Northampton Community College

Electromechanical Technology

Academic Program Review 2017-2022

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I. Introduction

A. Provide the current purpose of the program.

Northampton Community College's Electromechanical Technology program is designed to help students understand how automated technology and instrumentation are used in industrial manufacturing settings. NCC combines theory and practice within the curriculum to fully cover each degree area, including Electrical, Mechanical, Automation, and Instrumentation. In addition, an extensive selection of courses provides a comprehensive overview of professional maintenance technicians' topics and technologies.

Technicians install, troubleshoot, and repair machinery used in the manufacturing industry. The complexity of these machines and electronic/electrical systems requires the student to gain a strong understanding of electricity, motor controls, fluid power, mechanical components and mechanisms, programmable logic controllers, and instrumentation as they are applied in Industry 4.0. NCC has worked closely with the area's local manufacturers and engineering firms to develop programs that will provide graduates with hands-on skills and help place them into entry-level positions.

B. How does the program advance the mission or strategic focus areas (SFAs) of the college? (Reflect on the program's curriculum, success rates, etc. to highlight where the program specifically promotes one or more of the SFAs)

The most impacted portion of the SFAs is in the advancement of excellence in technology and academic excellence. The Electromechanical Technology program has remained current with technology changes, striving to add new courses and methodologies to the curriculum where needed while maintaining instruction delivered by experienced, professional instructors. Our success rate speaks for itself in that we have 100 percent employment. If the student does well academically and pursues employment in their field of study, high-paying jobs within the local industry base are offered before graduation.

C. Comment on awards, honors, noteworthy accomplishments, or unique features related to the program during the review period.

NCC has had winners of the R Stengyl Automation award each year of the audit period. Students consistently obtain full-time, high-paying jobs by graduation, usually in their last full-time semester. Loyal companies in the local community such as Crayola and Just Born continually send their employees to our program to provide them with necessary training. Companies such as Westrock have taken NCC courses and embedded them into their internal HR training manuals.

D. Catalog Description

1. The current program catalog description is included in Appendix A.
2. Does this description accurately describe the current program?

Yes X No _____

If No, what changes does the program review committee recommend?
Explain reasons for any recommended changes.

E. Previous Program Review

1. Provide the date of the last program review: 2017
2. List the recommendations from that review and indicate the extent to which these recommendations have been implemented. Indicate "I" for recommendations implemented, "IP" for those in progress, and "NI" for those not implemented. For those recommendations not implemented, please explain the circumstances.

Table 1. Status of Recommendations from Last Program Review

Recommendation	Status
Add machining and simple fabrication of parts	IP
Alternate programming language such as C, C++, Arduino and/or raspberry pi	NI
A stand-alone Siemens PLC course	NI
CAD level I	NI

Arduino and raspberry pi are not recognized as industrial programming languages and therefore not considered. Adding another industry recognized programming language such as Siemens automation, C or C++ would certainly enhance the student's academic experience, and job prospects. However, adding additional courses such as coding or CAD courses would require removing another core course from the program.

Creating the new Industrial Maintenance Millwright program will allow us to review the current Electromechanical coursework and redefine and realign some of the courses to meet industry needs.

II. Program Outcomes

A. Program-Level Student Learning Outcomes (see Appendix B).

1. Have the PLOs been updated or revised since the last program review?

Yes x No _____

2. If yes, briefly explain the rationale for the changes (e.g., improving assess ability, conforming to best practices, etc.) Conforming to best practices language, including new course direction.

- Verbs were changed using Bloom's Taxonomy standards to reflect a positive description better and conform to best practices.
- Some courses were updated to reflect the addition of new materials and equipment while maintaining the same course code.

B. Program-Level Performance Indicators

1. Describe the key indicators used to assess the quality and effectiveness of your program relative to its core purpose and the college mission. Best practice is to utilize 8-10 key performance indicators.

   At a minimum, provide data related to retention, persistence, completion, and transfer/job-placement/licensure in Appendix C (year over year tend data for the last five years). Then select four to five other indicators as applicable to include in Appendix C as well. Suggestions include:

   - Indicators of Student Success
   - Transfer/job-placement
   - National, state, or disciplinary benchmarks
   - Student Satisfaction/Feedback, including CCSSE data
   - Alumni Survey (conducted by Institutional Research)
   - Employer Feedback/Placement Reports (Career Services)
   - Other benchmarks as appropriate

   Please consult the data provided through the program review website and discuss the unique indictors that demonstrate how your program is fulfilling its purpose as well as supporting the overall institution and/or other programs (i.e., STEM courses supporting Allied Health programs).

   - Job placement – the Electromechanical Program consistently has more jobs offered by employers than we have students to fill those positions. Based on first-hand knowledge, every student graduating from the program had employment before graduation.
   - Based upon anecdotal knowledge, many enrolled students are full-time employees of companies that send their maintenance staff to NCC to acquire a standard skill set level by selecting specific courses.
   - Many of these companies do not enroll their employees for a 2-year degree but will select courses they want their employees to have.

- Transfer students to 4-year programs include Bloomsburg University, Drexel University, Georgia Institute of Technology, Indiana University of Pennsylvania, and Thomas Edison State University.

III. Environmental Scan

A. Identify current trends in the program's field or discipline.

- Employers are searching to replace their skilled workforce due to retirement.
- Industry is replacing human workforce with automated machinery, robotic workers, and cobots. This has increased the need for employees with those skills to maintain these systems.
- Industry is embracing the 4th industrial revolution dubbed Industry 4.0, which includes high-tech energy-efficient devices to keep a plant running, providing increased feedback on machine status to limit failures and downtime.

B. What has the program done to respond to these trends?

The inclusion of Industry 4.0, Flexible manufacturing, and smart sensor technology has been integrated into the curriculum to prepare students with up-to-date skills and a fundamental understanding of these systems.

C. Does the program have any external transfer articulation or joint admissions agreements?

Yes X No _____

If yes, complete Table 2.

Table 2. Top five program-to-program articulation agreements.

Name of the Institution	Type of Agreement	Average number of students who transfer here each year	Date agreement was last reviewed or updated
Bloomsburg University (BS in Technical Leadership)	60 credit Articulation Agreement	Unknown (data not tracked by program)	2021
Georgia Institute of Technology	NA	NA	NA
Indiana University of Pennsylvania	NA	NA	NA
Thomas Edison State University	NA	NA	NA
Penn State University	NA	NA	NA
Temple University			

Have any problems been encountered concerning the transferability of courses?

Yes _____ No X

If yes, specify the nature of these problems.

D. Does the program have any inbound articulation agreements?

Yes X No _____

If yes, complete Table 3.

Table 3. Inbound articulation agreements.

Name of the Institution	Type of Agreement	Average number of students who transfer here each year	Date agreement was last reviewed or updated
Lehigh Career Technical Institute (LCTI)	IP	TBD	TBD

Notes

An articulation agreement with Bethlehem Vocational-Technical is currently under discussion.

Technical education institutes not offering an electromechanical program can be awarded college credits into NCC's Electromechanical program.

E. Provide regional workforce data with respect to (1) the number of people currently employed in the field; (2) projections for employment growth or decline; and (3) the current salary range. Discuss the implications of these numbers for the program.

