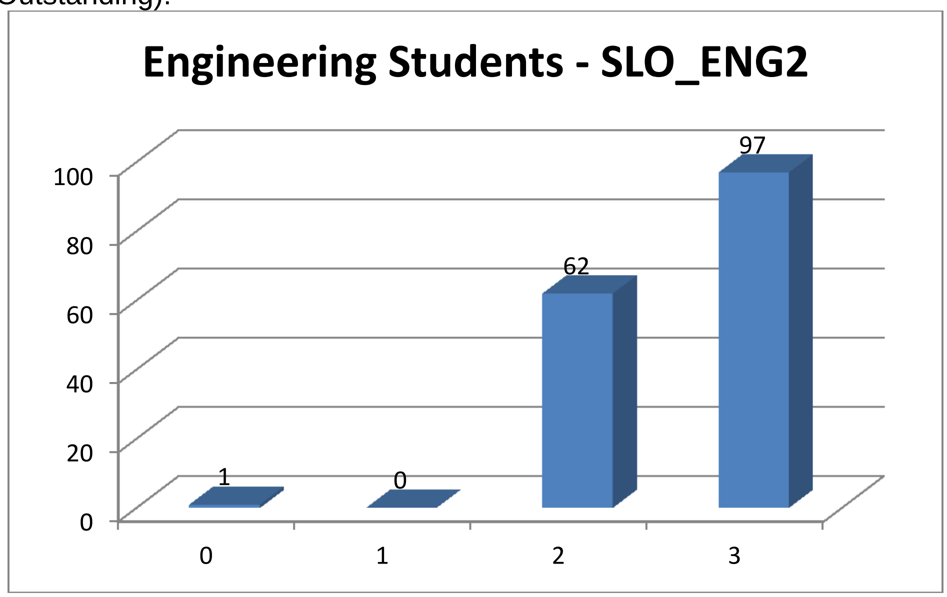
With regards to SLO_ENG1 (… problem solving…), in general, 74% of engineering students obtained learning achievement levels of 2 or 3 (Reinforcement/Improvable, Evaluation/Outstanding):



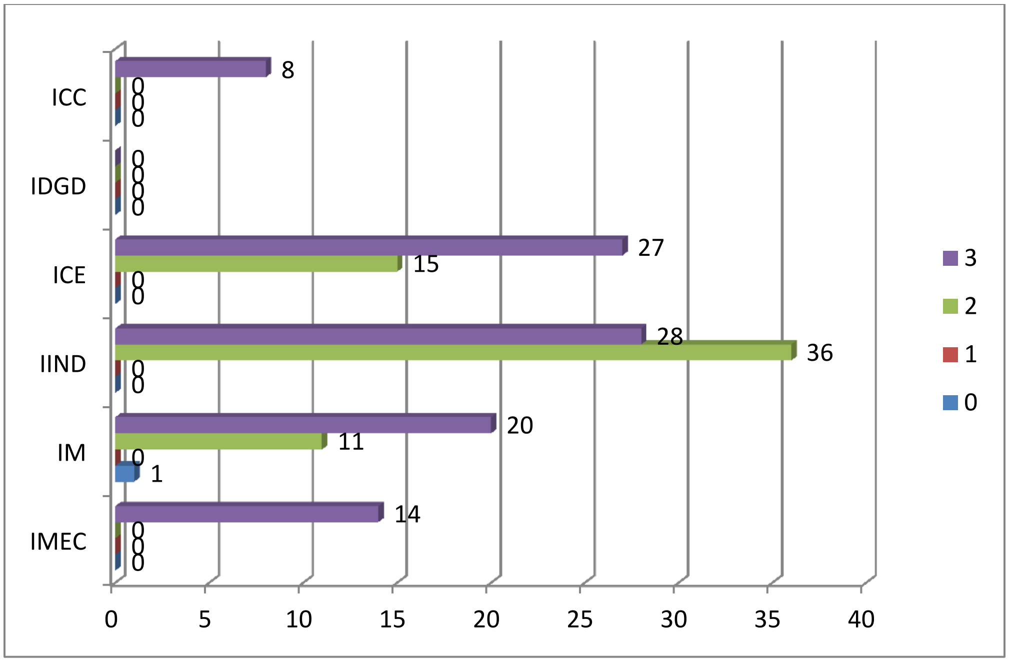
For this same learning outcome (SLO_ENG1), Mechatronics Engineering students, 100% obtained learning achievement levels of 2 or 3 (Reinforcement/Improvable, Evaluation/Outstanding):



Regarding to SLO_ENG2 (… project management…), in general, 99.3% of engineering students obtained learning achievement levels of 2 or 3 (Reinforcement/Improvable, Evaluation/Outstanding):



For this same learning outcome (SLO_ENG2), Mechatronics Engineering students, 100% obtained learning achievement levels of 2 or 3 (Reinforcement/Improvable, Evaluation/Outstanding):



