
# WASC Accreditation
# Educational Effectiveness Review

**Bachelor's in Mechatronics Engineering.**
**The program is currently offered in the following Campi:**
**Mexicali, Tijuana and Ensenada.**

**Last Program Review: August 2005**

**Table of Contents**

## 1. **Introduction.**

The Mission of the Bachelor's in Mechatronics Engineering Program is to generate highly qualified professionals with profound knowledge of select fundamentals in materials, manufacturing processes, automation and industrial robotics, that are able to develop a successful professional life within the manufacturing industry as an employee or independent professional.

The Vision of the Bachelor's in Mechatronics Engineering Program is be the primary source in the region for professionals that provide solutions that require the applied knowledge of materials, manufacturing processes, automation and industrial robotics.

The Bachelor's in Mechatronics Engineering Program was launched in the Mexicali Campus in 2005, in the Tijuana Campus in 2006, and in the Ensenada Campus in 2005. The program has not yet undergone major reviews and it's first graduating class will finish in 2009.

## 2. Denomination and description of the academic program.

The Bachelor's in Mechatronics Engineering Program is focused on the following Primary Areas of Knowledge, also called Professional Formation Lines:

a) Mechanical Design.
b) Manufacturing.
c) Electronics.
d) Control.
e) Computer Systems.

To obtain the degree, a student must complete the following requirements:

- Accreditation of 42 courses (totaling 328 credits).
- Completing 400 hours of professional practice.
- Completing 500 hours of social service.
- Completing the corresponding EGEL examination administered by CENEVAL.
- Completing any of the degree obtainment requirements established by CETYS University.

The program has chairs by campus, who are full time faculty that are in charge of the program, and are involved in enrollment and promotional activities, student guidance and alumni follow up, program review, accreditation projects, etc. The program has chairs in the Mexicali Campus and Tijuana Campus, and none in the Ensenada Campus because only half of the program is offered there. The chairs are:

- M.S. Cristóbal Capiz – Mexicali Campus.
- M.S. Roberto Salas – Tijuana Campus.

The Academy of Mechatronics Engineering is currently comprised by faculty that are members of Academy of Electronic Cybernetics Engineering and the Academy of Mechanical Engineering:

- M.S. Cristóbal Capiz – Mexicali Campus
- M.S. Jorge Sosa López – Mexicali Campus
- M.S. Bernardo Valadez – Mexicali Campus
- M.S. Roberto Salas – Tijuana Campus
- Dr. Carlos Fuentes – Ensenada Campus

The students of the program are full time, primarily male and local, and most of the students receive some sort of financial aid, the primary one being the Pro-Engineering scholarship. Students enrolled in the Ensenada Campus do the first four semesters in the Ensenada Campus and finish the last four semesters either in the Mexicali Campus or Tijuana Campus.

The program currently has the following laboratories by campus:

- Mexicali: Physics, General Electronics, Mechatronics, Networks and Operating Systems, Machine Shop, Thermodynamics.
- Tijuana: Physics, General Electronics, Mechatronics, Networks and Operating Systems, Machine Shop, Thermodynamics.

| Student population - Mexicali | | | |
|---|---|---|---|
| **Semesters** | **Male** | **Female** | **Total** |
| **1 and 2** | 18 | 2 | 20 |
| **3 and 4** | 20 | 5 | 25 |
| **5 and 6** | 16 | 4 | 20 |
| **7 and 8** | 1 | 0 | 1 |
| **Total** | 55 | 11 | 66 |
| **Percentage** | 83.3% | 16.7% | 100% |

| Student population - Tijuana | | | |
|---|---|---|---|
| **Semesters** | **Male** | **Female** | **Total** |
| **1 and 2** | 37 | 4 | 41 |
| **3 and 4** | 23 | 4 | 27 |
| **5 and 6** | | | |
| **7 and 8** | | | |
| **Total** | 60 | 8 | 68 |
| **Percentage** | 88.2% | 11.8% | 100% |

| Student population - Ensenada | | | |
|---|---|---|---|
| **Semesters** | **Male** | **Female** | **Total** |
| **1 and 2** | 13 | 0 | 13 |
| **3 and 4** | 7 | 2 | 9 |
| **5 and 6** | 5 | 0 | 5 |
| **7 and 8** | | | |
| **Total** | 25 | 2 | 27 |
| **Percentage** | 92.5% | 7.5% | 100% |