Location	Estimated total employment (excludes self-employed)	Median hourly wage	Mean hourly wage	Annual mean wage	Job Outlook 2020 -2030	Employment Change 2020-2030
Industrial Machinery Mechanics (49-9041)						
National	373,090	$28.77	$28.26	$58,780	19% (Much faster than average)	95,200
State - PA	18,500	$28.58	$27.39	$56,980		
Local*	1,190	$29.07	$28.05	$58,350		
Machinery Maintenance Workers (49-9043)						
National	57,660	$23.51	$25.75	$53,570		
State - PA	1,300	$23.09	$24.97	$51,94		
Local*	110	$23.81	$25.94	$53,950		
Millwrights (49-9044)						
National	39,240	$29.00	$29.45	$61,260		
State - PA	1460	$28.83	$29.48	$61,310		
Local*	80	$28.90	$28.58	$59,450		
General Maintenance and Repair workers (49-9071)						
National	1,416,740	$20.76	$21.60	$44,920	8% (As fast as average)	117,000
State - PA	59,040	$21.17	$21.28	$44,250		
Local*	3,870	$22.42	$22.47	$46,730		
Machinists (51-4041)						
National	333,220	$22.95	$23.57	$49,020	7% (As fast as average)	29,700
State - PA	11,490	$22.95	$23.39	$48,650		
Local*	660	$23.72	$24.48	$50,920		
Tool and Die Makers (51-4111)						
National	63,630	$27.41	$26.99	$56,150		
State - PA	3,330	$23.47	$25.81	$53,680		
Local*	150	$28.90	$27.83	$57,880		
Electro-mechanical and Mechatronics Technologists and Technicians (17-3024)						
National	11,590	$29.02	$30.71	$63,880	-2% (As fast as average)	N/A
State - PA	730	$25.83	$27.33	$56,840		
Local*	Numbers Unavailable					

*Local Area: Allentown-Bethlehem-Easton, PA-NJ (includes Carbon, Lehigh, and Northampton PA Counties and Warren County NJ)

Data Source

National https://www.bls.gov/oes/current/oes_nat.htm

State – PA https://www.bls.gov/oes/current/oes_pa.htm

Local – ABE https://www.bls.gov/oes/current/oes_10900.htm

F. Does the program have any community partnerships or other associations or memberships of note?

Yes X No _____

If yes, describe the nature of these relationships

Several companies in the local community including Just Born and Crayola partner with our program to send employees to attend selected classes.

G. Does the program have an advisory committee?

Yes X No _____

If yes, list the names and affiliations of the advisory committee members

- Ken Nasatka – NCC: Director, Automotive, Industry and Manufacturing
- Robert Wolff – NCC: FT Faculty Automation/Instrumentation side
- Gary George – NCC: FT Mechanical Program Manager
- Chuck Jones – General Manager, Keurig/Dr. Pepper
- Raymond Ziegler - Maintenance Manager, Keurig/Dr. Pepper
- George Abt – Electrical Controls Technician, Bihler of America
- Nelson May – Director of Sales and Service, Neal Systems
- Harold Fehnel – Maintenance Supervisor, Just Born
- Doug Metz – Allen Bradley Sales and Support, Kendall Electric
- Judith Milositz – Automated Manufacturing Technology Instructor, BAVTS

Note: This is a newly formed board, first meeting held 02/25/22. Due to personnel changes within the EMEC program leadership, the retirement of John (Skip) Todora, replaced by Robert (Rick) Wolff and Covid, the advisory board was idle for a few semesters.

IV. Curriculum

A. Curriculum Matrix

1. The program's most recent curriculum matrix for the program's learning outcomes can be found in Appendix D.
2. The key abilities matrix (see Appendix E) indicates how the program satisfies NCC's general education core requirements.
3. Based on the curriculum matrix and general education core review, are there any changes that need to be considered?

Yes X No _____

If so, describe these changes.

B. Program and co-curricular maps are in Appendix F and Appendix G.

1. Based on the program map, validate the adequacy of the organized, intentional, sequential learning experiences.

   The program map follows a logical progression of learning outcomes preparing the students with the foundational knowledge for the technical challenges of the second, third and fourth semesters.

2. Based on the co-curricular map, discuss the relationship between students learning and foundational knowledge.

   During the first two semester's majority of students enrolled in the EMEC program are focused on "Get the Courses You Need" and "Get ready for Life after Completion-Career Readiness" portions of the Co-curricular Map. During the third and fourth semesters our students will explore Internships and Externships, attend on-campus Career Fairs, as well as take advantage of resume development offers through Career Services.

3. Are there any changes to the program map or co-curricular map that need to be considered?

   Yes _____ No X

C. Discuss career development and experiential opportunities for students within your program (e.g., internship, capstone, career research courses, service learning, etc.).

The Electromechanical program is about career development as witnessed by all the companies sending their employees to learn base line materials. The nature of our classes is such that more than 50% of class time is experiential learning putting hands to task in both the electrical and mechanical sides. Students wire motors and controls, trouble control logic circuits, install bearings, align shafts, couple shafts, pipe instrumentation circuits for process variable measurement, connect, energize and measure hydraulic and pneumatic process variables and learn basic machining practice drilling, tapping, turning, and milling.

1. Based on a review of these opportunities, are there any changes that need to be considered?

   Yes _____ No X

   If so, describe these changes.

D. Modality Awareness

1. If courses are being offered in online or hybrid formats, discuss the assessment of the effectiveness of these formats.

The majority of EMEC courses are offered as in person modality. For lab-based courses the interaction and immediate instructor feedback is the most effective teaching method for students to master course PLOs.

EMEC130 “Introduction to Process Controls” is currently offered as a 100% on-line course. This course is predominantly lecture based. Students interviewed about course modality reported having difficulty following new material presentations without immediate instructor support to help explain new concepts. A change in course modality to that of a hybrid modality such that an instructor can present new material in a live format is being considered. Students get immediate feedback when new concepts are introduced.

SP2022 - EMEC125 Process Automation Diagrams (P&ID) was successfully converted to hybrid modality. Conversion of other courses into different modalities is continuously being evaluated.

2. Are there any changes to these formats that need to be considered?

Yes _____ No X

If so, describe these changes. _____

V. Assessment

A. Append the current version of the program's Assessment Plan (Appendix H).

B. Using Table 4, provide a summary of the assessment activity that has occurred since the last program review.

Table 4. PLO Assessment

Note: The assessment results are based on course test grades, student laboratory demonstrations and instructor's observations. They were assessed using the following percentile ranking: Above average = 99 to 85 percentile, Average = 84 to 70 percentile, Below Average = 69 to 55 percentile and Poor = 54 and lower percentile.

Any rubrics here to include not imperative

Program Learning Outcomes (include all program outcomes that are listed in the College Catalog)	Describe how the outcome has been assessed in the last five-year period.	What have been the results of that assessment?
Demonstrate an ability to work independently & collaboratively.	Classroom assignments and labs	Students have an above average understanding and retention of the material covered.
Demonstrate competent speaking skills when working with diverse groups	Classroom discussions around using vocabulary used in industry	Students have an average understanding and retention of the material covered.
Describe the operation and application of commonly used automated technology and instrumentation used in modern manufacturing and processing	Laboratory assignments hands-on application	Students have an average understanding and retention of the material covered. Students cannot get enough hands-on activities. They desire more hands-on.
Demonstrate observational, integrative and synthetic skills	Troubleshooting while performing lab assignments	Students have an average understanding and retention of the material covered. Some students spend the time to achieve this, others do not.
Demonstrate proficient research and computer skills in data gathering and analysis	Research and critical thinking assignments	Students have an average understanding and retention of the material covered.
Demonstrate a basic framework of technical vocabulary and graphics interpretation applicable to the area of equipment maintenance and design	Discussions in class and the requirement by the instructor to use proper vocabulary when speaking or asking a question. Reading prints and documents.	Students have an average understanding and retention of the material covered.
Describe the principles and function of the mechanical, electrical, and fluid power components and assemblies used in automated equipment	Through hands-on laboratory experiments/assignments the students must understand the principle function and proper deployment of hardware and software.	Students have an above average understanding and retention of the material covered.
Operate, program, troubleshoot, repair, and modify programmable automation equipment and associated components commonly found in industry	Through task assignments in programming along with implementation of basic troubleshooting	Students have an above average understanding and retention of the material covered.
Demonstrate the proper use of common tools and measuring gages used in automated systems	Hands-on laboratory exercises provide for learning these skills	Students have an above average understanding and

		retention of the material covered.
Apply mathematics to solving equipment related problems	Calculation of experimental probabilities and unknowns in hands-on exercises	Students have an average understanding and retention of the material covered.
Analyze and present data in an acceptable and standardized manner	Written report submissions	Students have an average understanding and retention of the material covered.
Demonstrate the use of OSHA safety standards in servicing electromechanical equipment	Each day students enter a lab environment; they are required to observe essential safety protocols.	Students have an above average understanding and retention of the material covered.
Demonstrate competent technical writing skills	Laboratory and outside of lab assignments.	Students have an above average understanding and retention of the material covered.

