MECHATRONICS PROGRAM REVIEW, 2013

1.1 Introduction.

The Mechatronics program was created by blending the then existing Maintenance Technician and Electronics Technology programs to better support changing industry in Solano County. After full accreditation of the Mechatronics program was received in 2009 both the Maintenance Technology and Electronics Technology programs were terminated and have been removed from the college catalog. From the catalog:

> Mechatronics is the blending of electronics, mechanics, electrical. and computers to produce a well-rounded technician capable of handling the complex maintenance and operations tasks demanded by modern manufacturing, transportation, communication, and other industries. The modularization of electro-mechanical devices no longer requires in-depth specialization of a single field of study as more emphasis is placed on troubleshooting and replacement skills for maintenance and generalized knowledge of how systems work together for operations and purchasing and planning.

Curriculum was originally developed in close cooperation with the Solano County Workforce Investment Board and a manufacturing task force that was created to promote opportunities in Solano County. The only significant curriculum change in the program since 2009 has been the inclusion of an alternative energy course.

Mechatronics is a fully vocational program and not considered eligible for establishment as a transfer program in accordance with SB 1440. No efforts to date have been made to find transfer opportunities for the program or individual courses beyond those that existed when the program was created.

The original Electronics and Maintenance Technician programs were created when the College moved to Fairfield in the early 1970's as part of a full vocational department designed to support local industry. At the time the largest vocational employer in the County of Solano was Mare Island Naval Shipyard. The two programs were sending as many as 75 graduates a year to the Navy's apprentice programs at Mare Island and other nearby military installations by 1996. Base closures eliminated all of the apprenticeship programs supported by the College and employment declined substantially. By the time classes in the Electronics program ceased to be scheduled in 2007 enrollment had declined to a handful of students who were finding jobs in the computer industry and local electronics retailers.

The Electronics Program included extensive technical instruction deeply rooted in providing graduates who understood electronic components, their interaction, and design and use in heavy industry. Heavy in mathematics, troubleshooting, and component repair the program graduated highly qualified electronic engineering technicians. The Maintenance Technician

program, like Electronics was deeply rooted in theory, and repair. The Mechatronics program has taken pieces from both programs but with much less depth and more breadth.

Obviously sending graduates to a naval apprentice program is no longer the goal. The Mechatronics program was originally intended to provide factory technicians in heavy industry. However placement of students at the local factories has been extremely rare with most going instead to agribusiness or building management. (See 1.6 below)

In 1996 there were two full-time and four adjunct instructors teaching Electronics and Maintenance for a total load of 6.5 FTE instructors as well as one-and-a-half dedicated laboratory technicians. By 2007 that had reduced to one full-time and three adjunct instructors at 2.6 FTE (the lab technician positions have been eliminated). After combining the programs in Mechatronics the load for one full-time and one adjunct instructor rests at 1.6 FTE. Scheduling has become a major issue as one of the courses in the program has yet to be offered and other courses have been overlapped or moved after students have enrolled. Other challenges include instructional equipment and space (see 4.3 below).

1.2 Relationship to College Mission and Strategic Goals.

The Mechatronics program educates an ethnically and academically diverse population of students to help them obtain employment in local industry. The workforce education and training received by students through lecture and hands-on experience with modern technology is next to no other program in the County.

Table 1. SCC's Strategic Directions and Goals

Goal 1: Foster Excellence in Learning	*Program Evidence*

Obj. 1.1 Create an environment that is conducive to student learning.	Instructors work hard to insure that the physical environment is conducive to student learning. Some of the efforts made by the institution and instructors to make students feel welcome and to provide a safe and healthy learning environment include: • Providing the latest technology in the classrooms • Keeping the classrooms open between classes so students can use the equipment and facilities for study • Instructors are available for help throughout the day • Keeping the classrooms clean (janitorial services have been cut back in recent years and the instructors have stepped up) • Classrooms mimic the work environment – even down to the coffee pot that's always full However, the campus no-smoking policy (Board Policy 4215) enacted in 2013 has had a negative impact on student learning. The Mechatronics program, like other career technical programs, attracts a great number of otherwise underserved students who through quirks in their socioeconomic behaviors include individuals more likely to be smokers. In the past all students were given a break of 10 minutes every hour and smokers were allowed to leave the building and smoke. Without that relief a number of students become agitated during regular class hours and have a difficult time focusing on their studies. The no smoking policy has become a barrier to education and detrimental to the learning environment. Enacting a no smoking policy did not discourage smoking, it discouraged education.

Obj. 1.2 Create an environment that supports quality teaching.	Instructors in the program are constantly striving to improve their instructional abilities. The full-time instructor worked hard for three years on his own time and expense to achieve Federal mechanic's licensure in order to better serve as a maintenance instructor. All instructors throughout the history of the program and its predecessors have taken advantage of training made available by the District when offered. The two remaining instructors have become prominent in their perspective fields and have been hired to give seminars to other institutions and organizations. In addition, guest speakers are regularly invited during class hours in order to introduce students to the industries they will be supporting.
Obj. 1.3 Optimize student performance on Institutional Core Competencies	Included in the Mechatronics curriculum is IT 151 – Vocational Math. This course, with no prerequisites or placement test requirements helps students master basic mathematic skills by teaching the topics using a hands-on approach that is more aligned with the typical student of the program. A Vocational English course similar to the current Vocational Math course once existed but has since been removed. In its place all courses incorporate technical reading assignments that help students improve both their reading and writing abilities. English comprehension is paramount to success in the modern industrial workplace. All courses are assessed regularly through the SLO and PLO processes.
Goal 2: Maximize Student Access & Success	*Program Evidence*

Obj. 2.1 Identify and provide appropriate support for underprepared students	Technical programs have a distinct advantage when it comes to so called underprepared students. Often the student is not underprepared to learn, only underprepared to learn traditional academic topics in a traditional classroom. The hands-on nature of technical training tends to better accommodate otherwise underprepared students. Only one of the courses in the Mechatronics program has a prerequisite. This was a deliberate effort to insure that student's could start the program at any time or level and be successful in their educational goals. Without prerequisites each classroom is populated with students of dramatically varying skill levels. To accommodate this diversity each course has basic skills learning included ensuring that each student can gain as much as possible from the technical education.

Obj. 2.2 Update and strengthen career/technical curricula	The field of Mechatronics is relatively new. Created by blending several traditional technical skill sets it feeds advanced manufacturing and the high tech computer controlled heavy industries. Because of this alignment with current technology, the field of Mechatronics is constantly changing, as is the curriculum in the program. Regular feedback is solicited from local industries and adjustments are continuously made to course curriculum. Formal advisory committee meetings are also held to foster collaboration with the community. Articulation agreements with high schools within the District have been in place for many years. Work is being done to form a close association with the high school robotics programs. Work is beginning on exploring the possibility of aligning curriculum to industry certification such as the National Manufacturing Institute or PMMI Mechatronics.
Obj. 2.3 Identify and provide appropriate support for transfer students	Mechatronics is not a transfer program and includes few courses that are UC/CSU transferable. The program does not directly support transfer students.

Obj. 2.4 Improve student access to college facilities and services to students	Course scheduling has been a challenge. Attempts to accommodate non-traditional students with flexible scheduling have faced administrative challenges. For example, the Veteran's Administration has a very popular program that helps returning vets transition into the civilian workforce that will pay for 12 months of education or training. Under the current schedule, these students can attend roughly half of the Mechatronics program before they are expected to find gainful employment. An effort is underway to determine if a "career-in-a-year" schedule is feasible for Mechatronics.
Obj. 2.5 Develop and implement an effective Enrollment Management Plan	N/A
Goal 3: Strengthen Community Connections	*Program Evidence*
Obj. 3.1 Respond to community needs	The Mechatronics program provides well educated and trained workers for the advanced manufacturing, agribusiness, and building management industries in Solano and several surrounding counties. This program was created specifically to fulfill the needs of these industries and in close conjunction with representatives from employers. Close ties have been maintained with employers who often ask for minor changes to curriculum to support their specific needs. For example, after consultation with local employers it was determined that the Programmable Logic Controller class need only support Allen-Bradley branded equipment and software.

