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". 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). 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". Rubrics to evaluate these learning outcomes are being developed by the Academy of Mechatronics Engineering.	Student Work and Final Projects from selected courses. 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 David Sánchez Salvador Baltazar Susana Dominguez Jesús Sánchez Isaac Azuz	M.A. B.E. M.S. M.S. B.E. Dr.	Math, Stat Math, Phis Mah, Phis Math, Phis Math 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 Jorge Sosa López Bernardo Valadez Roberto Carlos Fuentes	M.S. M.S. M.S. M.S. M.S.	Digital Design Process Control Mech. Design Physics 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:

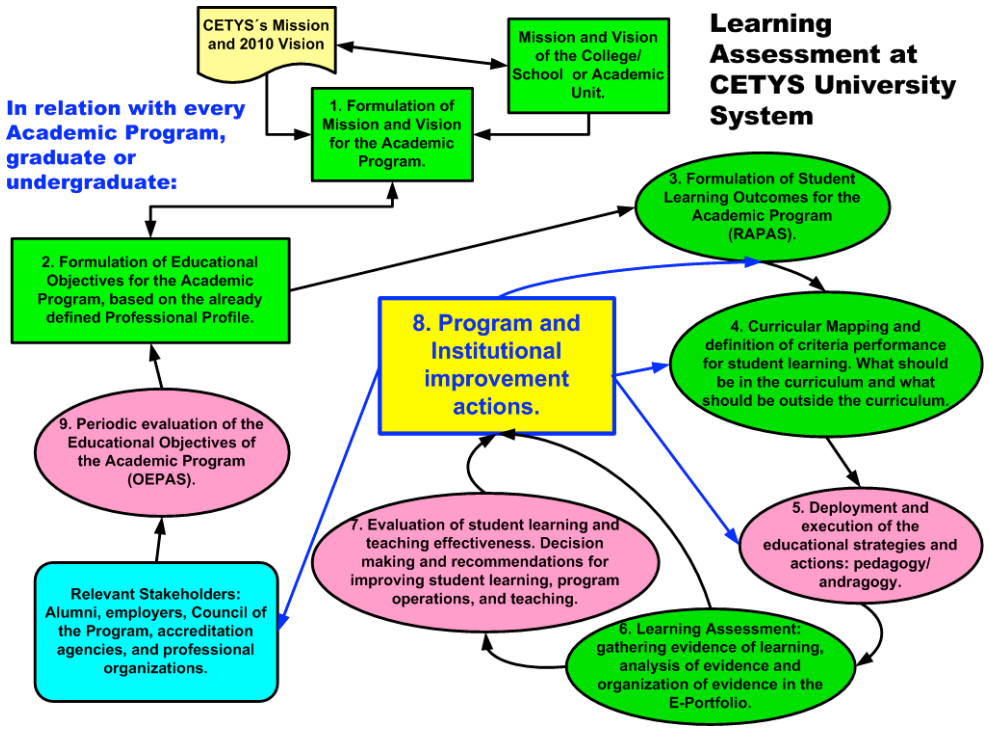
Engineering Bachelor's Programs. The student of a CETYS University Bachelor's in Engineering Program will…	**Bachelor's in Mechatronics Engineering** The student of the Bachelor's in Mechatronics Engineering program will…
SLO_ENG1: …correctly apply to engineering, the tools provided by the basic sciences, 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.