C. What programmatic changes have been implemented as a result of recent programmatic assessment activities?

Every semester the instructional staff discusses ways to improve student performance. The comments and suggestions from the advisory committee are reviewed and if valid are implemented into the curriculum.

D. Identify desired changes as a result of programmatic assessment that have yet to take place.

A program of standardized final exams, common assignments and labs are being developed to ensure consistency in student learning outcomes independent of the instructor.

VI. Students.

A. Describe full-time and part-time enrollment trends since the last program review or the past five years.

Table 5. Student Enrollment Data

Academic Year	2020/21	2019/20	2018/19	2017/18	2016/17
FALL					
Full-Time	13	10	20	19	10
Part-Time	19	34	26	33	38
Total Fall	32	44	46	52	48

SPRING					
Full-Time	6	10	14	12	13
Part-Time	19	30	27	37	30
Total Spring	25	40	41	49	43

Within the audit years there has been a trend of more part-time students and more employer sponsored (non-degree seeking) students. This may be partly due to the pandemic and labor shortages in industry attracting unskilled workers with lucrative starting salaries.

B. Describe enrollment trends regarding student age, gender, race, and socio-economic status since the last program review or the past five years.

Table 6. Student Demographic Data

Academic Year	2020	2019	2018	2017	2016
Ethnicity					
Black or African American	3	5	1	3	1
Hispanic	3	6	3	7	6
Non-Resident/ alien	1	1	3	4	1
Two headed or more races	0	1	2	2	0
White	23	29	34	32	37
Sex					
Male	31	42	42	48	45
Female	1	2	4	4	3

Enrollment trends have been consistent over the past five years. There is a mix of ethnic diversity among the student population but very few female students. 60% of students are sent here by their employer, and the remaining 40% directly from High School cyber and Career and Technical Education (CTE). CTE enrollment trend is not readily available for their programs.

C. Describe any concerns the program review committee has regarding: (1) any enrollment trends mentioned above or (2) other enrollment-related issues.

Our greatest challenge is attracting more students into the EMEC program so they can gain the skills needed by industry. Technical skills acquired through this program are in demand equating to employees being highly compensated. We need targeted marking to attract more students into the program. Additionally, Industry continues to hire directly from CTEs to fulfill entry-level positions, which negatively impacts the program enrollment.

D. Has the program instituted any methods or materials to encourage and increase applications by <u>new</u> students since the last program review or the past five years?

Yes X No _____

If yes, please describe any initiatives.

The following course material has been added to the program to further enhance the skills acquired: (1) Fluid Power course covering advanced fluid power concepts, including electrical controls and assorted pumps for students to tear apart and re-assemble for hard skills. (2) Began implementing introductory machining concepts and skills to assist graduates with the ability to fabricate simple parts.

E. Has the program instituted any methods or materials to encourage and increase the recruiting of continuing students to choose this program major or emphasis?

Yes _____ No X

If yes, please describe any initiatives.

F. Comment on graduation rates since the last program review or the past five years.

Graduation rates have been lower, due to lower full-time enrollment rates. This is partly due to the impact of Covid 19 and several students who have chosen full-time work over the completion of their degree, with the intent for completion as a part-time student.

G. Comment on transfer rates for students who have and who have not graduated from the program.

Since 2018, we are unaware of any transfer students. Most seek full-time employment after graduation.

H. Discuss your program's engagement with and impact of new student orientation, advising, tutoring support, disability support, student life, and career services.

Student support, orientation, advising, tutoring, disability support, etc. are of the highest importance. It is the responsibility of the program team to ensure our students have the resources to succeed academically. It is not unusual for us to refer students to potential employment prospects with local employers that we communicate with on a regular basis. Resume writing tasks are referred to student services

VII. Physical and Financial Resources

A. Comment on the availability, adequacy, and use of learning tools, such as computer software, instructional media, laboratories, studios, etc.

IT support equipment (computers, software, etc. is adequate. A simulation software package was purchased for the program. This simulation software will allow students the ability to simulate physical lab environments such as fluid power, electrical, digital logic, and PLC training. This initiative is still in the preliminary stages of implementation.

B. Discuss the adequacy of (1) instructional space, (2) office space, (3) instructional supplies, and (4) equipment for the program.

There is little physical real estate available to expand the program. With additional real estate there would be opportunities to expand our offerings to include additional machining skills, robotics, and an industrial work cell to provide more hands-on exposure to modern industrial environments.

C. Discuss library resources.

The EMEC program does not typically rely on library services; however, EMEC students seeking general studies information would be directed to library services.

D. Comment on the role of marketing and public relations in supporting the program.

Institutional marketing dollars do not extend to individual programs. A marketing strategy has been created by the Program Director and Managers. Other methods of marketing include staff campaigning for the program, student word of mouth and employer enrollment. Skills learned within the program are in demand, and this trend should continue to grow as the current work force retires coupled with the steady growth of industrial automation.

Program Director and Program Managers have been doing targeted outreach to our middle school and high school educational partners as well as meeting with industry to partner in their educational benefit offerings.

As with all the programs in the Industry & Manufacturing AOS (Areas of Study), public exposure needs to be increased. Most middle and high school students and their parents are unaware of the Electronics program at NCC, the articulation agreement in place, and the employment potential for graduating students.

New brochures and data sheets were created by the Program Director to clearly lay out the current articulation agreements with the local CTEs, which companies that hire NCC graduates, and a condensed bi-fold document that gives an overview of all the Industry & Manufacturing programs.

E. Program costs and income.

Table 7. Financial Data

	FY2021	FY2020	FY2019	FY2018	FY2017
Program Income					
Tuition	101,924	136,309	165,171	163,701	134,607
Local Reimb	19,142	23,045	28,067	27,165	22,085
Operating Reimb	46,852	55,890	65,657	62,027	50,796
Stipend Reimb	-	-	-	-	-
Total Income	167,918	215,244	258,895	252,893	207,488
Program Costs					
Direct Costs	125,362	126,037	164,966	167,395	151,667
Indirect Costs	81,872	102,213	128,170	116,777	90,646
Total Costs	207,234	228,250	293,136	284,172	242,313
FTE	19.35	26.80	33.40	33.85	28.49
Income per FTE	8,676	8,031	7,750	7,472	7,283
Cost per FTE	10,707	8,516	8,776	8,396	8,505
Inst Avg Cost per FTE	8,901	7,820	7,933	7,075	6,703
Rank	45 of 138	54 of 135	49 of 133	37 of 126	35 of 132
Income over Expenses	(39,316)	(13,006)	(34,241)	(31,279)	(34,825)

1. Describe how the program is financed, including college budget (if any) as well as any grants that have been received over the past five years, and outline any major expenses over the past five years.

   The program's benefitted from a Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant and Perkins Grant funding in the past. There was no TAACCCT or Perkins Grant funding during the current school year.

   The 2020 year to year expendables were covered by College Budgetary resources.