Obj. 3.2 Expand ties to the community	Mechatronics faculty members were deeply involved in the Career Education Fair the three years it was held (2010-2012). Instructors not only assisted in the planning and execution, but held demonstrations and participated in the open house. The Career Education Fair allowed the public to come to the main campus and see the facilities, speak to the instructors, and work some hands-on demonstrations. They were the main marketing/recruiting event of the entire division. The Mechatronics department opened up the labs, ran continuous robotics and PLC demonstrations, allowed the public to use some of the tools of the trade, performed some fun demonstrations for the kids (i.e. Diet Coke and Mentos), sponsored the high school robotics clubs, and did all of the set up and tear down for all of the exhibiters. Up until 2012 the full-time Mechatronics instructor visited every high school within the District at least once per year to speak with students about opportunities at Solano College. These visits were orchestrated by the then TechPrep Coordinator Julia May and councilors at the high schools. Typically, the visit included speaking before a career counseling class or manning a booth at their transfer/career day. This was a very effective outreach method and expanded both matriculation and articulation. The visits ended when the Tech Prep Coordinator was removed and the duties moved to an already busy administrator.
Goal 4: Optimize Resources	*Program Evidence*

Obj. 4.1 Develop and manage resources to support institutional effectiveness	Annual program budgets are used to purchase instructional equipment, instructional materials, repair equipment, pay software license fees, etc. The funds come from allocations, Perkins, lottery and other sources. Budget amounts vary from year to year and on occasion have been zeroed during times of economic crisis. Other than funds for salaries and benefits faculty in an individual department has typically been entrusted with maintaining the budget. (See 4.5 Budget/Fiscal Profile below)
Obj. 4.2 Maximize organization efficiency and effectiveness	N/A
Obj. 4.3 Maintain up-to-date technology to support the curriculum and business functions.	Instructional equipment used in the original Electronics and Maintenance Technician programs were purchased when the Fairfield campus was built in the early 1970s and was not updated for over 30 years. Starting in 2002 individual pieces of instructional equipment were replaced, starting with the basic electronics lab stations, until a major overhaul was performed with Measure G bond funds in 2008. The latest addition to the instructional equipment includes Electrical/PLC trainers purchase with grant moneys in 2013. Still left to update are the mechanical sets (using tools and equipment salvaged from the Carpentry and Machine Tool programs that closed in the 1990s) and hydraulics/pneumatics training equipment (using salvaged and donated parts only).

1.3 Enrollment.

This is the first program review for Mechatronics. Enrollment data in courses included in the program go back to the Fall 2009 semester. Courses listed under MT (Maintenance Technician) are included exclusively in the Mechatronics program. The program also shares courses under ACR (Air Conditioning & Refrigeration), CIS (Computer and Information Science), DRFT (Drafting), IT (Industrial Technology), and OCED (Occupational Education). Computer and Information Science, Drafting, and Occupational Education have their own program reviews

and their data will not be included here, but Air Conditioning & Refrigeration and Industrial Technology will.

Air Conditioning & Refrigeration is not a stand-alone program. The ACR classes, while technically part of the Mechatronics program are often populated with students either in, or working toward a career in refrigeration. Industrial Technology courses are intended to be shared across multiple career technical disciplines. IT courses cover common technical topics such as vocational mathematics and industrial materials that are required for several disciplines. ACR and IT classes are inflated with students from other programs.

ACR -Number of sections offered

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
1	2	2	1	0	1	1	1

ACR –Number of students enrolled

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
36	55	44	39	0	41	29	33

ACR – WSCH

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
108	171	161	117	0	123	87	99

ACR – FTE

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
3.6	5.7	5.38	3.9	0	4.1	2.9	3.3

IT -Number of sections offered

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
4	2	4	1	1	2	4	3

IT –Number of students enrolled

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
65	24	52	29	24	44	61	56

IT – WSCH

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
357	115	289	145	120	214	284	274

IT – FTE

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
11.91	3.38	9.64	4.83	4.0	7.13	9.47	9.15

MT – Number of sections offered

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
2	3	2	2	2	1	2	3

MT – Number of students enrolled

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
28	40	26	23	37	13	25	41

MT – WSCH

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
160	265	155	145	205	65	145	219

MT – FTE

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
5.33	8.83	5.18	4.83	6.83	2.17	4.83	4.2

Combined Mechatronics - Number of sections offered

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
7	7	8	4	3	4	7	7

Combined Mechatronics – Number of students enrolled

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
129	119	122	91	61	98	115	130

Combined Mechatronics – WSCH

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
625	551	605	407	325	402	516	592

Combined Mechatronics – FTE

Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
20.84	17.91	20.2	13.56	10.83	13.4	17.2	16.45

Course enrollments, as with course offerings are increasing. This is to be expected in a new program. Growth should continue over the next few years as the program comes into its own. Note that WSCH is already above 525 and growing. The program has already had its first two graduates, one with an Associate Degree in Mechatronics in 2012 and the other with both a certificate and degree in 2013.

1.4 Population Served.

Mechatronics has consistently attracted a racially diverse mixture of students with over half being non-white and students who ages span across the generations. Of note is that the African-American enrollment is about double the school average. However, the percentage of women enrolled remains below 10%. This is an area that has not been addressed.

Combined Mechatronics – Enrollment by Ethnicity

	Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
Enrollment	129	119	122	91	61	98	115	130
Am. Indian or	0%	1%	0%	1%	0%	2%	3%	1%

Alaskan								
Asian or Pacific Islander	26%	16%	12%	15%	13%	5%	16%	14%
Black Non-Hispanic	6%	18%	25%	12%	13%	21%	17%	25%
Hispanic	16%	19%	18%	13%	20%	17%	26%	18%
Other	19%	9%	10%	37%	25%	13%	8%	6%
White Non-Hispanic	33%	34%	35%	21%	30%	41%	29%	37%

Combined Mechatronics – Enrollment by Age

	Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
Enrollment	129	119	122	91	61	98	115	130
Less than 18	11%	10%	11%	3%	5%	6%	8%	3%
Between 18 and 20	16%	15%	15%	10%	12%	14%	10%	9%
Between 20 and 30	36%	38%	38%	39%	36%	32%	41%	39%
Over 30	36%	37%	36%	47%	47%	47%	42%	48%

Combined Mechatronics – Enrollment by Sex

	Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12	Fall 12	Spring 13
Enrollment	129	119	122	91	61	98	115	130
Female	6%	4%	3%	2%	1%	9%	1%	4%
Male	92%	95%	96%	96%	90%	89%	87%	96%
Not Reporting	2%	1%	2%	2%	0%	2%	2%	0%

1.5 Status of Progress toward Goals and Recommendations.

Mechatronics is a new program and has not undergone program review before this cycle or been included in the Educational Master Plan. Interesting, however are the four goals set in the May, 2012 Educational Master Plan for Electronics:

Table 2. Educational Master Plan (Electronics Technology)

Educational Master Plan	*Status*
1. Incorporate mechatronics (mechanics and electronics) curriculum	This was completed in 2009. Electronics was deleted from the inventory before the 2012 Ed Master Plan was written.
2. Assess potential to support Automotive Technology program	Automotive Technology was revived during the Fall, 2013 semester without input or support from Electronics.

3. Offer hybrid online/onsite laboratory courses	Online/onsite laboratory classes were developed for Electronics and offered during the 2004-05 and 2005-06 school years. They were poorly received by the students and not scheduled again.
4. Develop a marketing plan/strategy for program and other Career Technical programs	A formal marketing plan for Career Technical Education programs does not exist.

The Education Master Plan should reflect the deletion of the Electronics program and include the goals of Mechatronics in the future.

No previous Program Review exists for Mechatronics.

Table 3. Program Review Recommendations

Program Review Recommendations (Previous Cycle)	*Status*
1. *N/A*	*N/A*

1.6 Future Outlook.

The future of the Mechatronics should be bright. However, the goal of the program is to prepare students for employment in local heavy industry and local heavy industry is not in a position to absorb a great number of entry level employees. Labor market data collected for dissemination by schools and other agencies still reflect the outlook from before the latest economic downturn and do not take into account local trends. In an advisory committee meeting in 2013 managers from factories in Fairfield stated that they simply do not consider hiring entry level workers. Instead they wait for some other factory to close and then snap up their former employers – experienced technicians desperate for work. While labor market surveys tell us that manufacturing is returning to America they make no adjustments for local realities.

In the meantime, agribusiness is currently involved in a rapid phase of automation that requires highly educated technicians ready to take care of electronic and computer controlled mechanical equipment used in crop harvesting, processing, water treatment, waste management, and even retail sales. For example, many larger wineries are installing SCADA (system control and data acquisition) computer systems to manage production that reduce overall labor costs but require highly educated technicians to operate and maintain.

Pressure to reduce energy consumption and other costs associated with large buildings is putting pressure on building managers to automate such systems as lighting controls, heating, and water use. These new technologies need well educated technicians to operate and maintain.

Providing these well educated technicians will not be possible unless the Mechatronics program can get needed instructional equipment and materials. Currently no instructional equipment exists for the air conditioning courses, and only donated scraps and pieces exist for at least four other courses. Mechatronics covers several topics and in order to teach these subjects the proper instructional equipment and materials must be made available.