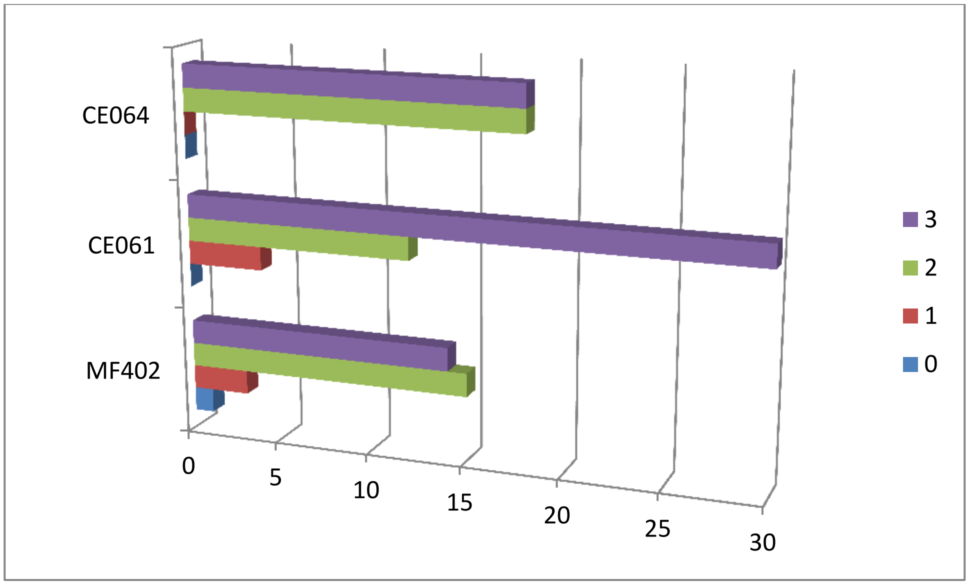
For the January-June cycle of 2013, the learning measuring process focused on assessing Learning Outcome Program designated as SLO_IMEC3, this was measured in three different subjects taught in the Mexicali and Tijuana campuses.

The trend of the results obtained in each subject for all students who were tested, are shown in the following table:

Subject	**Assessment results (MODE)**
Computer Manufacturing	Level 2 = In process (DE) (It is equivalent to Sufficient scale based on Institutional measurement)
Industrial Automation and Robotics	Level 3 = Exemplary (EX) (Equivalent to outstanding performance based on Institutional measurement)
Modeling mechatronic prototypes	Level 3 = Exemplary (EX) (Equivalent to outstanding performance)

The results correspond to the level expected in the program curriculum map that appears in 3.2.

A summary of the results of the evaluation in the three campuses is shown in the following chart:



In this chart it can be seen that MF402 and CE061 courses meet expected levels, however in the course CE064 was not achieved that most students have the required level.

4.6 Improvement actions derived from the learning assessment

With the evaluations that have been carried out to this moment, the academy has realized that it is necessary to improve the learning assessment plan. This has been done until now by selecting the courses that contribute to the measured learning and choosing the groups in which Mechatronic Engineering students are enrolled.

As a result of the analysis of the global summary of assessment results, the academy came to the following conclusions and areas of opportunity:

- The results were consistent in both the Mexicali and Tijuana Campuses.
- The results are acceptable and are congruent with student learning expectations according to the current curricular mapping done for the academic program.
- We found the need to standardize the measurement process of learning outcomes of the program and to include the three campuses in measuring those results.
- Based on the need found, the Academy has to develop a learning measurement plan that will begin in August 2013.
- The program measurement plan will be carried out in parallel with institutional and engineering measurement plans, in order to obtain short-term feedback and to establish improvement actions.
- The improvements resulting from the learning measurement results will impact in restructuring programs, changes in infrastructure and convenient actions to achieve the learning outcomes set by the program.

4.7 Student performance in CENEVAL's EGEL

The performance levels obtained in CENEVAL's EGEL have presented variations in the different generations, which is normal due to the variations in students. The fact that the first generations of graduates took the test in Mechanical Electrical Engineering, because CENEVAL did not have a test on Mechanical Engineering has also influenced this.
It is desirable that students that take the test obtain at least satisfactory performance, to prove that they can apply the knowledge and skills learned throughout the program.
In the results of the generations that have graduated in Mexicali, it can be seen that no student has obtained outstanding performance (DSS), only 27.5% obtained satisfactory performance (DS) and the majority of students, 72.5%, obtained NOT satisfactory performance (ANS).

- **Fifteen students presented the exam, of which none was honored as Outstanding Performance (0.0%), six as Satisfactory performance (40.0%) and the remaining nine (60.0%) did not get any of these.**

- **This test consists of four areas: Technology Integration for Mechatronic Systems Design, Products and Processes (DMSPP) Process Automation (PA), Research, Innovation and Technological Development (IIYDT) and Mechatronic Systems Coordination (MSC). The results are summarized in the following table:**

AREA	STILL NOT SATISFACTORY	SATISFACTORY	OUTSTANDING
DMSPP	26.0 %	66.6 %	6.6 %
AP	53.3 %	46.6 %	0.0 %
IIYDT	60.0 %	40.0 %	0.0 %
CSM	60.0 %	40.0 %	0.0 %

The results shown in the table for this program suggest that all areas included in the review are a priority to strengthen. However it is emphasized that there was a great improvement over the 2012 results. All this is based on the fact that we want to bring our graduates to have outstanding performance in all areas.

Taking the historical facts into account, in the two past years the percentage of satisfactory performance has increased, but the fact that there are no students that achieve outstanding performance is a point to review, mainly because the orientation of EGEL changed.

Year	Total students	TDSS	TDS	ST
2013	15	0	6	9
2012	11	0	4	7
2011	17	0	2	15

2010	19	0	5	14
2009	17	0	4	10
2008	1	0	1	0

4.8 Program accreditations and recommendations

The Mechatronics Engineering program is accredited by the Accreditation Board of Engineering Teaching CACEI (*in Spanish: "Consejo de Acreditacion de la Enseñanza de la Ingenieria"*), from 2013. The recommendations from this organization are:

1.- Strengthen the equipment and laboratory safety measures according to the requirements of the curriculum, as well as manage the expansion of some of the spaces.
2.- Increase and update the book collection of the program.
3.- Increase the number of research and / or technological development projects with the participation of students.