   Previous TAACCCT and Perkins Grant funding Resources applied to:

   I. Purchased Instrumentation trainers ($550K)

   Perkins Grant Funding:

   I. Purchased 1 additional Pneumatic training cart ($22K)
   II. Purchased 3 Hydraulic training carts ($132K)
   III. Purchased 2 mid-sized low-end lathes ($16K)
   IV. Purchased tooling ($10K)
   V. Purchased Mechanical Training equipment and tooling ($38K)

2. If possible, analyze the program's cost-effectiveness (i.e., does current/projected student enrollment cover the cost of faculty, supplies, etc. and/or are the faculty staff, space and/or facilities appropriate for the current/projected enrollment).
   The program is capital intensive and relies on NCC Capital approval and Perkins funding.
   Course material fees need to be increased to reflect the increased costs for course materials.
3. Are you getting additional funding from grants or donors?
   No

VIII. Human Resources

A. Briefly describe Program Leadership and oversight.
One full-time instructor and one program manager oversee development of the program, teach the majority of courses, maintain the labs as well as oversee adjunct instructors.

B. Report the numbers of full-time and part-time faculty, professional staff, and clerical staff currently associated with the program.

Table 8. Faculty Demographic Data

Rank	Last Review	Current Review
Full Time	2	2
Part Time	6	4
Clerical	1.5	1

Note: Six adjuncts are on our list, however in the current spring 2022 semester, only four are teaching.

1. Note any changes that have occurred in these numbers since the last program review or the previous five years.

   The full-time instructor was hired for the electrical side of the program and retired in spring 2019, creating a large gap in the teaching staff. In the summer 2020, a replacement full-time instructor was hired to fill the position.

2. Briefly explain how these changes have affected the program.

   It's never easy losing someone who was instrumental in the development of EMEC program and a part college community for many years; however, the program is at an inflection point, and the introduction of new leadership at this junction is a positive thing. It's an opportunity to interject new perspectives into the program.

C. What is the ratio of full-time to part-time faculty? What percentage of (1) day sections, (2) traditional evening/weekend sections, (3) distance education/hybrid sections, and total

sections are taught by full-time faculty. Comment on the levels of full-time, part-time faculty, and professional or clerical staff.

The ratio of full-time to part-time instructors is 1:3, which is manageable. As enrollment increases and more courses are added to the program this ratio will need to be revaluated.

The percentage of day to evening program specific courses is approximately 75% day, 25% evening with no weekend offerings this time; however, to accommodate students working full time additional evening courses and the possibility of weekend courses are under consideration for Fall22.

There are fifteen program specific courses, with only one course currently offered online. The percentage of program specific distance education/hybrid courses is 6.5% compared to the 93.5% of face-to-face courses. This is predominantly because of the hands-on nature of the core classes.

The nine required Math, English, Physics, Communication and General Electives all have numerous modality options.

D. Faculty Expertise/Experience

1. Northampton hires faculty members who are well-credentialed (see Appendix I, Appendix J and Appendix K) and understand and embrace the open-access mission of the community college. The faculty and instructors are evaluated at the end of every semester.

2. How do faculty in this program promote academic excellence through professional development, scholarship, and service?

   Technical journals provide insights toward academic excellence. The staff keeps abreast of current trends through constant review of textbooks, online journals and webinars, interactions with local industry leaders and the advisory board. All these resources combined support advancement of the curriculum.

IX. Analysis of Findings

A. Based upon the data collected in this document, discuss the strengths and weaknesses of your program. *For example: do students' progress successfully through courses; are staffing/equipment/facilities needs filled; are assessment efforts successful; etc.*

Based on data within this audit, feedback from the program advisory board, and demand by industry to hire NCC's Electromechanical Technology graduates, the program is meeting industry needs.

Due to the demand for the skillsets gained during the student's progression through the program, most students have secured employment by their third semester. Hiring daytime adjuncts from the industry is an issue due to the high demand for these employees. As with any program with embedded technology requirements, securing funding, placement, and implementing new technology is a constant challenge.

B. Based on the data collected in this document, discuss the opportunities for improvement available to your program and the internal and external challenges your program faces. *For example: is the program in demand; are graduates employable/able to transfer; what is the future plan for this program; etc.*

The skills gained in this program are in demand and will continue to be for the foreseeable future. We consistently have more employers looking to hire our graduates than graduates to fill these jobs. Many of our part-time students are enrolled in the coursework by their employer to gain training. The fact that employers send their employees here to increase their value within the company speaks highly of the demand our program exhibits.

Our biggest external challenge is attracting more full-time students into the program. Industry is competing against positions with starting salaries over $20 per hour with minimal skills required and limited advancement opportunities. Industry is also competing against itself by hiring students graduating from the CTEs to fill entry-level positions, thus reducing the number of AAS graduates available. NCC needs to market to middle schools to educate potential students, parents, guidance counselors, and teachers about the potential careers available with an Electromechanical Technology AAS degree.

The biggest internal challenge is deciding how to update the Electromechanical program curriculum to be more relevant to industry needs. Technically the program is two separate areas of study, based on electrical (automation) and mechanical (maintenance) disciplines. The skills gained for either discipline is very marketable. Steps have been taken to update the current program curriculum. Students will have the option to pursue a broader exposure to either the electrical (automation) or mechanical (maintenance) disciplines. This change will lead to two separate programs, the Industrial Maintenance Millwright program, which will focus on the mechanical, electrical, and welding skills, and

an Electrical Automation (Electromechanical) program that would emphasize more computer programming skills, industrial hardware networking exposure, and robotics. The Industrial Maintenance Millwright program will allow multiple CTE programs to articulate into it based on the student's interest. Graduates from either program will continue to be in high demand for the foreseeable future.

C. What additional data that is currently not available would have been helpful to evaluate this program effectively?

The ability to obtain specific data during the academic year when needed to assist in making decisions that could improve enrollment and retention, schedule course sections when needed, evaluate where incoming students are coming from and why, and general industry trends and future directions.

X. External Review Report

Refer to Appendix L for the external/accreditor review report.

XI. Action Plan Identify 2-3 program goals for the future.

Goal: Review the current program course requirements and realign them to meet industry standards. This effort will allow us to remove courses no longer required, add new courses per Industry recommendations and keep the program within its current number of credits. The feasibility of a standard first semester for the Electronics and Electromechanical programs will be reviewed.

i. Timeframe: 1 year
ii. Responsible Parties: Robert E. Wolff, Stephen Strom
iii. Resource Implications: Approval by the Tech cluster and the curriculum committee.

Goal: Incorporate the following technologies into the program: Industrial program languages (function block, sequential function charts, scripting), operator interface programming, robotics, and smart technology (sensors, valves, and VFDs).

i. Timeframe: 2-4 years
ii. Responsible Party: Robert E. Wolff
iii. Resource Implications: Capital Investment will be required for hardware and trainers, additional instructor resources, and to utilize the available credits resulting from the successful completion of goal one.

Goal: Incorporate computer networking into the program

i. Timeframe: 2 years
ii. Responsible Party: Robert E. Wolff
iii. Resource Implications: To provide an in-depth knowledge of this skill will require an additional instructor resource and additional program credits. The course CISC 131 Data Communications and LANs will be reviewed for relevancy. If this course meets the program requirements it will accelerate the completion timeframe.

Goal: Update the Industrial Automation Lab (bring the trainer up to current standards: power supplies, operator interfaces, field devices).

i. Timeframe: 2-4 years
ii. Responsible Party: Robert E. Wolff
iii. Resource Implications: (Capital Investment required for hardware updates)

iv. Resource Implications:

The EMEC is constrained by financial and program credit limitations. The technological complexity of industrial manufacturing is continuously evolving requiring students to be exposed to more information allowing them to thrive in the industrial manufacturing environment. These financial and program credit constraints have and will continue to be the challenge for the EMEC program leadership to determine how best to provide our students with the best information possible given these limits.