Several students have complained that visits to the Counseling department have been problematic. Among the complaints are:

- At first time visits, counselors attempt to steer students away from CTE programs by telling them that programs do not exist or that students must take transfer courses before enrolling in CTE courses.
- When applying for certificates students are told that they cannot graduate without taking more courses not listed in their original education plan – specifically more transfer courses.
- Students are routed to lower division general education courses even when they are coming to Solano College with an undergraduate degree.
- Counselors are creating education plans for students that do not include courses in their requested major.

There is no way to know how many students have been routed away from CTE programs – never to be seen again. It is expected that these concerns will grow as the requirement that all students visit a counselor before enrolling is put in place.

And finally, instructional staffing is an issue. Instructors have not been replaced as they left until now only one full-time and one adjunct instructor are available for scheduling. In addition each vocational program had at least one lab technician – electronics, one of the predecessors to Mechatronics had one and one half lab technicians – who set up classrooms, equipment and materials and acted as a safety officer during lab activities. If the faculty and staffing reduction trend continues the program will collapse.

CURRICULUM DEVELOPMENT, ASSESSMENT, AND OUTCOMES

Program Level Outcomes

2.1 Measuring PLO's.

Mechatronics is a "flat" program. Students may enter at any point and exit at any point. There are no entry courses and no completion or capstone course. As a result, all courses are expected to measure Program Level Outcomes.

Table 4. Program Level Outcomes

Program Level Outcomes	*ILO (Core 4)*	*How PLO is assessed*

1.	*Safely operate a variety of testing instruments and diagnostic tools.*	*II A* *II D*	*Each course with a lab component requires the student demonstrate the use of testing instruments. Success is measured by instructor observation of laboratory work using a rubric.*
2.	*Recognize complex systems and understand their function, operation, advantages and disadvantages.*	*II A* *II B*	*Students are required to pass with a score of 70% or better written tests in all courses.*
3.	*Analyze complex systems and diagnose/troubleshoot problems.*	*II A* *II D*	*Each course with a lab component requires the student demonstrate their ability to diagnose and troubleshoot problems. Success is measured by instructor observation of laboratory work using a rubric.*

2.2 PLO Levels.

Table 5. Program Courses and Program Level Outcomes

Course	*PL01*	*PL02*	*PL03*
	Safely operate a variety of testing instruments and diagnostic tools.	*Recognize complex systems and understand their function, operation, advantages and disadvantages.*	*Analyze complex systems and diagnose/troubleshoot problems.*
ACR 100		I	I
ACR 101		D	D
IT 050		I	I
IT 101		D	D
IT 140	D		
IT 151		D	I
TM 120	M	D	I
MT 122	M	D	I
MT 130	M	D	I
MT 132	M	D	I
MT 140	M	D	I
MT 142	M	D	I
MT 160	M	D	I

MT 162	M	D	I

2.3 PLO Assessments.

Table 6. Program Level Assessments

Program Level Outcomes	*Dates Assessed*	*Results*	*Action Plan*
1. Safely operate a variety of testing instruments and diagnostic tools.	Spring, 2013	All students were able to safely operate testing instruments and diagnostic tools.	Will narrow the PLO and the rubric to measure how *accurately* students use the equipment and not just that they can safely use it.
2. Recognize complex systems and understand their function, operation, advantages and disadvantages.	Spring, 2013	83% of students achieve a passing grade on written tests that measure "complex systems analysis."	Believe this testing to be an accurate measurement and will not make changes at this time.
3. Analyze complex systems and diagnose/troubleshoot problems.	Spring, 2013	Slightly more than half of students achieve an Acceptable and less than half of students achieve an Excellent rating on the evaluation rubric.	If the industry advisory group believes the rubric is too rigorous it will be adjusted. If they believe the skill level is necessary courses will add more troubleshooting skills building.

Student Learning Outcomes

2.4 Adjusting SLO's.

No efforts have been made to date to synchronize the assessment of SLO's across multiple sections of a single course because the Mechatronics program has not grown large enough to make it practical to schedule multiple sections of a single course in a single semester. The specialized nature of each course and only two instructors makes it unlikely that many classes will be taught by more than one instructor making standardization of the SLO process unnecessary.

With this in mind, SLO's are handled by the individual instructor. SLO's are included in the course syllabi given to the students at the beginning of each class, explained, and used to evaluate the effectiveness of the course at the end. Adjustments to SLO's have been made to

improve measurement and facilitate evaluation. One course (IT 151) has been modified based on feedback from the SLO process.

2.5 Timeline/Cycle for Completing SLO's.

A pattern has been established that guides departments to complete SLO assessments in the Fall for even numbered courses and in the Spring for odd numbered courses. Nearly all of the courses in Mechatronics are even numbered and not all courses are taught every semester, so the SLO schedule does not follow the guideline very closely.

Table 7 includes the schedule for completing SLO's for courses in the Mechatronics program that are taught by Mechatronics instructors and not courses controlled by other departments.

Table 7. SLOs Schedule

Course #	Course Name	F2013	S2014	F2014	S2015	F2015	S2016	F2016	S2017
ACR 100	Air Conditioning			X		X		X	
ACR 101	Air Conditioning			X		X		X	
IT 050	Alternative Energy	X		X		X		X	
IT 101	How Things Work		X		X		X		X
IT 120	Electrical Safety			X		X		X	
IT 140	Industrial Materials		X		X		X		X
IT 151	Vocational Math		X		X		X		X
MT 120	Analog Electronics	X		X		X		X	
MT 122	Digital Electronics		X		X		X		X
MT 130	Mechanical Power	X		X		X		X	
MT 132	Fluid Power		X		X		X		X
MT 140	Industrial Electrical	X		X		X		X	
MT 142	Electrical Machinery		X		X		X		X
MT 162	Robotics	X		X		X		X	
MT 164	PLCs		X		X		X		X

2.6 Assessment Currency.

Currently all PLO and SLO assessments are up to date with the single exception of MT 120 Electrical Safety which has not been scheduled since the College implemented the assessment process. MT 120 is expected to be scheduled during the Summer, 2014 semester and will be assessed then.

2.7 Gap Analysis.

All faculty realize the importance of completing SLO's and are committed to maintaining accurate assessments and planned changes based on outcomes. Difficulties arise in CTE departments such as Mechatronics which have only one full-time faculty member to bear the load. Mechatronics has many courses and assessment has been a challenge.

2.8 Courses Affected by SLO's.

The only course that has undergone changes as a result of feedback from SLO's is IT 151 Vocational Math. Outcomes were improved when it was discovered that students learn better with hands-on practice. Physical objects were introduced in the classroom to demonstrate mathematical concepts. Hands-on practice now includes the use of yard sticks, measuring tapes, measuring cups, micrometers and calipers, nuts and bolts, lumber, and other materials common to the trades.

Curricular offerings

2.9 Course Offerings.

This is the first program review for Mechatronics. The only change to the program since it was originally approved is the addition of IT 050 Introduction to Alternative Energy, a course requested by the program advisory group. All courses are either taught online or at the Fairfield campus in classroom/laboratories with specialized instructional equipment.

Considerable effort was made during the 2011-2012 academic year to clear up errors and omissions in the college catalog. Those efforts continue.

Mechatronics

Program Description

Mechatronics is the blending of electronics, mechanics, electrical. and computers to produce a well-rounded technician capable of handling the complex maintenance and operations tasks demanded by modern manufacturing, transportation, communication, and other industries. The modularization of electro-mechanical devices no longer requires in-depth specialization of a single field of study as more emphasis is placed on troubleshooting and replacement skills for maintenance and generalized knowledge of how systems work together for operations and purchasing and planning.

Certificate of Achievement and Associate of Arts Degree

A Certificate of Achievement can be obtained upon completion of the 42 unit major listed below. The Associate in Science Degree can be obtained by completing a total of 60 units, including the 42 unit major, the general education requirements, and electives. All courses in the major must be completed with a grade of C or better or a P if the course is taken on a Pass/No Pass basis.

Program Outcomes

Students who complete the Certificate of Achievement/Associate Degree will be able to:

1. Safely operate a variety of testing instruments and diagnostic tools.
2. Recognize complex systems and understand their function, operation, advantages and disadvantages.
3. Analyze complex systems and diagnose/troubleshoot problems.