This year, the program of Mechatronics Engineering of Tijuana Campus has changed its CACEI accreditation process. They are awaiting results.

In Ensenada Campus, the program is currently not accreditable, since the full program has not been taught yet and it does not have several generations of graduates.

4.9 Follow up on the recommendations of the accrediting bodies

Currently, a plan is being developed to address the recommendations made by CACEI to the program. In addition to this plan, it is important to note that the construction activities of the building for the Center of Excellence in Design and Innovation are about to begin. The School of Engineering and several additional laboratories will be located in this building. It is also important to mention that CONACYT-EMPRESA projects are being developed with the participation of students and faculty of the program.

4.10 Faculty productivity

The faculty of engineering colleges in addition to their work as professors carry out various scientific researches related to research lines in: manufacturing, aerospace design, renewable energy, software development. These research areas have been defined as part of the needs identified in the 2020 plan of CETYS University System. The results of this research are published in articles by professors in conferences, articles in journals and books.

Another important activity of the faculty is industry-related projects which most times are funded through the stimulus for innovation awarded by organizations such as CONACYT. These projects arise from innovation needs of Industry to improve their products and /or manufacturing processes, these Companies go to CETYS asking for support in the specialty areas of the University.

The services required to the Institution are basically giving technical consultancy to develop an engineering project such as making an innovation. The results of these investments are documented as technical reports which describe that participation involved with the company, main activities and results obtained.

To CETYS is important that professors are continually conducting research, publishing and participating in projects linked to the industry. For this reason CETYS supports and recognizes professors for their productivity. The help provided to professors, who conduct research and publish, consists in give a balance in the quantity of courses assigned, one less course than normal quantity of courses (four instead of three courses); so professors have the time to publish and conduct research.

Each year CETYS University launches a call with different categories to invite professors to participate in the award given to those with more publications, research and partnership activities with the industry.

Faculty productivity is considered in the following aspects:

-Publications: articles in conferences, articles in journals, books

-Participation in projects in partnership with the industry

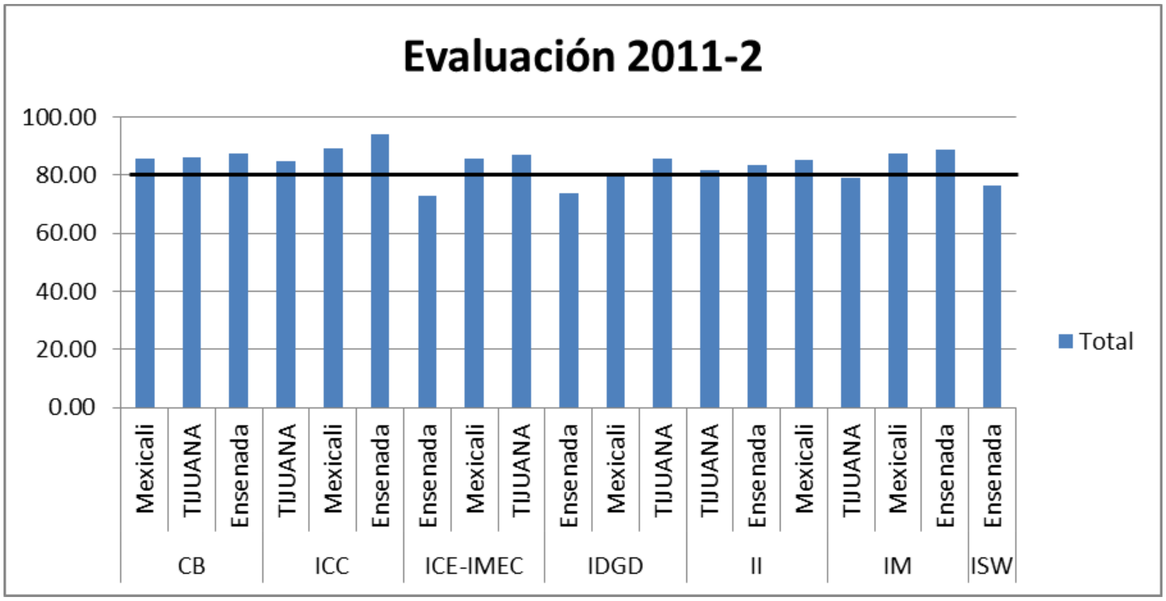
-Certifications and trainings

-Patents

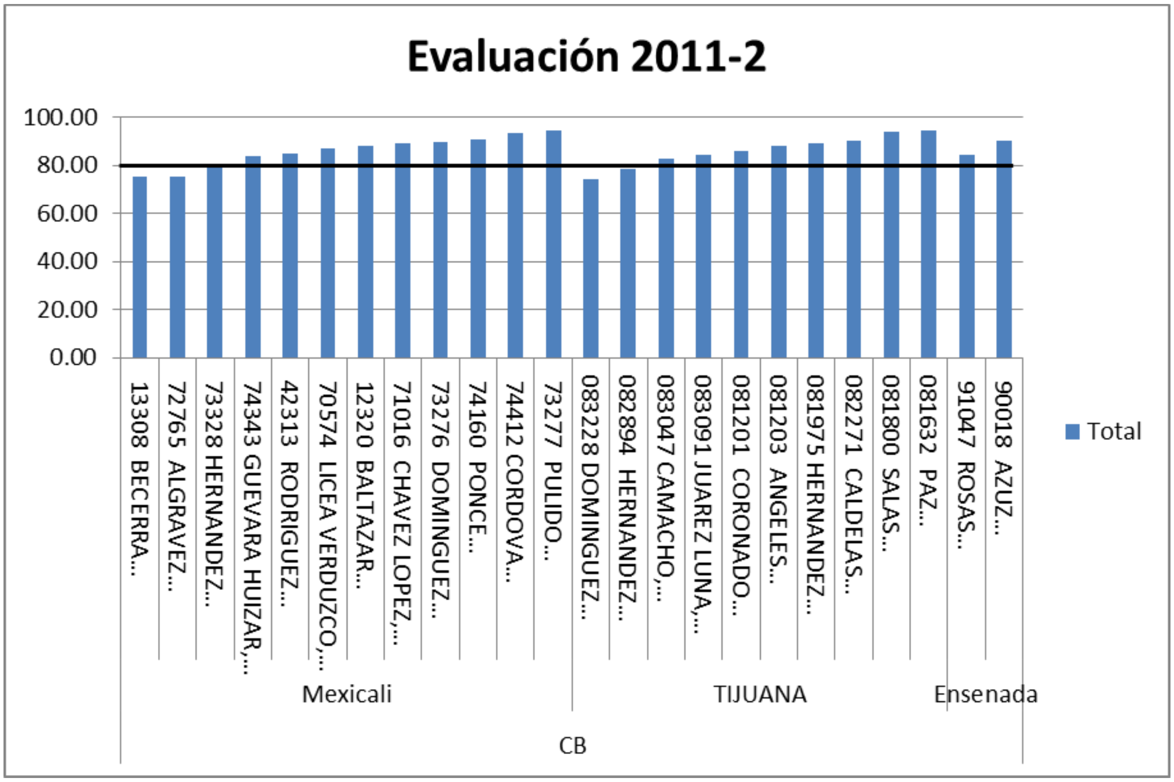
-Level of SNI (National System of Researchers).

4.11 Faculty evaluation

Evaluations presented are collected from the professor evaluation system, and the last two semesters are presented as a sample, from August to December, 2011 and 2012. As it is shown in the chart, the overall level has an evaluation in 8 out of 10 as a minimum, which is Tijuana campus, however overall it is a good evaluation.



As shown in the chart, all professors from Tijuana and Mexicali who teach mechatronics exceeded the minimum required by the engineering school. In Ensenada the results show that there are opportunities for improvement.