August – December 2007 (SIA-CETYS)

**3. Educational Objectives of the academic program.**

The Educational Objectives that the Academy of Mechatronics have established for the Bachelor's in Mechatronics Engineering are the following:

- The graduate from this program will make at least one proposal to an industry for the automation of a production system.
- The graduate from this program will improve an existing manufacturing process by the means of the integration of electronic, pneumatic, etc. elements.
- The graduate of this program will integrate, install, probe, and assure the means of operation of electronic and/or mechanical based systems.
- The alumni from this program will be able to pursue graduate studies with success.
- The alumni from this program will be able to find a professional job within 6 months after graduation.
- The graduate from this program will be able to start his/her own business.
- The graduate from this program will be able to fill middle or top manager positions with in 3 years after graduation.

These Educational Objectives will be the primary focus for alumni studies and follow up, which will be used for various purposes during the assessment cycle, as well as program review.

## 4. Learning outcomes of the program and metrics for assessment.

There are 5 Learning Outcomes for all Engineering Bachelor's Programs that have been established by the Academies of the Engineering College, that describe knowledge, abilities and attitudes that every engineering student must achieve by the end of the academic program. These are:

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.

The Learning Outcomes that the Academy of Mechatronics Engineering have established for the Bachelor's in Mechatronics Engineering are the following:

The student of the Bachelor's in Mechatronics Engineering program will be able to…

- SLO_IMECA1: … design, implement and maintain the control and/or the automation systems in a manufacturing system by the usage of sensors, programmable logic controllers and actuators.
- SLO_IMECA2: … integrate computer systems to supervise, data acquisition and production control in manufacturing ambiances.
- SLO_IMECA3: … design, build, install and program robots for manufacturing.
- SLO_IMECA4: … design, select materials, machining and test mechanisms using numerical control equipment or basic metal-mechanic shop equipment.

The above student learning outcomes are a work in progress and are a part of the assessment cycle and program review, however we are just beginning to understand and develop tools to measure them.

| # | Student Learning Outcomes | Metrics to evaluate student performance | Evidence of achieved learning |
|---|---|---|---|
| 1 | SLO_ENG1 | Currently the system that is in place to evaluate student performance is a scale of 0 to 100, where a grade above 70 is considered as "passing" and below as "failing".<br>Rubrics for the Engineer College are being developed to evaluate these learning outcomes. The rubrics are being developed by the Academy of Basic Sciences in conjunction with the other Academies of the Engineering College. | Student Work and Final Projects from selected courses (i.e. Physics II and III, Statistical Inference, Programming Methods II, Numerical Methods).<br>EGEL Examination (Basic Sciences areas). |
| 2 | SLO_ENG2 | | |
| 3 | SLO_ENG3 | | |
| 4 | SLO_ENG4 | | |
| 5 | SLO_ENG5 | This learning outcome is measured by the English Language Center (ELC) using appropriate performance standards for the study of ESL. | Student work follow up administrated by ELC. |
| 7 | SLO_IMECA1 | Currently the system that is in place to evaluate student performance is a scale of 0 to 100, where a grade above 70 is considered as "passing" and below as "failing".<br>Rubrics to evaluate these learning outcomes are being developed by the Academy of Mechatronics Engineering. | Student Work and Final Projects from selected courses.<br>Employer reports from professional practice and social service activities. |
| 8 | SLO_IMECA2 | | |
| 9 | SLO_IMECA3 | | |
| 10 | SLO_IMECA4 | | |

The Academy of Mechatronics Engineering has the following members:

| **Name of the Academy or Faculty Coop: Academy of Mechatronics Engineering.** | | | | |
|---|---|---|---|---|
| **#** | **Name** | **Degree** | **Area of knowledge** | **Campus** |
| 1 | Cristóbal Capiz | Master's in Science | Digital Design | Mexicali |
| 2 | Jorge Sosa López | Master's in Science | Process Control | Mexicali |
| 3 | Bernardo Valadez | Master's in Science | Mechanical Design | Mexicali |
| 4 | Roberto Salas | Master's in Science | Physics | Tijuana |
| 5 | Carlos Fuentes | Doctorate | Process Control | Ensenada |