REQUIRED COURSES . . . . . Units
CIS 001 Introduction to Computer Science. 3
IT 050 Alternative Energy Technologies 3
IT 101 How Things Work 3
IT 151 Vocational Mathematics. 3
MT 120 Principles of Analog Electronics 3
MT 122 Principles of Digital Electronics 3
MT 130 Principles of Mechanical Power Systems 3
MT 132 Principles of Fluid Power Systems 3
MT 140 Principles of Industrial Electrical Systems 3
MT 142 Principles of Electrical Machinery 3
MT 162 Robotic Manufacturing Systems 3
MT 164 Programmable Logic Controllers 3
Electives Selected from List A. 6
Total Units 42

Recommended Electives

ACR 100 Air Conditioning and Refrigeration 3
OR
ACR 101 Air Conditioning and Refrigeration 3
DRFT 045 Introduction to Computer-Aided
Drafting (CAD) 3
DRFT 050 Basic Drafting 3
DRFT 079 Blueprint Reading 3
IT 110 Modern Welding 3
IT 120 Electrical Safety 3
IT 140 Industrial Materials 3
OCED 090 Occupational Work Experience . . . . . 1 - 8

Course Descriptions

ACR 100 3 Units
Air Conditioning and Refrigeration
Course Advisory: SCC minimum English standard.
A study of compression systems, controls, refrigerants, various refrigeration systems, and commercial applications designed to develop the ability to understand and apply the basic principles required to maintain and service this type of specialized equipment.
Three hours lecture.

ACR 101 3 Units
Air Conditioning and Refrigeration
Course Advisory: ACR 100; SCC minimum English standard.
The maintenance and servicing of commercial air conditioning and refrigeration systems with the study of techniques applied to refrigerant handling, systems controls, and compression systems.
Three hours lecture.

CIS 001 3 Units
Introduction to Computer Science
Course Advisory: SCC minimum English and Math standards; keyboarding 30 wpm.
An introduction to the hardware and software components of basic computer systems. A review of historical, social and cultural implications of computer technology in today's society. Course content will include 'hands-on'

familiarization with a computer operating system and common application software. Additionally, the course includes an introduction to computer programming using the Visual Basic .Net language. Students will learn to develop problem specifications, detailed analysis, design algorithms, and construct structured computer programs. Lab hours may be scheduled or TBA depending on the section. Students are expected to complete both the lecture and lab portion of the class.
Three hours lecture, one hour lab weekly by arrangement.

DRFT 045 3 Units
Introduction to Computer-Aided Drafting (CAD)
Course Advisory: SCC minimum English and Math standards; DRFT 050; drafting experience helpful.
Designed to introduce the drafting student to CAD technology and terminology. The student shall complete a series of related drawing problems using a CAD work station.
Two hours lecture, four hours lab.

DRFT 050 3 Units
Basic Drafting
Course Advisory: SCC minimum English and Math standards.
Presents the fundamentals of drafting, including the use of instruments, lettering, freehand sketching, orthographic projection, dimensioning and sectioning. Recommended for non-majors and drafting majors.
Two hours lecture, four hours lab.

DRFT 079 3 Units
Blueprint Reading
Course Advisory: SCC minimum English and Math standards.
Designed to provide understanding and interpretation of a variety of blueprints. Emphasizes the ability to recognize and identify modern industrial blueprints and architectural blueprints. Includes basic development of freehand sketching abilities.
Three hour lecture, one hour lab.

IT 050 3 Units
Alternative Energy Technologies
Course Advisory: SCC minimum English and Math standards.
Introduces the topics of power generation, transmission, and consumption of both conventional and alternative energy sources. Students will be exposed to an in-depth analysis of the design and use of fossil fuel based systems and then compare those systems to alternatives. Energy use in transportation, industrial, commercial, and residential applications will be examined.
Three hour lecture.

IT 101 3 Units
How Things Work
Course Advisory: SCC minimum English and Math standards.
Provides an understanding of how the technology in our lives works using only basic concepts and rudimentary mathematics. This course considers objects from our daily environment and focuses on their principles of operation, histories, and relationships to one another. Students learn about common technologies through lecture, classroom discussion, and laboratory experiments.
Two hours lecture, three hours lab.

IT 110 3 Units
Modern Welding
Course Advisory: SCC minimum English standard.
Designed to acquaint the student with the fields of arc and acetylene welding, the tools and equipment used, shop safety and employment opportunities.
Two hours lecture, three hours lab.

IT 111 3 Units
Modern Welding

Prerequisite: IT 110.
Designed to acquaint the student with MIG and TIG welding methods and knowledge necessary to weld in all positions utilizing the mild steel, low hydrogen electrodes, metal inert gas and tungsten inert gas techniques.
Two hours lecture, three hours lab.

IT 120 1.00 to 3.00 Units
Electrical Safety
Course Advisory: SCC minimum English and Math Starndards.
A survey of the proper use, handling, and hazards associated with electrical and electronic equipment. The student will be introduced to the current generally accepted (National Electrical Safety Code) safety practices and procedures associated with power transmission, industrial, and consumer electrical and electronic equipment.
Formerly ECTN 102.
Open entry-open exit.
One to Three hours lecture.

IT 140 3 Units
Industrial Materials
Course Advisory: SCC minimum English standard.
A broad overview of the characteristics and comparative qualities of naturally occurring, alloyed and man-made materials used in industry. Testing and practical use of materials are required.
Two hours lecture, three hours lab.

IT 151 3 Units
Vocational Mathematics
Course Advisory: SCC minimum English and Math standards.
Focuses on mathematical functions, plane and solid geometry, measurement systems, algebra, and trigonometry applied to specific vocational areas.
Three hours lecture.

MT 120 3 Units
Principles of Analog Electronics
Course Advisory: SCC minimum English and Math standards.
Introduces the topic of analog electronics as it applies to mechatronics. Studies include an introduction to DC and AC circuitry as well as advanced electronic components, instruments used in the operation, installation, and troubleshooting of electronic systems, schematic diagrams, and breadboarding. Students will construct several kits as part of the class.
Two hours lecture, three hours lab.

MT 122 3 Units
Principles of Digital Electronics
Course Advisory: SCC minimum English and Math standards.
Introduces the topic of digital electronics as it applies to mechatronics. Studies include an introduction to digital numbering systems, digital codes and logic, registers, memories, Boolean Algebra, and integrated circuits as well as advanced topics in computerized control systems. Students will construct several kits as part of the class.
Two hours lecture, three hours lab.

MT 130 3 Units
Principles of Mechanical Power Systems
Course Advisory: SCC minimum English and Math standards.
Introduces the topic of mechanical power systems and mechanical power transmission as it applies to mechatronics. Studies include mechanical theory, mechanical power, thermal systems, hand tools, precision measuring instruments, and mathematics applied to mechanical power systems. Includes studies in manufacturing technology using modern manufacturing equipment and software simulators.
Two hours lecture, three hours lab.

MT 132 3 Units

Principles of Fluid Power Systems
Course Advisory: SCC minimum English and Math standards.
Introduces the topic of hydraulic and pneumatic systems as they apply to mechatronics. Studies include fluid power systems theory, pumps, actuators, accumulators, filters, meters, valves, control devices, and mathematics applied to fluid power systems. Includes studies in manufacturing technology using modern manufaacturing eqipment and software simulators.
Two hours lecture, three hours lab.

MT 140 3 Units
Principles of Industrial Electrical Systems
Course Advisory: SCC minimum English and Math standards.
Introduces the topic of DC, single-phase and three-phase AC circuits as they apply to mechatonics. Introduces commerical/industrial electrical installations that meet National Electrical Code requirements. Students will complete labs and wiring projects. Lab, electrical and worksite safety is emphasized.
Two hours lecture, three hours lab.

MT 142 3 Units
Principles of Electrical Machinery
Prerequisite: MT 120 with a grade of C or better or MT 140 with a grade of C or better.
Course Advisory: SCC minimum English and Math standards.
Introduces the topic of electrical machinery as it applies to mechatronics. Studies include direct-current and alternating-current generators, alternators, transmission equipment, and motors. Students will complete labs and electrical machinery projects. Lab, electrical and worksite safety is emphasized.
Two hours lecture, three hours activities.

MT 162 3 Units
Robotic Manufacturing Systems
Course Advisory: SCC minimum English and Math standards.
Presentation of physical principles applied to automated manufacturing systems. Students will develop solutions to manufacturing problems using robots, programmable logic controllers (PLC) and computer numerical control (CNC) manufacturing machines. Students will also apply safety-oriented work habits to the completion of laboratory projects while working individually and in groups.
Two hours lecture, three hours lab.