Evaluación 2011-2
100.00
80.00
60.00
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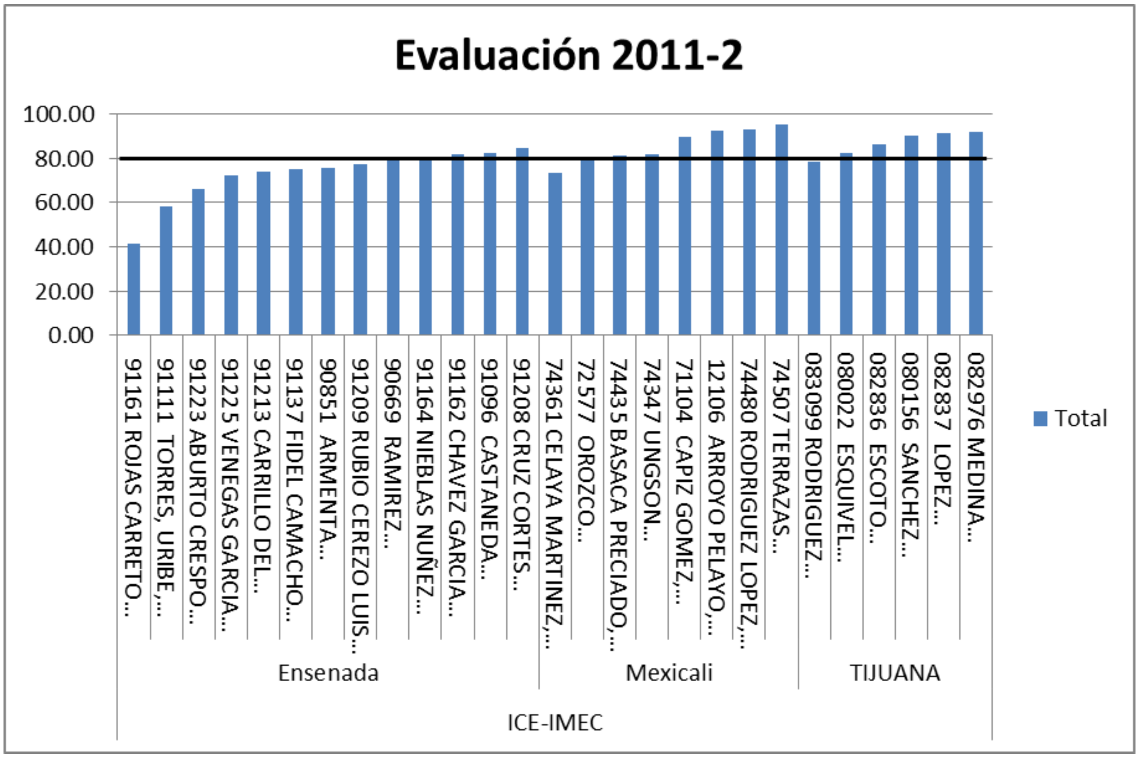
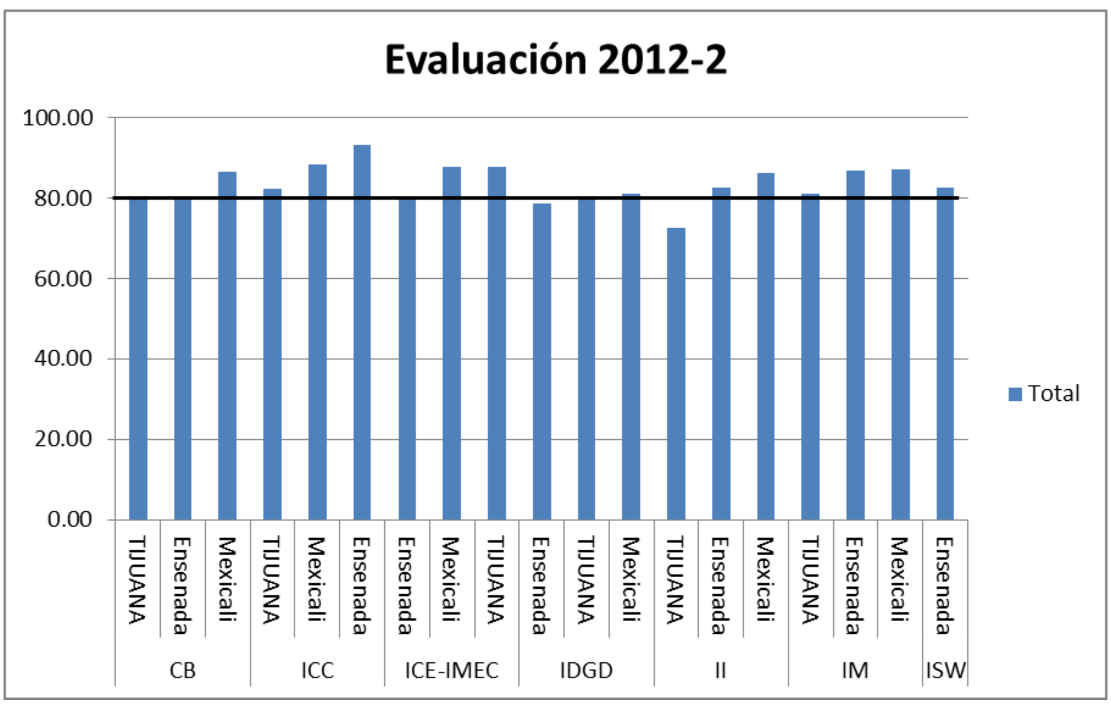
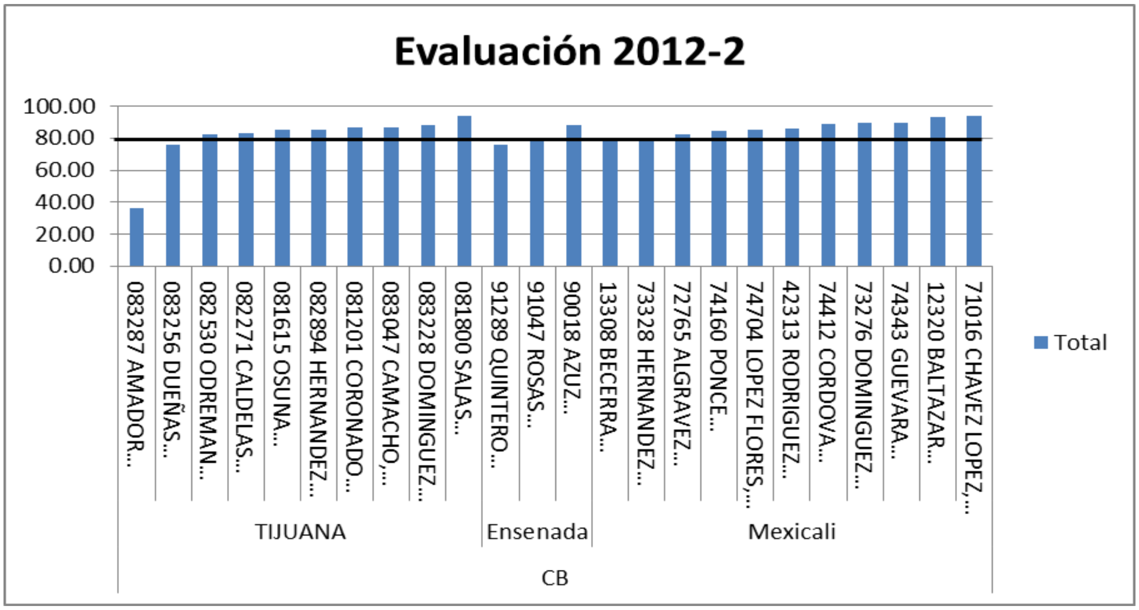
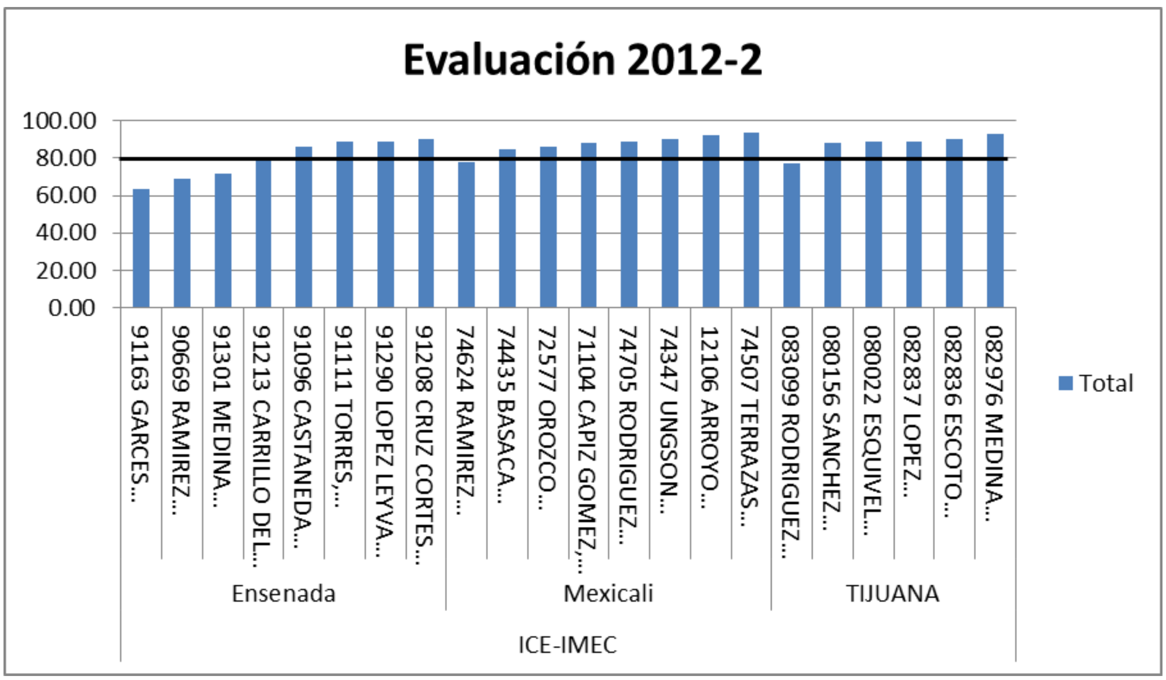
13308 BECERRA...
72765 ALGRAVEZ...
73328 HERNANDEZ...
74343 GUEVARA HUIZAR,...
42313 RODRIGUEZ...
70574 LICEA VERDUZCO,...
12320 BALTAZAR...
71016 CHAVEZ LOPEZ,...
73276 DOMINGUEZ...
74160 PONCE...
74412 CORDOVA...
73277 PULIDO...
083228 DOMINGUEZ...
082894 HERNANDEZ...
083047 CAMACHO,...
083091 JUAREZ LUNA,...
081201 CORONADO...
081203 ANGELES...
081975 HERNANDEZ...
082271 CALDELAS...
081800 SALAS...
081632 PAZ...
91047 ROSAS...
90018 AZUZ...
Mexicali
TIJUANA
Ensenada
CB
Total