Appendix A: Program Description

Northampton's Electromechanical Technology Program offers a range of stackable degrees; starting with a specialized diploma, 25 credits, that can be completed in a year and a half, a certificate program requiring a minimum of 27 credits in a year and a half, and an AAS degree requiring a minimum of 68 credits in two years.

The Specialized Diploma in Electromechanical Technology prepares students to enter a manufacturing position in an abbreviated time frame or advance current skills to the next level as a Machine Repair Technician Trainee, or Mechanic Helper.

The Electromechanical Technology Certificate prepares students to enter a career in automated manufacturing as a skilled technician as a Maintenance Technician, Instrumentation Technician in areas such as Chemical Equipment Maintenance, Biotech Equipment Maintenance, Electromechanical Equipment Assembler, Control Valve Installer/Repairer, Maintenance Technician, Wastewater Treatment Systems Maintenance.

The Electrical Technology AAS Degree prepares students to enter the workforce as an Electromechanical Technician, Industrial Maintenance Technician, Instrumentation Technician, or Maintenance Supervisor. This program offers the student a well-rounded technical education with opportunities to seek an advanced 4-year degree in Electrical or Mechanical Engineering Technology studies.

Narrative

Industrial technology is a high priority occupation. The use of electromechanical automation to control manufacturing processes enables high productivity and competitiveness in the global economy. It also demands well-trained technicians who can service, maintain, install, and retrofit this sophisticated equipment.

Northampton's Electromechanical Technology Automated Systems A.A.S. degree program is designed to prepare you to enter the maintenance or computer-controlled manufacturing environment. Our graduates are qualified to work on such technology as robotics, material handling systems and pharmaceutical packagers as well as most machines and equipment that are controlled with programmable logic controllers.

You can choose to complete our specialized diploma in Machine Repair or our certificate in Instrumentation Process Control to enter the field more quickly. However, if you would like to add to your competitiveness or are considering furthering your education, Northampton's associate degree in Electromechanical Technology is an excellent option.

Appendix B: Program-Level Learning Outcomes

Students who complete the Electromechanical Technology Automated Systems program will be able to:

- Demonstrate an ability to work independently & collaboratively.
- Demonstrate competent speaking skills when working with diverse groups.
- Describe the operation and application of commonly used automated technology and instrumentation used in modern manufacturing and processing.
- Demonstrate observational, integrative and synthetic skills.
- Demonstrate proficient research and computer skills in data gathering and analysis.
- Demonstrate a basic framework of technical vocabulary and graphics interpretation applicable to the area of equipment maintenance and design.
- Describe the principles and function of the mechanical, electrical, and fluid power components and assemblies used in automated equipment.
- Operate, program, troubleshoot, repair, and modify programmable automation equipment and associated components commonly found in industry.
- Demonstrate the proper use of common tools and measuring gages used in automated systems.
- Apply mathematics to solving equipment related problems.
- Analyze and present data in an acceptable and standardized manner.
- Demonstrate the use of OSHA safety standards in servicing electromechanical equipment.
- Demonstrate competent technical writing skills.

Appendix C: Program-Level Performance Indicator Data

Year	Total Students[a]	Withdrew[b]	Withdrew and transferred[c]	Retained in new major[d]	Retained in same major[e]	Graduated[f]	Graduated and Transferred[g]	% retention[h]
2019	44	20	0	0	22	0	2	54.5%
2018	46	14	1	1	21	8	1	67.4%
2017	52	25	0	3	18	5	1	51.9%
2016	48	14	1	4	23	5	1	68.8%
2015	43	14	0	0	20	9	1	68.2%

a. Enrollment as of Fall census date
b. Withdrew prior to following year census
c. Withdrew and transferred prior to following year census
d. Stayed at NCC but was in a different major the following year census
e. Stayed at NCC and was still in the same major the following year census (these students will be part of the following year total enrollment number)
f. Graduated prior to following year census
g. Graduated and transferred to another institution prior to following year census
h. Percent of total students either graduated or still at NCC

Appendix D: Curriculum Matrix

List all of the program learning outcomes for the program of study in the first column. List the program courses across the top row. Then make "**I**" for a learning outcome that is introduced (*addressed for the first time*), "**R**" for a learning outcome that is reinforced (*addressed again, but not emphasized in a major way*), and/or "**M**" for a learning outcome that emphasized (*addressed in a major way, emphasis toward mastery*) under each specific course.

Please note: Not every course will address every program learning outcome.

Program Learning Outcomes	EMEC 101 ELTC101	EMEC 125	EMEC 130	EMEC 105	EMEC 110	EMEC 135 ELTC135	EMEC 140	EMEC 220	EMEC 240	EMEC 251	EMEC 225
1. Demonstrate an ability to work independently & collaboratively.	I,R	I	I	I,R	R	R	R	R	R	R	R
2. Demonstrate competent speaking skills when working with diverse groups				I,R	R						I
3. Describe the operation and application of commonly used automated technology and instrumentation used in modern manufacturing and processing	I,R	I	I	R,M	I,R	R	I,R	I,R	I,R	I,R	R
4. Demonstrate observational, integrative and synthetic skills	I,R	I	I	R,M	R	R	R	R	R	I,R	R
5. Demonstrate proficient research and computer skills in data gathering and analysis		I	I								
6. Demonstrate a basic framework of technical vocabulary and graphics interpretation applicable to the area of equipment maintenance and design				R,M	R		R	R	I,R	R	I,R
Program Learning Outcomes	EMEC 101 ELTC101	EMEC 125	EMEC 130	EMEC 105	EMEC 110	EMEC 135 ELTC135	EMEC 140	EMEC 220	EMEC 240	EMEC 251	EMEC 225

7. Describe the principles and function of the mechanical, electrical, and fluid power components and assemblies used in automated equipment				R	R	R	R	R	R	R	I,R
8. Operate, program, troubleshoot, repair, and modify programmable automation equipment and associated components commonly found in industry				R	R		R	R	I,R	I,R	R
9. Demonstrate the proper use of common tools and measuring gages used in automated systems	I			R	R	R	R	I,R	I,R	I,R	I,R
10. Apply mathematics to solving equipment related problems	I			R	R	R	R	R	I,R		R
11. Analyze and present data in an acceptable and standardized manner	I,R	I,R	I	R		R	R	R	R		R
12. Demonstrate the use of OSHA safety standards in servicing electromechanical equipment	I,R			R	R	R				R	
13. Demonstrate competent technical writing skills				R							

Appendix E: Key Abilities Program Matrix

The five Gen Ed Key Abilities help students navigate the world. In each class they take, they should expect to be challenged to develop and deepen their key abilities. After they graduate, these abilities will help them continue learning, adapt to change, and become citizens who can make wise choices and contribute to their communities.

1. ***Communicate***
   - *Students are able to share their ideas powerfully and clearly.*
     - *Uses appropriate, relevant, and compelling content and sources that illustrate knowledge and understanding of the topic.*
     - *Assignment is organized and understandable. Distinct intro, body, and conclusion, as appropriate for the discipline.*
     - *Language is clear and understandable. Executes assignment within conventions of a specific discipline, including source citation.*
2. ***Analyze and Solve Problems***
   - *Students are able to see and solve the problems around them, using solid data to draw and communicate reasonable conclusions.*
     - *Identify and understand an issue, concept, or problem, any data needs, and constraints that have to be considered in order to analyze an issue or solve a problem. Students recognize multiple perspectives*
     - *Use various tools, representations, notation, etc. to help them organize data and see relationships or identify assumptions related to the issue, concept or problem*
     - *Evaluate any conclusions drawn, implications made, or plans for solving a problem, including evaluating any assumptions and any evidence gathered.*
3. ***Use Technology***
   - *Students are able to select and ethically use appropriate technology to create, communicate and discover.*
     - *Effectively select and use the appropriate technology applications or resources to accomplish specific goals.*
     - *Be an active and responsible participant in online communities.*
     - *Understand the legal and ethical facets of technology in a global society.*
4. ***Understand Diversity***
   - *Students are able to understand how each individual's experiences shape our society, and how societies, in turn, shape the way local and global resources are used.*
     - *Explain how the range of human differences shape the historical and current formation of artistic, economic, social, scientific, cultural or political institutions*
     - *Explain how individuals experience equality and inequality with a society, its institutions or its cultures*
     - *Analyze how individuals and institutions have addressed persistent global challenges, including physical resources and social values.*
5. ***Engage in Ethical Questions***
   - *Students are able to identify ethical choices, consider alternatives and consequences, and choose actions keeping in mind everyone affected.*

Indicate in the table below the program courses in which a key ability is assessed ("**A**"- Assessed) – if possible, identify the specific assignment/activity in which the key ability is assessed. Focus on the required courses and designated program electives.