MT 164 3 Units
Programmable Logic Controllers
Course Advisory: SCC minimum English and Math standards.
Introduces the student to process control via Programmable Logic Controllers (PLC's). Content includes the popular Allen-Bradley PLC systems and the most common command instructions for the RSLogix 5, RSLogix 500, RSLogix 5000, Micrologix 1000, SLC5 and SLC 500 as well as ControlLogix processors. Troubleshooting and electrical safety are emphasized.
Two hours lecture, three hours lab.

OCED 090 1 – 8 Units
Occupation Work Experience
Corequisite: Student must be enrolled in 7 units (including Occupational Work Experience).
Student must be available to work from 5 to 40 hours per week for a licensed business for a total of 75 hours per unit for paid work and 60 hours per unit for unpaid work. Duties must relate to student's major field. Course Advisory: SCC minimum English and Math standards. To qualify for Occupational Work Experience credit, the student must be available to work from 5 to 40 hours per week for a licensed business in a job directly related to the declared major. Student will attend a weekly coordination semi nar, develop job-oriented objectives and remain currently enrolled in at least 7 units including Occupational Work Experience. Includes all occupational education certifi cate and degree programs. Qualified students who are not working may seek placement assistance from the Student Placement Office. 1 unit of credit may be earned for each 75 hours paid or 60 hours unpaid work per semester to a maximum of 8 units per semester. Students enrolled in OCED 090 may not enroll in OCED 091 during the same

semester. Combined units in all work experience courses shall not exceed 16. NOTE: CSU will accept up to 12 units for transfer.

2.10 Instructional Quality.

Instructors in the Mechatronics program place quality of instruction above all other considerations. The challenges to a new program are daunting, and many factors threaten to degrade quality (budget, facility, instructional equipment, materials, scheduling to name a few). Instructors do their best to hide these distractions from students. Unfortunately, the instructor is the only one in the class and students will equate problems at the school with the performance of the instructor. For example, when the electrical lab was closed and the instructional equipment locked away during the Spring, 2013 semester students in the affected class blamed the instructor for forcing them to sit in seats and listen to lectures rather than allowing them to complete their hands-on projects.

As the program matures and facility and equipment issues subside, the quality of instruction will become less affected by outside distractions. In the meantime, instructors are actively engaged in bringing more and more materials into class (much purchased out-of-pocket) to enhance student learning. IT 151 Vocational Math is an excellent example. What was originally a sample-and-drill course taught in the traditional math lecture format has become a hands-on class with students engaged in learning to use precision measuring equipment such as micrometers to stepping outside the classroom to calculate the height of a tree using its shadow and a solar table.

Class enrollment limits in nearly all of the courses in Mechatronics are limited by the instructional equipment in the classrooms. For instance, 12 electronics lab stations support no more than 24 electronics students. Exceeding these limits stresses the equipment, presents a safety concern, and limits the learning opportunities of students.

2.11 Teaching Methodologies.

Students in career technical programs tend to learn better in a hands-on environment. Employers who direct what and how we teach demand that entry level employees be well versed in the hands-on aspects of the job. Every course in the Mechatronics program has at least some hands-on instruction while most are extensively hands-on. The goal is to make all Mechatronics courses lecture/lab (only 4 out of 21 of the courses are still lecture only) to fully support this important learning style.

The Mechatronics program regularly sponsors field trips to view industrial settings first hand. Whenever possible, students are invited to visit local heavy industries through tours sponsored by advanced manufacturing plants, electrical producers, and agricultural centers in the local area. Instructors attempt to organize a field trip at least once per semester.

Industry leaders are invited to visit classes as guest speakers. Two examples stand out: Three industry leaders visited the MT 142 to speak to students about the skills they were learning and how they apply to business during the Spring, 2013 semester – the first time the class was offered. Each year the program sponsors "HAM Day" where amateur radio operators in the area come to the Fairfield campus to talk to students and demonstrate their equipment.

2.12 Fill rates/Class size.

According to data from ITRP, fill rates for Mechatronics classes over the last few years are:

ACR	100 Air Conditioning and Refrigeration	99.31
ACR	101 Air Conditioning and Refrigeration	82.83
IT 050	Alternative Energy Technologies	61.11
IT 101	How Things Work	113.34
IT 140	Industrial Materials	97.5
IT 151	Vocational Mathematics	83.83
MT 120	Principles of Analog Electronics	73.96
MT 122	Principles of Digital Electronics	76.04
MT 130	Principles of Mechanical Power Systems	61.11
MT 132	Principles of Fluid Power Systems	83.34
MT 140	Principles of Industrial Electrical Systems	59.43
MT 142	Principles of Electrical Machinery	47.92
MT 162	Robotic Manufacturing Systems	83.34
MT 164	Programmable Logic Controllers	104.17

ACR classes have averaged a combined 91.82% fill rate over the last five years. This popular pair of classes is typically scheduled on Friday evenings allowing both full-time and working students to attend. As lecture-only classes the enrollment maximum is set high and the reputation of the classes preparing students for immediate employment or enhancing current employment keeps the fill rates high.

IT classes have had a fill rate averaging 92.04% over the last few years. These classes serve several programs and attract a wide range of students. IT 050 has suffered from scheduling problems with students having had difficulty finding the course in the current online schedule.

MT classes have had a combined fill rate of 70.17% in the last few years. This is a typical fill rate for classes in a new program. As the program matures enrollment will improve. The two lowest classes, MT 140 and MT 142 have improved as instructional equipment was added. The highest, MT 164 has only been scheduled once and there was considerable pent up demand for the course.

IT 120 Electrical Safety is not included in the above list because it has not yet been scheduled.

2.13 Course sequencing.

Attempts have been made to schedule courses in a manner that would allow students to complete the program in two years. Courses are scheduled in the morning, afternoons and evenings in an effort to accommodate students with varying personal schedules. A three year scheduling plan is in place, and if followed will allow students to complete the program in two years by attending courses in either the day or the evening by flipping offering each year. In other words, half of the courses are offered in the day one year and in the evening the next while the other half of the course are offered in the evening one year and in the day the next. And especially ambitious student may be able to take both day and evening courses and complete the program in less time.

It is important to note that only one course in the program has a prerequisite (MT 142) and is always scheduled directly after that prerequisite (MT 140) so that students may enter the program at any semester with any combination of courses.

However, scheduling stability is a major issue. Worst are changes to the schedule made after enrollment has already begun. Students work very hard to develop personal schedules that support their job and family obligations and late changes to the schedule inhibit their abilities to complete their education. Here is a single example from each of the past three semesters:

- During the Fall, 2012 semester IT 050 Introduction to Alternative Energy was scheduled for evenings but was moved to Friday mornings after enrollment had already started. Not a single student who was originally enrolled attended the course after the move.
- In Spring, 2013 IT 151 Vocational Math was moved to deferent days and times overlapping it with DRFT 079. Students who had been enrolled in both suddenly faced a scheduling conflict and had to choose which course to attend. Further exasperating the problem the administrative computer system did not detect the conflict so students were not aware of it until after the semester started.
- One week before the beginning of the Fall, 2013 semester ACR 100 and ACR 101 were canceled. The classes were full, the instructor ready, the room prepared. The dean did not recall cancelling the classes and why it happens remains a mystery. Those students were left to scramble to find new courses.

2.14 Basic Skills.

IT 151 Vocational Math offers instruction in basic mathematics as it applies to the trades. The course is taught in a manner that supports the math used by all of the CTE programs and prepares students for standardized employment screening tests. The course is not transferable and as of Fall, 2011 no longer fulfills the mathematics requirement for associate degree in occupational programs.

The only course in the Mechatronics program that requires a prerequisite is MT 142 Principles of Electrical Machinery. It requires a grade of C or better in MT 140 Principles of Industrial Electrical Systems. The topics in the two courses were originally designed to be in a single course, but feedback from industry required they be split into two consecutive courses. Therefore, what was originally a single electrical course with 32 hours lecture and 48 hours lab was split into two with 64 hours lecture 96 hours lab. Topics in the two courses are sequential and a student would not be expected to succeed starting in the second course – just as a student would not be expected to succeed starting any course at the midpoint.

2.15 Student Survey.

Only informal surveying has been done of students. Each semester students are asked to complete a document that lists the courses they have completed, which course they still need to take, and their scheduling preference. Only occasionally has a student listed topics not already included in Mechatronics or more advanced coverage of existing topics. Students do however, list scheduling as a major barrier to completing of their studies. The three most common scheduling suggestions are:

- Delay cancelling classes until all interested students have had a chance to enroll.
- Compressed scheduling that allows for completion of the certificate in 12 months.
- Avoid scheduling overlapping classes.