## 5. Curriculum and faculty resources.

| Bachelor's in Mechatronics Engineering | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **Full time faculty** | | |
| | | | | | | | | | **Name** | **Degree** | **Area** |
| **Fundamentals for Bachelor's in Engineering** | MA400 | MA401 | MA402 | MA407 | MA406 | | | | Alfredo Rodriguez<br>David Sánchez<br>Salvador Baltazar<br>Susana Dominguez<br>Jesús Sánchez<br>Isaac Azuz | M.A.<br>B.E.<br>M.S.<br>M.S.<br>B.E.<br>Dr. | Math, Stat<br>Math, Phis<br>Mah, Phis<br>Math, Phis<br>Math<br>Math, Stat |
| | CC400 | CC402 | MA403 | MA404 | | | | | | | |
| | | FI400 | FI401 | FI402 | | | | | | | |
| | | MC400 | | | | | | | | | |
| **Professional Formation in Mechatronics Engineering** | CE058 | MF400 | MF401 | MF402 | MC410 | CE061 | CE062 | CE065 | Cristóbal Capiz<br>Jorge Sosa López<br>Bernardo Valadez<br>Roberto<br>Carlos Fuentes | M.S.<br>M.S.<br>M.S.<br>M.S.<br>M.S. | Digital Design<br>Process Control<br>Mech. Design<br>Physics<br>Process Control |
| | | | | MC402 | CE059 | MC407 | CE063 | CE064 | | | |
| | | | | | MC404 | CE060 | CE414 | MC414 | | | |
| | | | | | | | CE401 | CE402 | | | |
| **General and signature courses** | CS401 | | ID400 | | EC400 | CS402 | | | Professors from Social Science Department. | | |
| | Cs400 | CS403 | CS404 | | | HU400 | HU401 | HU402 | | | |

Legend for courses:

| CODE | COURSE |
|---|---|
| MA400 | Mathematics for University |
| CC400 | Programming Methods I |
| MC400 | Computer Aided Drawing |
| MA401 | Differential Calculus |
| CC402 | Programming Methods II |
| FI400 | Physics I |
| MA402 | Integral Calculus |
| FI401 | Physics II |
| MA403 | Numerical Methods |
| MA404 | Probability |
| MA407 | Differential Equations |
| FI402 | Physics III |
| MA406 | Multivariable Calculus |
| CE058 | Introduction to Mechatronics |
| MF400 | Materials Properties |
| MF401 | Materials Manufacturing |

| CODE | COURSE |
|---|---|
| MF402 | Computer Based Manufacturing |
| MC402 | Mechanics of Materials |
| MC410 | Dynamics of Mechanisms |
| CE059 | Electronic Systems I |
| MC404 | Introduction to Design |
| CE061 | Automation and Industrial Robotics |
| MC407 | Electro-Pneumatics and Hydraulics |
| CE060 | Electronics Systems II |
| CE062 | Programmable Controllers |
| CE063 | Sensors and Actuators |
| CE414 | Power Electronics |
| CE401 | Computer Networks |
| CE065 | Microcontroller Based Design |
| CE064 | Mechatronics Prototype Modeling |
| MC414 | Heat Transfer |
| CE402 | Computer Networks Applications |