Gen Ed (Key Abilities) Learning Outcomes	EMEC101 ELTC101	EMEC125	EMEC130	EMEC105	EMEC110	EMEC135 ELTC135	EMEC140	EMEC220	EMEC240	EMEC251	EMEC225
Communicate: Students will be able share their ideas powerfully and clearly.			A	A	A	A	A	A	A	A	A
Analyze and Solve Problems: Students will be able to see and solved the problems around them, using solid data to draw and communicate reasonable conclusions.	A		A	A	A	A	A	A	A	A	A
Understand Diversity: Students will be able to understand how each individual's experiences shape our society, and how societies, in turn, shape the way local and global resources are used.				A	A					A	
Engage in Ethical Questions. Students will be able to identify choices, consider alternatives and consequences, and choose actions keeping in mind everyone affected.				A	A					A	
Use Technology. Students will be able to select and ethically use appropriate technology to create, communicate, and discover.				A	A	A	A	A	A	A	A

Communicate:

· Reports/presentations/discussions from various EMEC courses
· Technical reports from ENGL151T

Analyze and Solve Problems

· Standardized final exams and assessments
· All Electromechanical coursework and labs

Understand Diversity

· All PowerPoints and class materials will be reviewed and updated as needed.
· Include examples of DEI in lectures · Incorporating DEI YouTube videos into lessons 10-influential-women-in-engineering women in trades
· Note: A majority of the supporting course items are supplied by the textbook companies and cannot be modified by NCC.

Engage in Ethical Question

· Communication coursework instructions.
· Internships and employer feedback

Use Technology

· Successfully showing understanding of the various equipment required in the courses.
· All Electromechanical coursework, lab work, and exams

Appendix F: Program Maps

Electromechanical Technology: Automated Systems - Associate in Applied Science (2021-22 Catalog)

SEMESTER-BY-SEMESTER PROGRAM MAP FOR FULL-TIME STUDENTS
Courses are listed in preferred order of completion
Plans can be modified to fit student needs by adding more semesters
Choose your courses with your Advisor.

Developmental Education Courses *(if required)*					
☐	ACLS050	Introduction to Academic Literacy	☐	MATH020	Pre-Algebra
☐	ENGL027	Writing Skills Workshop	☐	MATH022	Elementary Algebra
			☐	MATH026	Intermediate Algebra

Location: B= BETH, M= MROE, S=SBTH, E= ESTN, D= DIST *subject to change

	complete	Course #	Course Title	Credits	Gen Ed	Fall	Winter	Spring	Summer	Pre-requisites / Co-requisites
Semester 1	☐	COLS101	College Success	1		B,M,D	----	B,M,D	D	
	☐	ELTC101	Electrical Fundamentals	3		B	----	B	B	
	☐	EMEC125	Process Automation Diagrams – P&ID	2		B	----	B	----	
	☐	EMEC130	Introduction to Process Control	3		D	----	D	----	
	☐	ENGG117	Technical Drawings and Specification	3		B	----	B	----	
	☐	ENGL101	English I	3	Comm.	B,M,D	----	B,M,D	B,M,D	PRE: ENGL Placement Policy
	☐	MATH140	College Algebra	3	QL	B,M,D	----	B,M,D	B,M,D	PRE: MATH026 or MATH Placement
			Total Semester Credits:	18						
Semester 2	☐	EMEC105	Introduction to Fluid Power	3		B	----	B	----	PRE: MATH022 or MATH Placement
	☐	EMEC110	Mechanical Components	3		B	----	B	----	PRE or CO: ENGG117
	☐	ELTC135	Electrical Motors and Controls	4		B	----	B	B	PRE: ELTC101
	☐	EMEC140	Sensors, Wiring and Troubleshooting	1		B	----	B	----	PRE: ELTC101
	☐	ENGL151T	English II (Technical Writing)	3	Comm.	B	----	B	----	PRE: ENGL101
	☐		AH, SIT, or SSHB General Ed.Elective	3	AH, SIT, SSHB	B	----	B	----	
			Total Semester Credits:	17						
Semester 3	☐	CMTH102	Introduction to Communication	3	Comm.	B,M,D	----	B,M,D	B,M,D	
	☐	EMEC220	Instrumentation I	3		B	----	----	----	PRE: EMEC125 and EMEC130
	☐	EMEC240	Industrial Control Systems I	4		B	----	----	----	PRE: ELTC101; PRE or CO: EMEC140
	☐	EMEC205	Electrical Controls of Fluid Power	3		B	----	----	----	PRE or CO: EMEC105, EMEC110, & ELTC135
	☐	PHYS101	Physics I	4		B,M,D	----	B,D	M,D	PRE: MATH140 with C or better
			Total Semester Credits:	17						
Semester 4	☐	EMEC225	Instrumentation II	3		----	----	B	----	PRE or CO: EMEC220
	☐	EMEC245	Industrial Control Systems II	3		----	----	B	----	PRE: EMEC240
	☐	EMEC251	Mechanical Systems	2		B	----	B	B	PRE: ENGL101; PRE or CO: completion of all other
	☐	OSAH101 or OSAH102	Construction Industry Outreach Safety Education* or General Industry Safety Education**	1		B,M,D	D	B,M,D	B,M,D	
	☐		AH, SIT, or SSHB General Ed.Elective	3	AH, SIT, SSHB	B,M,D	D	B,M,D	B,M,D	
	☐		Elective	3		B,M,D	D	B,M,D	B,M,D	
			Total Semester Credits:	16						
			Total Degree Credits	68						

General Education Requirements		
☐		Diversity
☐		Writing Intensive

**OSAH102 is the recommended selection
+For the General Education Electives, students must select one course from the list of approved courses in two of the following categories: Arts & Humanities (AH); Social Science: Societies and Institution over Time (SiT); Social Science: Scientific Study of Human Behavior (SSHB). *One course should be designated as Diversity and Global Awareness (D). *One elective must be taken a Writing Intensive (WI) section

***It is the student's responsibility to be knowledgeable of NCC graduation requirements and to verify transfer requirements with the 4-year institution. Courses listed on the program map are based upon the assumption that prerequisites and courses taken in previous semesters will be successfully completed**

Instrumentation Process Control Technician – Certificate (CE) (2021-22 Catalog)

Developmental Education Courses *(if required)*					
☐	ACLS050	Introduction to Academic Literacy	☐	MATH020	Pre-Algebra
☐	ENGL027	Writing Skills Workshop	☐	MATH022	Elementary Algebra
			☐	MATH026	Intermediate Algebra

SEMESTER-BY-SEMESTER PROGRAM MAP FOR FULL-TIME STUDENTS
Courses are listed in preferred order of completion
Plans can be modified to fit student needs by adding more semesters
Choose your courses with your Advisor.