Classes are cancelled when enrollment falls below a threshold. Unfortunately, the timing of when a class is cancelled has frustrated students who were waiting for funding, work scheduling, or other obligations in their lives to settle. The idea of early class cancellation is that it gives students time to find another class to join before the semester starts. This works fine when 30 sections of English 1 are offered, but not for an individual course that is only scheduled once a year.

A disproportionality large percentage of Mechatronics students are either veterans, displaced workers, or others taking advantage of scholarship and education assistance programs that include a time limit on benefits. For these individuals stretching their education an additional semester because of scheduling is not an option and they would like a compressed, high intensity program that gets them back into the workforce as fast as possible. Efforts are currently being made to develop a 12-month schedule that satisfies this requirement while still supporting the program.

Occasionally class sections are scheduled to overlap. When this happens students are forced to choose one of the other. For example, in the Fall, 2012 semester IT 151 Vocational Math was scheduled to overlap DRFT 73 Blueprint Reading. Students were unable to enroll in both classes and they both ended up low enrolled – not to mention the chaos caused to the student's individual schedules and their plans to graduate.

2.16 Four-year articulation.

Mechatronics does not articulate to a university.

2.17 High school articulation.

Currently only one course articulates with a high school. Vallejo High School in Vallejo offers a basic electronics course that articulates to MT 120 Principles of Analog Electronics. The final exam for the high school course is administered by a Mechatronics instructor and upon passing the test (and with high school instructor's recommendation) students are granted credit for MT 120.

2.18 Distance Education.

Seven courses in the Mechatronics program are offered online. Four of these courses are supported by other departments:

- CIS 1 Introduction fo Computer Science is supported by the Computer Science department.
- DRFT 045 Introduction to Computer-Aided Drafting (CAD) is supported by the Drafting department.
- DRFT 079 Blueprint Reading is also supported by the Drafting department.
- OCED 090 Occupational Work Experience is supported by the Work Experience Coordinator.

Three online IT courses are supported by the Mechatronics program.

IT 050 Introduction to Alternative Energy has been offered twice online. It was expected that a course in alternative energy would be very popular, but the lack of advertising combined with the difficulty of finding class offerings in the WEB based enrollment system kept enrollment low for both sections.

IT 050 is a lecture-only course that lends itself well to online. Online lectures are presented to students in both text and audio format. The online format differs from the face-to-face offering only in that online students are *required* to participate in discussions. IT 050 is currently being converted to the new Learning Management System and expected to be offered online again during Fall, 2014.

IT 120 Electrical Safety was originally designed as an open entry/open exit variable unit course. Introduction of a new administrative computer system (Banner) made this sort of course impossible to offer in an online format and the course has not been scheduled in several years. An update to the curriculum is underway to make the course more conventional and it is

expected to be offered again (face-to-face) during the Summer, 2014 semester. Plans to offer it again online have not yet been set.

IT 151 Vocational Mathematics is a lecture-only course that has been offered online in the past. It is planned to be converted to the new learning management system for online offering during the Spring, 2015 semester. However, feedback from SLO's show that this course works best with considerable hand-on practice by students and a method to duplicate this practice online has not yet been determined.

The so called core courses, those with the MT designation, are designed to include extensive hands-on laboratory work with specialized equipment and materials and would be a poor fit for online offering. No plans are currently in development to add more online courses within the Mechatronics program.

2.19 Advisory Boards/Licensing (CTE) (if applicable).

When the Mechatronics program was created monthly meetings were held with representatives from area manufacturers. These meetings, originally facilitated by the Solano County WIB started as a way for the companies to promote manufacturing as a viable career objective. One of the goals of the group was to create a pathway for perspective employees to get the education necessary to work in the advanced manufacturing field. The curriculum offered in Mechatronics was the result of this effort.

Mechatronics holds formal advisory meetings with manufacturers each year. The industry has changed considerably in the last two years with manufacturers showing little interest in entry-level employees, so the program has branched out into other industries. Regular, informal contact is kept with leaders in local agribusiness and building management. These two industries have been modernizing considerably and have been hiring from the program.

Feedback from manufacturers has led the Mechatronics program to adopt specific equipment for the labs. For example, programmable logic controllers (PLC) are manufactured by several companies for use in advanced manufacturing and other automated tasks. Manufacturers in Solano County tend to use Allen Bradley PLC's so the Mechatronics program has adopted their use exclusively.

Input from agribusiness has added a course to the original program. Agriculture is a huge industry in Solano and the surrounding counties and leaders in the industry have become much more aware of their energy consumption. As a result they have asked the program to include alternative energy instruction. The Mechatronics program now includes a course in alternative energy as part of the standard curriculum.

3.1 Course Completion and Retention.

All of the classes in the Mechatronics program provide extensive hands-on experiential education directly related to employment as mechanics in the modern computer-controlled world. Basic experience is gained in analog and digital electronics, mechanics, hydraulics and pneumatics, electrical, robotics and programmable logic controllers, computer science, and alternative energy. Also included is Vocational Mathematics which prepares students for the pre-interview math screening exam used by many employers with hands-on applications of mathematics in real world examples. Students also have the option of including experience in air conditioning, drafting, or welding.

Classes are offered both during the day and in the evenings. The schedules are rotated to better accommodate students who may already be employed and do not have a flexible enough schedule to work around school. Courses that do not require specialized laboratories are offered online to further relieve scheduling pressure.

Course success rates vary by course. Air conditioning (ACR) course success rates vary from 48-74%, Industrial Technology (IT) from 48-84%, and Maintenance Technician (MT) from 59-87%. This can be directly related to the amount of hands-on included in the individual courses. Courses with less hands-on such as the air conditioning courses that have been reduced to lecture/demonstration due to lab space and equipment loss do not accommodate hands-on learners as well as the electronics classes (for example) with their well established labs and modern equipment. The lack of women in the program makes the data for gender success unreliable, but race and age rates are almost identical to the overall rates.

The persistence rates for ACR classes are very low - as low as 24% some semesters. Many students take air conditioning courses to enhance or start their careers and do not need any other education. The college has an excellent working relationship with home appliance warranty service companies in the area and is able to place students in that industry after completing only the two ACR courses. In effect, persistence in ACR is hindered by job-outs.

The persistence rates in IT courses is much higher, topping out at 83% for semester persistence in Fall, 2012. This is because IT courses are part of many other CTE programs. For example, IT 140, Industrial Materials usually has students enrolled who are also taking Auto Body, Drafting, Mechatronics, Welding, and other CTE courses. These students take IT 140 as part of their major and continue until they graduate or job-out.

The persistence rates in MT courses appears to be steady in the mid-60% range. As the program matures, this may change, but it is easy to assume that the mid-60% persistence is due to students who either job-out or run out their financial aid.

3.2 Degrees/Certificates Awarded **(if applicable).**

As a new program, Mechatronics has not gone through enough cycles of the required classes to create a graduation trend. Only two individuals have graduated thus far. One individual graduated with an associate degree in 2012 and the other with a certificate and degree in 2013. One reported to be a white male while the other did not specify sex or race.

Many students job-out of the program - they find employment before completing the program. Unlike regular academic programs the overwhelming desire of students in Mechatronics is to become more employment worthy. When an opportunity to find employment is found the student will take the job and drop out of school. Completing their studies with a certificate or degree is a secondary goal and to the student often means that they were unable to find employment as fast as they wanted.

Many other students are taking advantage of one of several 12-month training or transition programs and are not able to complete a certificate or degree program. For example, the VA has a 12-month transitions program that pays for recent veterans to get the training of their choice. This program pays for only 12 months of training and requires that they be immediately eligible for employment. Students attempting to stay in school beyond the program limits will not only do so without financial support they may actually breaking the rules of the grant program.

Graduation rates are expected to remain low in the future unless a way can be found to shorten the scheduled time to complete the program.

3.3 Transfer (if applicable).

Mechatronics is not a transfer program.

3.5 Career Technical Programs (if applicable).

A specific skills requirements list was developed in cooperation with employers in the County before the program was first proposed. Only one course has been added to the program - Alternative Energy Technologies - since the program was launched. The program will continue to remain stable through the next curriculum review which is scheduled for the 2013-2014 academic year.

PROGRAM RESOURCES

4.1 Human Resources.

Faculty for Mechatronics is now down to two instructors; one full-time and one adjunct. Mark Berrett is the full-time faculty member and Fred Coburn the adjunct.

Mark Berrett is currently the only full-time instructor in the Mechatronics program. Mr. Berrett taught adjunct in the Electronics program from 1989 through 2001 and full time since. Mr.