## 6. Curricular mapping.

| | | | ENGINEERING BACHELOR'S PROGRAMS STUDENT LEARNING OUTCOMES | | | | BACHELOR'S IN MECHATRONICS ENGINEERING STUDENT LEARNING OUTCOMES | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CURRICULAR ELEMENTS | | | SLO_ENG1 | SLO_ENG2 | SLO_ENG3 | SLO_ENG4 | SLO_IMECA1 | SLO_IMECA2 | SLO_IMECA3 | SLO_IMECA4 |
| CODE | COURSE | SEMESTER | LEVEL | LEVEL | LEVEL | LEVEL | LEVEL | LEVEL | | LEVEL |
| MA400 | Mathematics for University | 1 | SU | SU | | | | | | |
| CC400 | Programming Methods I | 1 | SU | SU | SU | | | SU | SU | SU |
| MC400 | Computer Aided Drawing | 1 | SU | SU | SU | | | | SU | |
| MA401 | Differential Calculus | 1 | SU | SU | | | | | | |
| CC402 | Programming Methods II | 2 | ME | SU | SU | SU | SU | SU | SU | SU |
| FI400 | Physics I | 2 | SU | SU | SU | | | | SU | SU |
| MA402 | Integral Calculus | 2 | ME | SU | | | | | | |
| FI401 | Physics II | 3 | ME | SU | SU | | | | SU | |
| MA403 | Numerical Methods | 3 | ME | SU | ME | | | | | |
| MA404 | Probability | 3 | ME | SU | | | | | | |
| MA407 | Differential Equations | 4 | ME | SU | | | | | | |
| FI402 | Physics III | 4 | ME | ME | SU | SU | SU | SU | SU | |
| MA406 | Multivariable Calculus | | ME | SU | | | | | | |
| CE058 | Introduction to Mechatronics | 5 | SU | SU | SU | SU | SU | SU | SU | SU |
| MF400 | Materials Properties | 1 | SU | SU | SU | SU | SU | | SU | ME |
| MF401 | Materials Manufacturing | 2 | ME | ME | SU | SU | ME | | SU | ME |
| MF402 | Computer Based Manufacturing | 3 | ME | SO | SO | ME | ME | | ME | SO |
| MC402 | Mechanics of Materials | 4 | ME | ME | ME | ME | ME | | ME | SO |
| MC410 | Dynamics of Mechanisms | 4 | SO | ME | SO | ME | ME | | ME | SO |
| CE059 | Electronic Systems I | 5 | ME | ME | ME | ME | ME | ME | ME | |
| MC404 | Introduction to Design | 5 | ME | ME | ME | SO | ME | | ME | ME |
| CE061 | Automation and Industrial Robotics | 5 | SO | SO | SO | SO | SO | SO | SO | ME |
| MC407 | Electro-Pneumatic ans Hydraulic Systems | 6 | ME | ME | ME | SO | SO | ME | ME | |
| CE060 | Electronic Systems II | 6 | ME | ME | SO | SO | SO | ME | ME | |
| CE062 | Programmable Controllers | 6 | ME | SO | SO | SO | SO | SO | | |
| CE414 | Power Electronics | 7 | ME | ME | ME | SO | SO | ME | ME | |
| CE063 | Sensors and Actuators | 7 | SO | ME | ME | SO | SO | SO | ME | SO |
| CE401 | Computer Networks | 7 | ME | ME | SO | SO | | SO | | |
| CE402 | Computer Network Applications | 8 | SO | SO | SO | SO | | SO | | |
| CE065 | Microcontroller Based Design | 8 | SO | SO | SO | SO | SO | SO | SO | SO |
| CE064 | Mechatronics Protoype Modelling | 8 | SO | SO | SO | SO | SO | SO | SO | SO |
| MC414 | Heat Transfer | 7 | ME | SO | ME | SO | SO | | | SO |
| CO-CORRICULAR ELEMENTS | | SEMESTERS | LEVEL | LEVEL | LEVEL | LEVEL | LEVEL | LEVEL | | LEVEL |
| CETYS University College of Engineering Projects Expos in each Campus | | 2,4,6,8 | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | | SU, ME, SO |
| CETYS University College of Enginerering Simposiums in each Campus | | 1,3,5,7 | SU | SU | SU | SU, ME, SO | SU | SU | | SU |
| Scholarships awarded by external institutions | | 1,2,3,4,5,6,7,8 | SU | SU | SU | SU, ME, SO | SU, ME, SO | SU, ME, SO | | SU, ME, SO |
| External engineering competitions | | 1,2,3,4,5,6,7,8 | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | | SU, ME, SO |
| Professional Practice | | 6,7,8 | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | ME, SO | ME, SO | | ME, SO |
| Social Sevice | | 6,7,8 | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | ME, SO | ME, SO | | ME, SO |
| Student Exchange | | 6,7,8 | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | ME, SO | ME, SO | | ME, SO |
| CENEVAL EGEL Examination | | 8 | SU, ME, SO | SU, ME, SO | SU, ME, SO | SU, ME, SO | ME, SO | ME, SO | | ME, SO |

Legend for levels used for curricular mapping:

**SU** ("*SUFICIENTE*") = SUFFICIENT.
**ME** ("*MEJORABLE*") = IMPROVABLE.
**SO** ("*SOBRASALIENTE*") = OUTSTANDING.

Legend for Student Learning Outcomes:

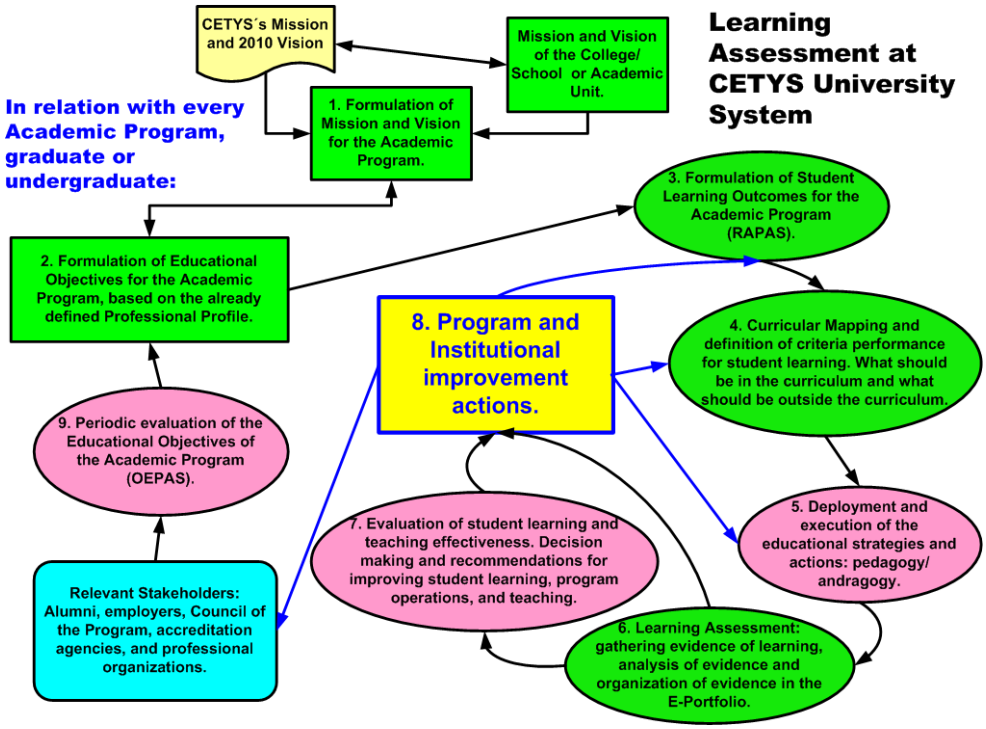
| **Engineering Bachelor's Programs.** The student of a CETYS University Bachelor's in Engineering Program will… | **Bachelor's in Mechatronics Engineering** The student of the Bachelor's in Mechatronics Engineering program will… |
|---|---|
| **SLO_ENG1**: …correctly apply to engineering, the tools provided by the basic sciences, such as physics, calculus, probability, statistics and programming to the solution of diverse problems. | **SLO_IMECA1**: … design, implement and maintain the control and/or the automation systems in a manufacturing system by the usage of sensors, programmable logic controllers and actuators. |
| **SLO_ENG2**: …design analytic and functional models, quantitatively and qualitatively, for the analysis and improvement of systems for diverse applications. | **SLO_IMECA2**: … integrate computer systems to supervise, data acquisition and production control in manufacturing ambiances. |
| **SLO_ENG3**: … effectively use software tools and technologies to build solutions to engineering problems. | **SLO_MECA3**: … design, build, install and program robots for manufacturing. |
| **SLO_ENG4**: … effectively design and manage projects. | **SLO_MECA4**: … design, select materials, machining and test mechanisms using numerical control equipment or basic metal-mechanic shop equipment. |

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.

This learning outcome is developed primarily via the co-curricular ESL program that all students must go through, and which is managed by the English Language Center. Some curricular courses contribute to the improvement of this learning outcome, like Advance Communication in English and selected courses from 5th semester onward.

## 7. Assessment plan.

Based on the Assessment Plan for CETYS University System:




Currently, the following actions have been done, with regards to the Bachelor's in Mechatronics Engineering Program, with the participation of faculty members from the Academy of Mechatronics Engineering:

1) Formulation of the Mission and Vision.
2) Formulation of the Educational Objectives.
3) Formulation of Student Learning Outcomes.
4) Curricular Mapping.

The assessment components that are currently in the process of being defined, but have not yet been developed and therefore have not been implemented are:

a) Definition of assessment tools for student learning to be used in the assessment of the Student Learning Outcomes.
b) Identification of key courses where evidence of student learning can be gathered.
c) Systematic gathering of evidence of learning and the analysis and organization of the evidence.