						Location: B= BETH, M= MROE, S=SBTH, E= ESTN, D= DIST *subject to change				
	complete	Course #	Course Title	Credits	Gen Ed	Fall	Winter	Spring	Summer	Pre-requisites / Co-requisites
Semester 1	☐	COLS101	College Success	1		B, M, D	----	B, M, D	D	
	☐	ELTC101	Electrical Fundamentals	4		B	----	B	B	
	☐	EMEC125	Process Automation Diagrams – P&ID	2		B	----	B	----	
	☐	EMEC130	Introduction to Process Control	3		B, D	----	B, D	----	
	☐	MATH140	College Algebra	3	QL	B,M,D	----	B,M,D	B,M,D	PRE: MATH026 or MATH Placement
			Total Semester Credits:	13						
Semester 2	☐	ENGL101	English I	3	Comm.	B,M,D	----	B,M,D	B,M,D	PRE: ENGL Placement Policy
	☐	EMEC140	Sensors, Wiring and Troubleshooting	1		B	----	B	----	PRE: ELTC101
	☐	EMEC240	Industrial Control Systems I	4		B	----	----	----	PRE: ELTC101; PRE or CO: EMEC140
	☐	EMEC220	Instrumentation I	3		B	----	----	----	PRE: EMEC125 and EMEC130
			Total Semester Credits:	11						
Semester 3	☐	EMEC225	Instrumentation II	3		----	----	B	----	PRE or CO: EMEC220
	☐	EMEC245	Industrial Control Systems II	3		----	----	B	----	PRE: EMEC240
	☐	PHYS101	Physics I	4	Science	B,M,D	----	B,M,D	M,D	PRE: MATH140 with C or better
			Total Semester Credits:	10						
			Total Degree Credits	34						

***It is the student's responsibility to be knowledgeable of NCC graduation requirements and to verify transfer requirements with the 4-year institution. Courses listed on the program map are based upon the assumption that prerequisites and courses taken in previous semesters will be successfully completed**

Machine Repair - Automated Systems Technology Specialized Diploma (2021-22 Catalog)

SEMESTER-BY-SEMESTER PROGRAM MAP FOR FULL-TIME STUDENTS
Courses are listed in preferred order of completion
Plans can be modified to fit student needs by adding more semesters
Choose your courses with your Advisor.

Developmental Education Courses *(if required)*			☐	MATH020	Pre-Algebra
☐	ACLS050	Introduction to Academic Literacy	☐	MATH022	Elementary Algebra
☐	ENGL027	Writing Skills Workshop	☐	MATH026	Intermediate Algebra

Location: B= BETH, M= MROE, S=SBTH, E= ESTN, D= DIST *subject to change

	complete	Course #	Course Title	Credits	Gen Ed	Fall	Winter	Spring	Summer	Pre-requisites / Co-requisites
Semester 1	☐	COLS101	College Success	1		B, M, D	----	B, M, D	D	
	☐	ELTC101	Electrical Fundamentals	3		B, M, D	----	B, M, D	B, M, D	
	☐	EMEC105	Introduction to Fluid Power	3		B	----	B	----	
	☐	EMEC114	Mechanical Skills for the Trades	2		B	----	B	----	
	☐	ENGG117	Technical Drawings & Specifications	3		B	----	B	----	
			Total Semester Credits:	12						
Semester 2	☐	EMEC110	Mechanical Components	3		B	----	B	----	Pre- or Coreq. - ENGG 117
	☐	ELTC135	Electrical Motors and Controls	4		B	----	B	----	PRE: ELTC101
	☐	EMEC140	Sensors, Wiring, and Troubleshooting	1		B	----	B	----	PRE: ELTC101
	☐	EMEC251	Mechanical Systems	3		B	----	----	----	Pre- or coreq. - EMEC 105, 110, and 135
	☐	OSAH101 or OSAH102**	Construction Industry Outreach Safety Education or General Industry Safety Education**	1		B	----	B		
			Total Semester Credits:	12						
			Total Degree Credits	24						

** OSAH102 General Industry Safety Education is the recommended selection

Appendix G: Co-curricular Map

PROGRAM NAME: **Electromechanical Technology**

AY 18-19

	0 - 15 credits	16 – 30 credits	31 – 45 credits	46+ credits
Get the Courses You Need	Take the following courses:	Take the following courses:	Take the following courses:	Take the following courses:
	COLS101 College Success (1) **EMEC101 Electrical Fundamentals (3)** **EMEC125 Process Automation Diagrams – P&ID (2)** **EMEC130 Introduction to Process Control (3)** ENGG117 Technical Drawings and Specification (3) ENGL101 English I (3) MATH140 College Algebra (3) 18 Credits	EMEC105 Introduction to Fluid Power (3) **EMEC110 Mechanical Components (3)** **EMEC135 Electrical Motors and Controls (4)** **EMEC140 Sensors, Wiring and Troubleshooting (1)** ENGL151T English II (Technical Writing) (3) AH, SIT, or SSHB General Education Elective (3) 17 Credits	CMTH102 Speech Communication (3) **EMEC220 Instrumentation I (3)** **EMEC240 Industrial Control Systems I (4)** **EMEC205 Electrical Controls of Fluid Power (3)** PHYS101 Physics I (4) 17 Credits	**EMEC225 Instrumentation II (3)** **EMEC245 Industrial Control Systems II (3)** **EMEC251 Mechanical Systems (2)** OSAH100 Industry Outreach Safety Education (1) AH, SIT, or SSHB General Education Elective (3) Elective (3) 16 Credits
	For details on course requirements, see the Program Map.	*For details on course requirements, see the Program Map.*	*For details on course requirements, see the Program Map.*	*For details on course requirements, see the Program Map.*
Engage with the Spartan Experience	- Attend at least one campus recreation event - Attend Guest Speakers - Join student club(s) - Review academic plan - Seek out community service/ service learning opportunities	- Attend Guest Speakers - Discuss elective/gen ed options - Explore internships via Career Services - Seek out community service/ service learning opportunities - Tour Fowler/Fab Lab	- Attend Guest Speakers - Mentor new students - Research Center for Innovation & Entrepreneurship - Seek out community service/ service learning opportunities	- Apply for student awards - Attend Guest Speakers - Mentor new students - Seek out community service/ service learning opportunities

Get Ready for Life after Completion – Career Readiness	- Attend Career Service Sessions - Attend on-campus Career Fairs – Fall & Spring semesters at both Bethlehem & Monroe campuses - Complete the career readiness GPS to help select a potential Business major	- Attend on-campus Career Fairs – Fall & Spring semesters at both Bethlehem & Monroe campuses - Attend sponsored company tours - Complete stackable credentials	- Arrange job shadowing experience - Attend on-campus Career Fairs – Fall & Spring semesters at both Bethlehem & Monroe campuses - Complete stackable credentials - Explore Internships, externships – list potential experiences - Explore job shadowing experience – list potential employers - Research practicum sponsors (list potential employers) - Resume Development - Social media creation or update	- Apply for FT jobs - Apply for graduation - Attend on-campus Career Fairs – Fall & Spring semesters at both Bethlehem & Monroe campuses - Complete practicum - Complete stackable credentials - Review and take certification testing
Get Ready for Life after Completion – Transfer Readiness	- Identify transfer colleges/universities – list transfer articulation agreements or other transfer opportunities	- Contact Transfer Advisor to gain knowledge of application process - Create list of potential transfer schools	- Attend college fairs/visits - View list of articulation agreements - Choose your transfer institution and gather application materials - Ask a professor(s) for an “excellent” reference	- Apply for graduation - Apply for transfer to a college or university at the beginning of the semester.