Berrett has two graduate degrees, an undergraduate degree, five associate degrees and will be completing one more associate degree in the Spring of 2014. Mr. Berrett's FSAs include Industrial, Tool and Related Technologies; Electronics, Computer Science, Aeronautics, and Education. He has taught in the Mechatronics, Electronics, Computer Science, and Aeronautics departments at Solano College as well as other institutions. Before teaching Mr. Berrett spent nearly 30 years in industry as a software developer and design engineer.

Mr. Berrett was instrumental in the early adoption of online instruction at Solano College. He converted 12 electronics classes to online or online/classroom hybrid in just under two years becoming the first instructor in the United States to offer hybrid electronics courses (a method pioneered in Canada in the early 2000s). To fully support the new instructional method Mr. Berrett went back to school and earned a masters degree in Instructional Design for Online Learning.

For Solano College Mr. Berrett has written the complete curriculum for three distinct programs and over 30 courses, course proposals for an additional three programs and another 20 courses, and modified the curriculum for one program and 12 courses. He has worked two complete programs all the way from inception to approval by the State of California Chancellor's Office. Included in this work is his creation of the Mechatronics program from information gathered from employers in the County. To make sure that he was fully qualified to teach in the program he completed a three-year training program and extensive testing to receive a Federal mechanic's license (FAA Aircraft Mechanic license).

Fred Coburn is currently the only adjunct instructor in the Mechatronics program. He has been teaching at Solano College since 2002 after retiring from Federal civil service as an instructor at the Mare Island Naval Shipyard. Mr. Coburn taught electrical and other industrial trades at the Island for over 20 years.

Mr. Coburn teaches:

- IT 120, Electrical Safety
- IT 151, Vocational Mathematics
- MT 120, Principles of Analog Electronics
- MT 122, Principles of Digital Electronics
- MT 140, Principles of Industrial Electrical Systems
- MT 142, Principles of Electrical Machinery
- MT 162, Robotic Manufacturing Systems
- MT 164, Programmable Logic Controllers

Mr. Coburn may also be teaching the air conditioning and refrigeration classes in the future.

Obviously, he does not teach all of these classes every semester. These classes are scheduled over several semesters. However, he is only instructor for MT 140, 142, 162 and 164.

4.2 Staffing Changes.

In 1996 there were two full-time and four adjunct instructors teaching Electronics and Maintenance for a total load of 6.5 FTE instructors as well as one-and-a-half dedicated laboratory technicians. The lab technician positions were eliminated in 1997, both full-time instructors retired and one of the adjunct instructors was hired to replace them by 2002, and the adjunct positions reduced to two in 2008. By the time Electronics and Mechanics merged (roughly 2010 - 2012) the program had one full-time and two adjunct instructors and was scheduling 1.9 FTE or less each semester.

Larry Tow has decided not to return in the Spring of 2014. He had a long career in both military and civilian employment in the heating, ventilation and air conditioning (HVAC) industry and has taught the ACR classes since 1988 as an adjunct instructor. No plans are in place at the time of this report to replace him.

It should also be noted that Fred Coburn is 68 years old as of the writing of this report.

An adjunct position opening for a Mechatronics instructor has been posted by the college for several years but no actions toward hiring have been taken. Scheduling is now down to 1.6 FTE per semester.

Obviously if the program is to grow then this trend needs to be reversed. First and foremost should be the hiring of a second Mechatronics adjunct instructor to replace Larry Tow. Then a third adjunct instructor should be hired to allow flexible scheduling. A reasonable program growth outlook would expect a second full-time faculty member necessary by 2017.

4.3 Equipment.

Because Mechatronics covers so many otherwise discreet technologies a wide variety of instructional equipment and materials need to be made available for student use. In the past equipment and materials were shared across programs, but vocational-based programs have been physically separated in recent years making this impossible. For example, Aeronautics maintains a full set of hydraulics training equipment as part of the aircraft maintenance program which was used by other mechanics programs as well. However, Aeronautics is now located at the Nut Tree Airport in Vacaville making use of that equipment by other programs problematic. The result is that Mechatronics (as well as most all CTE programs) needs its own instructional equipment and materials (as well as facilities - see 4.4 below) for every skill set included in the curriculum.

Mechatronics requires access to instructional equipment and materials for the following skill sets:

- Air Conditioning and Refrigeration - Before the Measure G bond build-out, space in the auto body shop was provided for some HVAC demonstration equipment. That space and the equipment are gone and ACR classes are now lecture-only. Even the most rudimentary hands-on equipment would greatly improve the education of ACR students.
- Basic Physics - IT 101, How Things Work teaches students the basic physics behind technology. The class uses trainers from the Home Technology Integration program that was deleted in 2008 as the primary instructional equipment. The instructor also regularly purchases items "out of pocket" that can be used in class (for example, microwave ovens that are destroyed in the class).
- Computer Science - Mechatronics students receive their computer science education from the CIS department.
- Drafting - Mechatronics students receive their blueprint reading and drafting education from the Drafting department.
- Electrical - Instruction equipment for electrical, electrical machinery, and motor controls has been pieced together from donations and scraps. In the middle of the Spring, 2013 semester the equipment was removed from the electrical lab and locked up forcing the electrical instructor to complete the class without equipment (see 4.4 below). Much of the equipment was lost (due to theft) or broken during this move and the remainder is not yet available for instruction as of the writing of this document.
- Electronics - The Mechatronics program has inherited the electronics lab, which was refurbished as part of Measure G, from the Electronics program. The electronics lab is the shining star of the program with modern training equipment and plenty of instructional supplies to last for several years.
- Hydraulics - Like the electrical equipment above, hydraulics training equipment and supplies are scraps that have been collected over time. The one working piece of hydraulics training equipment (purchased by the school in 1974) was broken when the lab was disassembled during the Spring, 2013 semester. Without replacement equipment, hydraulics will be a lecture-only class starting the Spring, 2014 semester when it is expected to be offered again.
- Industrial Materials - The industrial materials lab was refurbished with Measure G bond monies. The instructional equipment however, was not. Most of the equipment is more than 35 years old and must be repaired extensively after each use.
- Mathematics - Because Mechatronics uses hands-on instruction to teach mathematics, various equipment and materials have been collected for this subject. An actual mathematics lab does not exist for Mechatronics.
- Mechanics - The Mechatronics program lacks instructional equipment for teaching mechanics. Instructors bring tools from home but having only one item at a time makes for demonstrations and not hands-on education. Mechanical instructional equipment would greatly enhance student learning.
- Pneumatics - A full set of pneumatics training equipment was purchased in 2005. However, many critical parts are in poor repair and replacement parts are needed to continue to use the equipment.

- Programmable Logic Controllers (PLC) - Four new PLC trainers were purchased in 2013. Two more are needed to complete the lab. These new PLC trainers also double as advanced electrical trainers.
- Robotics - The industrial robotics trainer was purchased in 1999. It is in relatively good working order but has been orphaned by the vendor. Parts and instructional materials are no longer available and textbooks must be copied each year for student use. Computers that are used by the students in conjunction with the trainer are in poor repair, having been inherited from a different program, and the software is dated. If robotics is to continue to be part of the Mechatronics curriculum then the industrial robotic trainer will need to be replaced.
- Welding - Mechatronics students receive their welding education from the Welding department.

A prioritized list of instructional equipment needs for Mechatronics includes:

- An additional two PLC trainers to complete the PLC lab and support the electrical lab.
- Hydraulics trainers and equipment.
- Mechanical trainers, tools, and instructional materials.
- Repair/replace broken pneumatics instructional equipment.
- Air conditioning and refrigeration instructional equipment and materials in order to return ACR to lecture/lab classes.
- Replace the aging industrial robot. Also, update the computers used with the robot.
- Update the industrial materials lab.
- Add instructional equipment to the basic physics lab.

Mechatronics is participating in the TAACCCT grant which may provide some needed funding for instructional equipment and materials.

4.4 Facilities.

Mechatronics uses two classroom/labs and a "dirty lab" for instruction. Because of the wide variety of topics covered in the program it is impossible to provide all necessary laboratory environments in a single room. Also, room overlap would make scheduling impossible if a single space were used for the program.

Room 1818 is a lecture/lab classroom that was refurbished with Measure G bond monies in 2009. The lab equipment in the room is primarily electronics but the room also has good general purpose tables in the middle so lecture/demonstration classes are typically scheduled in 1818 as well. 1818 has room for 30 lecture students or 24 lab students. The only problem with the room is that for some reason the ventilation system dumps thousands of tiny, dead insects onto the lab stations every day.

Room 1819 is a lecture/lab classroom that was also refurbished with Measure G bond monies in 2009. The lab is more general purpose than 1818 and equipment is moved in and out from storage as needed. The chem-top tables and high lab chairs make the room a poor quality lecture hall, and the large robot trainer in the front of the room makes it awkward for anything but industrial education. The lab has plenty of electrical and Internet access, and compressed air is available at each of the tables. No space is available for computers so when computers are needed (primarily for robotics instruction) they must be wheeled in on carts before class and then removed because they block passage between the tables.