When analyzing professor evaluations we can see that there are opportunities for improvement in some of them that are below the standard, of at least 8 out of 10. To improve professors that get low points, there is a “Teaching Improvement Program” which professors are invited to attend.







In the evaluation of the second half of 2012 may see an improvement in the results due to actions such as the "Teaching Improvement Program".

5. External revision of the program

5.1 Academic profile of the external reviewers

Salomón Oldak, Ph.D.
Professor
Electrical and Computer Engineering Department
Cal Poly Pomona

5.2 Recommendations of the external reviewers

1. Program of Studies

This reviewer finds the program of studies well in sync with the industrial local needs, technologically current and although not part of this review, aligned with most of ABET requirements. The General Education, as well as the Core components of the program, both in depth and breadth, are very similar to those of most other Bachelors leading to Engineering Degrees.

This program deserves special commendation in their requirement for the completion of 400 hours of Professional Practice. This requisite gives the student invaluable practical experience and a fast path to obtain employment after graduation.

Recommendations for improvement:

This reviewer pointed out during the visit, a couple of issues on the curriculum:

a. Most students entering Engineering programs in México have good fundaments of pre-calculus as this is a High School requirement for graduation in the Physics-Mathematics concentration area. It seems therefore redundant to require from these students to take a class like MA400 in the first semester. For the few students that do not follow the typical path towards engineering this class could be required as a remedial course.

   This reviewer would like to recommend removing this class from the program of studies, and beginning teaching Differential Calculus on the first semester, without changing the order of the rest of the math courses. This leaves and empty spot on the fifth semester that was occupied by Multivariable Calculus, (which would now be taught on the fourth semester. Fill in this spot with a Control Systems class (see b.).

b. It is the opinion of this reviewer that the Mechatronics plan of studies would benefit enormously with the inclusion of a Control Systems class inasmuch part of the curriculum deals with Automation. A good understanding of the benefits and perils of Feedback would clarify certain aspects in consequent classes such as Sensors and Actuators that specifically covers closed loop systems. Moreover students have expressed their desire of having such a class included as part of their program of studies (see below in section 3).

c. The program is inflexible in the sense that it lacks Elective classes. Some have expressed their desire to be able to deviate a bit from the program of studies and be able to take towards credit some classes beyond the current offerings students (see section 3). While this would be hard to accomplish in its current form, future program reviews may want to include the possibilities of the inclusion of Elective classes.

d. The program puts emphasis on traditional Materials and their use in manufacture. However in the last decade there has been significant research and applications in nanotechnology, MEMS, biomaterials and similarly related topics. This reviewer recommends introducing these subjects in the curriculum as part of one of the classes that covers Material Science.