Room 1854 was used as a "dirty lab" for industrial electrical, hydraulics, and mechanics instruction until it was closed mid-semester during Spring, 2013. In March of 2013 instructional equipment, materials, and half completed student projects were summarily packed up and moved to an open area behind the building before being locked away in a storage container. While exposed, much of the "recyclables" were stolen, and several pieces of instructional equipment were broken during the move. Instructors did not gain access to the storage container for most of the rest of the semester. As of the writing of this report electrical, hydraulic, and mechanical instructional equipment and materials remain in a storage container making a full assessment of the losses impossible.

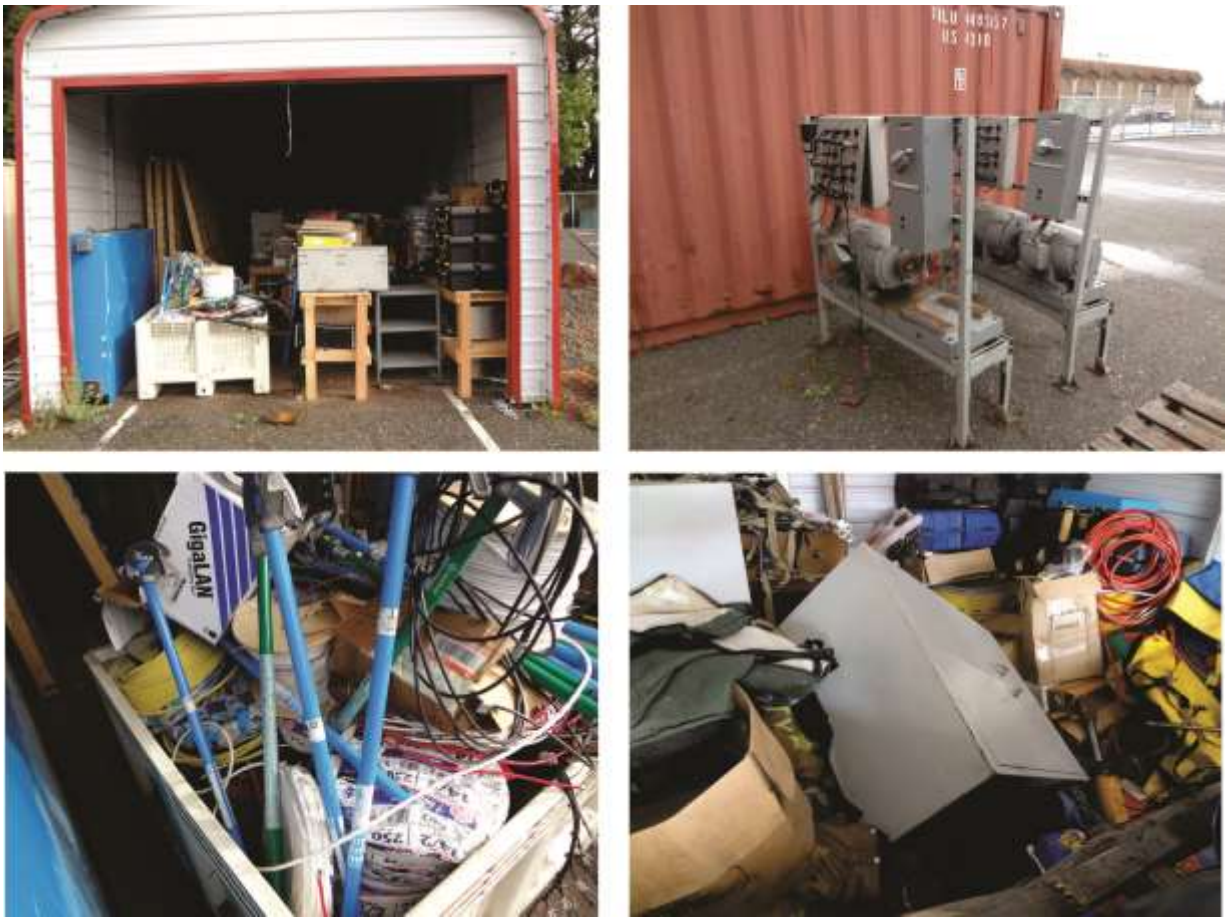

Figure 1. Instructional equipment and materials after being removed from room 1854.

The space has since been refurbished and is being used by a different program. By the end of the Spring, 2013 semester new space in room 1878-1880 had been promised for use by the Mechatronics program to be ready for the start of the Fall, 2013 semester. The new space is still not usable half way into the semester and courses that need that space and equipment are being offered without hands-on.

Should the new space be ready for the Spring, 2014 semester, it will be used for electrical, mechanical, hydraulic, PLC and (hopefully) air conditioning hands-on instruction.

One of the challenges of using multiple rooms for multiple purposes is that equipment must be moved in and out of rooms between semesters (and sometimes between classes). Each time equipment is moved there is a risk of damage to the equipment unless it is moved by individuals familiar with its proper handling. Using labor from the college's facilities department is not helpful because they do not know how equipment needs to be arranged and assembled for instruction. Without laboratory technicians, equipment must now be moved by instructors. Moving heavy equipment places the instructors at risk. Of note is that the full-time instructor was injured moving equipment requiring shoulder surgery and was recovering from a second shoulder surgery when the room 1854 equipment was moved. Also, the part time instructor (now 68-years old) was required to bring more than 100 pieces of equipment into a classroom after the new PLC trainers were delivered.

4.5 Budget/Fiscal Profile.

The Electronics and Maintenance Technician programs had a combined budget of around $6000 for instructional materials, instructional equipment repairs, and software licenses up until the programs were closed. These moneys were regularly supplemented with VTEA funds used for instructional equipment and one-time Measure G funds for capital improvement.

The transition to Mechatronics has been very difficult. No materials budget was provided for the 2011-2012 year forcing the instructors to purchase needed materials out-of-pocket resulting in personal expenditures of nearly $4000. Funding was restored for the 2012-2013 year.

Mechatronics is participating in the TAACCCT grant which may provide some needed funding for instructional equipment and materials.

PROGRAMMATIC GOALS & PLANNING

5.1 Summary of the Last 5 Years.

For all intents and purposes, the Mechatronics program is not yet five years old. It was created by combining the Electronics program with the Maintenance Technician program with input from local industries. The first graduate of the program walked in 2012 and the second in 2013.

At least one student has found employment in advanced manufacturing and several others in agribusiness and building management.

The program has had the typical growing pains associated with new curriculum such as limited facilities and instructional equipment, but has suffered unexpected problems involving missing budgets, shrinking faculty, and capricious scheduling. Mechatronics is now an approved, recognized program and everyone concerned is looking forward to leaving the startup problems behind.

5.2 Short-term and Long-term Goals.

Table 8. Short-Term and Long-Term Goals

Short-Term Goals	***Planned Action***	*Target Date*	*Person Responsible*	*Source*
1. Replace closed "dirty" lab (room 1854)	Oversee construction of new lab in room 1878-1880	August, 2013	Dean	P
2. Hire adjunct instructor to replace ACR instructor.	Submit hiring request Fall, 2013	Summer, 2014	Dean, Mark Berrett	DB
3. Purchase equipment to support PLC and electrical labs.	Submit purchase requests	Spring, 2014	Dean, Mark Berrett	P
4. Purchase instructional equipment to support mechanical and fluid power labs.	Submit purchase requests	Fall, 2014	Dean, Mark Berrett	P
5. Modify ACR curriculum to support lecture/lab format.	Curriculum development	Fall, 2014	Mark Berrett, Advisory Committee	NR
6. Purchase instructional equipment to support air conditioning labs.	Submit purchase request	Spring, 2015	Dean, Mark Berrett	P
7.				

Long-Term Goals	*Planned Action*	*Target Date*	*Person Responsible*	*Source*
1. Replace aging instructional equipment in robotics and industrial materials labs.	Submit purchase requests	Fall, 2015	Dean, Mark Berrett	P
2. Hire additional full-time faculty	Submit hiring request	Fall, 2016	Dean, Mark Berrett	DP
3.				

In the source column denote "SP" for Strategic Proposals, "DP" for Department Budget, "P" for Perkins or "NR" for No Additional Resources Needed.

SIGNATURE PAGE

At the conclusion of the program review process, discipline faculty chose not to sign this self-study.
-Ferdinanda Florence, Academic Program Review Coordinator, 5/2/17