2. Faculty

Without exceptions all the faculty members this reviewer met seem to be enthusiastic, engaged and very willing to participate in the accreditation process. Everybody had a good understanding of the accreditation process and its requirements. Moreover there was a very active and productive exchange of ideas where the CETYS faculty seemed to be very receptive. The formal and informal talks showed a high degree of professionalism, competency and state of the art technical knowledge in their respective areas.

Also the campus split between Mexicali, Tijuana and Ensenada does not seem to be a significant issue. Faculty members visit on a regular basis each other campus or coordinate meetings and solve issues electronically.

3. Students

This reviewer met alone with a class of about 30 students studying towards the B.Sc in Mechatronics Engineering. Students were vocal, opinionated and very willing to express their thoughts.

A vast majority of students conveyed their satisfaction with the school and its programs. A huge majority indicated that they would recommend the school to others seeking Engineering degrees.

Students were particularly happy with the Professional Experience program and the way it works. Also they were very positive about the local employment opportunities, the perception that Industry has of their education, and the ease in which they may be incorporated into Industry immediately after graduation.

About 20% of the students indicated their willingness to further their education beyond graduation with graduate studies either in México, in the United States of America or in other countries.

Students brought up the concern of the lack of Elective classes in the program. They also feel that the program lacks focus on Automation and Robotics until the very end; they complained about not having a Control Systems class in their curriculum, and would like to have more Robotics oriented classes.

Students feel that the program of studies is organized in a way in which all the mechanics classes are covered, followed by the electronics, followed by networks, etc. They expressed their desire to see a shuffle of these classes throughout their studies.

In the lab area, students criticized the lab equipment; for example infrastructure problems with the CNC machine and the fact that all lathe machines are manual. They would also want to have easier access to prototype machines such as the 3D printer. Also be able to work with a diversity of materials such as wood and plastic as opposed to metals.

Finally students expressed their desire to have a "unifying project" that would distinguish them from other programs at CETYS and would lead them to national and international competitions.

Recommendation:
This reviewer believes that part of the complaints expressed by students, specially the one about having their own identity within Engineering at CETYS, could be addressed by the inclusion of a Student Chapter of the International Student of Automation (ISA). ISA currently has sections in México D.F., Tampico and several in Southern California. (www.isa.org). CETYS could join one of the existing sections.

4. Physical Installations

a. Classrooms

This reviewer visited some classrooms and conference halls. All of them seemed to be well equipped with multimedia equipment, Internet ready with either cabled or wireless connections. All installations are modern comfortable, and conductive to a learning environment.

b. Laboratories

The reviewer visited several laboratories. Labs have a combination of old and new equipment. It seemed to this reviewer that lab equipment is insufficient to handle the demand of one concurrent student section; sections have to be split either in time or equipment to accommodate demand.

Recommendation:

Given the hands on inclination of the Mechatronics Engineering program this reviewer feels that it is very important for the school to have state of the art, sufficient equipment to meet student needs. It is therefore recommended that further funding is sought to improve laboratory equipment upgrade older instruments and get sufficient equipment to be able to handle concurrently one full section of students.

6. Conclusions and long-term goals (4 years) for the program

Several conclusions have been made with the obtained results. Some were made with this analysis and others noticed by the members of the academy. One area of opportunity with a lot of improvement potential is the curriculum, which will have to be modified to better comply with the profile of Engineer we desire.

6.1 Goals and capacity challenges

In the distribution of subjects taught by type of professor, it can be noted that the majority of the subjects specific to the program are taught by adjunct professors. It is necessary to have full-time professors in the program. At least one professor per area in the mechatronics program is needed. These professors can be distributed in the different campuses. It is also necessary to facilitate that the professors that already teach the program are able to continue their academic and professional development. ***CACEI, WASC, AIMEC.***

The distribution by areas of study has a strengthening toward the area of analysis and mechanical design, which is one of the main characteristics of our graduates. It is considered that there is a deficit in the number of courses in these areas. There is a deficit in laboratory hours for subjects that require them due to lack of equipment, laboratory space and human resources. A change in the order of some subjects is suggested. It is necessary to put subjects of electronics in lower semesters. ***AIMEC*** which will help the program not to look like two separate entities.

The recommendations of the external reviewer regarding the curriculum are the following: The Mechatronics curriculum will benefit greatly from the inclusion of the Control Systems subject, ***SO*** which has been shown with the EGEL results. The program is not flexible in that it lacks elective subjects; it is desirable to include the possibility of elective subjects, ***SO*** which has been a request of the students that have curiosity in other areas and would facilitate the selection of subjects in academic exchanges. The program emphasizes traditional materials and their use in fabrication; however, there has been considerable research and applications in nanotechnology, MEMS, biomaterials and related topics in the last decade. ***SO***

There is a plan currently under development to address the recommendations made by CACEI to the program, in which the main recommendations are laboratory equipment and bibliographic collections.

In addition to this plan, it is important to note that the construction activities of the building for the Center of Excellence in Design and Innovation are about to begin. The School of Engineering and several additional laboratories will be located in this building.

It is also important to mention that there are CONACYT-EMPRESA projects in development, where students and professors of the program are participating. The main objective here is to increase the participation of students.

Establish agreements with universities that offer degrees in Mechatronic Engineering, ***AIMEC*** since there is only one program that offers the degree in administration and is limited by the reduced flexibility of the program.

Offer online options for subjects that do not have strong activities in the laboratory and/or analysis and give incentives to the professors who design them. ***AIMEC***, which is a CETYS tendency but it is not possible to apply in all subjects of the curriculum. Participation in this type of option has been started with one course that was considered the best to be taught online.

Open opportunities for students to do their professional practice in Research Centers. ***AIMEC***

6.2 Goals and effectiveness challenges

After analyzing the situation of how the program allows the students to achieve everything that is expected from them at the end of their program, the following challenges and recommendations were made:

Establish remedial classes in the areas of Mathematics and Information Technology for students who received less than 1,100 points in the admission test. ***AIMEC*** This is expected to lower the failing and dropping out rates of new entry students.

It seems redundant for students with pre-calculus to want to take a subject such as MA400 in the first semester. The few that do not follow the typical way of this engineering course, could take a remedial class. This is a suggestion of the external reviewer to leave a space of material in the curriculum; however, it is necessary to review the administrative aspects of this recommendation.

Regarding learning measurement, the results obtained by generations according to the measurement plan must be analyzed. ***AIMEC.*** This measurement plan must be analyzed and make known to every professor in the program. ***AIMEC.*** This will achieve better participation and making of products adequate to what needs to be measured.

Also, conducting longitudinal studies of each student. ***AIMEC*** This will allow knowing how each student improves throughout the program.

Affliliation to a student chapter of International Student of Automation (ISA). ***SO.*** Or to any other student organization to establish an identity as Mechatronic Engineers that lowers the dropout index due to aspects of identification with the program.

Regarding the performance obtained in CENEVAL's EGEL, an analysis of the subjects and their content must be made, ***AIMEC.*** and then decide how much the orientation of the wanted program is aligned with the EGEL profile, to increase the number of subjects to cover the spectrum of contents in the EGEL test ***AIMEC*** to comply with the desired profile.

Regardless, students are at least expected to achieve satisfactory performance in EGEL. To reduce the cases where students only attend the test but not give their best effort, it is suggested that the students who obtain ANS performance are not candidates to academic recognition. ***AIMEC***

It is necessary to introduce studies of correlation between the evaluation of the students and the evaluation the professor makes about the students (absences, final grade, averages and standard deviation) ***AIMEC***

Establish incentives and provide opportunities in time and resources to professors so that they can publish ***AIMEC***. Support professors for affiliation to different magazines and research centers. ***AIMEC.***

Establish activities that promote EDECs (Distinctive Elements of CETYS Education) and ways to evaluate them. ***AIMEC*** By putting these activities explicitly in courses, it will help make sure that the students have enough activities to develop these elements.

7. Attachments

CACEI

CONSEJO DE ACREDITACION DE LA ENSEÑANZA DE LA INGENIERIA A.C.

COMITÉ DE ACREDITACIÓN – ACTA NÚMERO MIL CUATROCIENTOS NUEVE

México, Distrito Federal, siendo las diez horas del día quince de febrero del año dos mil trece, dio inicio la sexagésima reunión del Comité de Acreditación del Consejo de Acreditación de la Enseñanza de la Ingeniería, A.C. bajo la Presidencia del Ingeniero Fernando Ocampo Canabal y actuando como Secretaria la Maestra en Ciencias Lucinda González Ruiz, para emitir el dictamen sobre el Programa de INGENIERÍA MECATRÓNICA de la ESCUELA DE INGENIERÍA del CAMPUS MEXICALI del CENTRO DE ENSEÑANZA TÉCNICA Y SUPERIOR, con base en la recomendación de la Comisión Técnica de la Especialidad correspondiente y el Reporte del Comité Evaluador integrado por la Maestra en Ciencias Lucinda González Ruíz como Coordinadora y como Evaluadores la Doctora Patricia Quintero Álvarez y el Ingeniero Alfredo González Ruíz. El Comité acuerda otorgar LA ACREDITACIÓN a dicho Programa por un período de CINCO AÑOS a partir del día quince de febrero del año dos mil trece, durante el cual éste deberá atender en forma oportuna las recomendaciones más relevantes que se detallan a continuación y las incluidas en el reporte correspondiente, así como enviar a la mitad de la vigencia de esta Acreditación un informe escrito al CACEI sobre las acciones tomadas al respecto, mismo que deberá ser satisfactorio, ya que en caso de que no sea o bien no lo envíe, el Programa perderá la acreditación.

RECOMENDACIONES RELATIVAS A REQUISITOS MÍNIMOS:

2.3 Seguimiento de Actividades

Implementar mecanismos que den seguimiento a las actividades de los profesores.

2.8 Integración

Incrementar el número de horas del grupo de Ciencias Básicas y Matemáticas impartidas por profesores de tiempo completo, así como el del grupo de Ingeniería Aplicada con la experiencia profesional señalada, hasta alcanzar los mínimos señalados en el Manual del CACEI.

RECOMENDACIONES RELATIVAS A REQUISITOS COMPLEMENTARIOS:

2.6 Promoción

Fortalecer los mecanismos que permitan que los profesores puedan promoverse de acuerdo a su productividad.

5.5 Reprobación

Implementar mecanismo que lleven a disminuir el alto índice de reprobación en asignaturas que tienen esta problemática.

Ing. Fernando Ocampo Canabal Presidente	M. en C. Lucinda González Ruiz Secretaria
Ing. Ricardo Avila Angulo	M. en I. José Juan Contreras Espinosa
Ing. Angel Fernández Gamero	Mtra. Laura E. Gassós Ortega
Ing. Francisco Martín del Campo	M. en I. Mario Gómez Mejía
Ing. Clemente Reza García	Dr. José Luis Vargas López

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