Appendix H: Assessment Plan

	Program Learning Outcomes (PLOs)	Course Used to Assess
AY 2020-2021	#6, #7, #8	All EMEC courses
AY 2021-2022	#1, #2	All EMEC courses
AY 2022-2023	#4, #9	All EMEC courses
AY 2023- 2024	#3, #5	All EMEC courses
AY 2024-2025	#10, #11	All EMEC courses
AY 2025-2026	#12, #13	All EMEC courses

Appendix I: Teaching Faculty Credentials

Robert Wolff, BS Electrical Engineering, AS Electrical Engineering

Gary George, BS Mechanical Engineering, AS Engineering, AAS Electromechanical Technology

Thomas Sutliff MBA, BAS Technical Leadership, Associates in Electromechanical Technology

Barry Russo, AS Electronics, AAS Electromechanical Technology

Gregory Glovas, BS Secondary Education: Social Studies

Michael Ahner, BS Drafting Technology, AAS Electromechanical Technology

Thomas Raidline, 2 years of Studies in Electrical Engineering, AS Electronics Technology

Jeffery Siegfried - Caterpillar Certified Training for: Hydrostatic Power Control, Bent Piston Pump, CFC Refrigerant Training, Electrical Control of Hydraulics, Fundamentals of Hydraulics, Computerized Monitoring Systems, Fuel Systems, Applied Failure Analysis, Fundamentals of Air Conditioning

Appendix J: Evaluations – Full Time

1 COURSE EVALUATION : (-)						
		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.1	The course materials (syllabus, course calendar, handouts, assignments, etc...) are clear and understandable.	○	○	○	○	○
1.2	Assignments allowed me to demonstrate my learning.	○	○	○	○	○
1.3	The instructor promotes an atmosphere of mutual respect.	○	○	○	○	○
1.4	The instructor creates an environment in which students feel comfortable contributing.	○	○	○	○	○
1.5	The instructor helps students relate course material to their lives.	○	○	○	○	○
1.6	The instructor provides useful feedback to students.	○	○	○	○	○
1.7	The instructor demonstrates interest in teaching the subject matter.	○	○	○	○	○
1.8	The instructor is open to feedback from students.	○	○	○	○	○
1.9	*Predefined optional question*	○	○	○	○	○
1.10	*Predefined optional question*	○	○	○	○	○
1.11	*Predefined optional question*	○	○	○	○	○
1.12	*Predefined optional question*	○	○	○	○	○
1.13	*Predefined optional question*	○	○	○	○	○
1.14	*Predefined optional question*	○	○	○	○	○
1.15	*Predefined optional question*	○	○	○	○	○
1.16	*Predefined optional question*	○	○	○	○	○
1.17	*Predefined optional question*	○	○	○	○	○

Appendix K: Evaluations – Part Time

1 COURSE EVALUATION : (-)

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.1	The course materials (syllabus, course calendar, handouts, assignments, etc…) are clear and understandable.	○	○	○	○	○
1.2	Assignments allowed me to demonstrate my learning.	○	○	○	○	○
1.3	The instructor promotes an atmosphere of mutual respect.	○	○	○	○	○
1.4	The instructor creates an environment in which students feel comfortable contributing.	○	○	○	○	○
1.5	The instructor helps students relate course material to their lives.	○	○	○	○	○
1.6	The instructor provides useful feedback to students.	○	○	○	○	○
1.7	The instructor demonstrates interest in teaching the subject matter.	○	○	○	○	○
1.8	The instructor is open to feedback from students.	○	○	○	○	○
1.9	The instructor was well prepared for class.	○	○	○	○	○
1.10	The instructor explained ideas and concepts in ways that I could understand.	○	○	○	○	○
1.11	I understood how my grade would be calculated for this class.	○	○	○	○	○
1.12	The instructor responded to emails and requests for assistance in a timely manner.	○	○	○	○	○

1.13 What did you like most about this course? Briefly explain.

1.14 What did you like least about this course? Briefly explain.

1.15 What advice would you give to another student who is considering taking this course?

1.16 Please provide additional comments.

Appendix L: External Review Report

February 27, 2022

Peter Bernsdorf
453 E. Beil Avenue
Nazareth, PA 18064

Denise François-Seeney, Ph.D.
Dean, School of Business & Industry
Northampton Community College
3835 Green Pond Road
Bethlehem, PA 18020

Re: Electromechanical Technology Academic Program – External Review Report 2022

Dear Dean François-Seeney,

In response to your request of an external audit of the Electromechanical Technology Degree Program at Northampton Community College, I have performed the following:

- Conducted an interview with Kenneth Nasatka
- Conducted an interview with Robert Wolff and Gary George
- Conducted an interview with a former student of the program who is now employed at Sanofi
- Conducted an interview with the Head of Automation at another large Lehigh Valley manufacturing company
- Toured the class and laboratory spaces of the program

Below are my responses to your primary requests:

1. Provide an independent opinion of the program and its courses.

   Let me start out by saying that the Electromechanical Technology Degree Program at Northampton Community College prepares students very well for an entry level position in a Technical Services department at any manufacturer in the Lehigh Valley and beyond. This opinion is supported by my personal experience with students, the graduate of the program, his supervisors and Maintenance/Automation department managers at other Lehigh Valley manufacturers. The knowledge gained by students in this program through a wide variety of classroom and extensive hands-on laboratory work, provide an excellent educational foundation and starting point to allow students to be immediately productive and successful upon employment.

There is a tremendous need in the manufacturing industry for individuals with the skill set that is being taught in this program. It has been very difficult, even pre-pandemic, to fill open headcounts for Electro-Mechanical, Instrumentation and Automation technicians. The longstanding record of almost 100% placement of graduates from this program is a testament to the need in local manufacturing companies and the quality of the program. The pandemic has only exacerbated this problem as manufacturers are looking to further automate their facilities to cope with lack of available labor, increased labor cost, fighting rising raw material costs and to improve overall manufacturing efficiencies. The same trend is true for warehousing, which has exploded in our area, and heavily relies on automated equipment such as Automated Guided Vehicles (AGVs), pick and place robots, automated packaging machinery, etc. This trend will only increase the need for graduates from the EMEC program.

One major difficulty in making specific recommendations as part of the Electromechanical Technology Degree Program assessment is the immense diversity of manufacturing companies in the Lehigh Valley and their specific needs. Many smaller manufacturers have very limited staffing in their maintenance groups and require generalists to troubleshoot and correct problems for all aspects of installed machinery, including instrumentation and automation. Larger companies generally have the luxury of higher staffing levels, allowing for separate mechanical, instrumentation and automation groups. This in turn, requires each of these to have more specialized skills sets. Depending on the product being manufactured, there is also a widespread from basic, legacy machinery with low-cost components to state-of-the-art, highly networked and automated machinery, with heavy utilization of robotics. Recommendations for the program, including some from the previous audit, are therefore easily affected by the particular circumstances of the individual making those recommendations. My assessment of course relevancy in Section 2 is focusing on the job function of a Generalist Maintenance Mechanic. Additional information, regarding more specific recommendations, is included in Section 3.

2. Assess whether the courses are current, relevant and the variety of course offerings accurately reflect the profession or industry.

    a. Mechanical Curriculum

        The mechanical curriculum covers everything from nuts and bolts, measuring, concept of tolerances to blueprint and specification reading. The setup of industrial drive systems including gearboxes and drive shafts are taught. Classes also cover different types of bearings and specific maintenance of each.

        Pneumatic and hydraulic trainers contain basic componentry and are adequate for students to get a basic understanding of pressure and flow regulation and various types of control solenoids.

        The mechanical lab is outfitted with basic manual machining equipment, such as vices in addition to two drill presses and two small lathes. This allows students to appreciate the safety measures required when utilizing drills and lathes as well as teaching basic knowledge of how to machine small components.

The rigging class teaches students how to identify the different types and capacities of lifting devices such as slings, chains, bars, hoists and cranes. The hands-on portion of this class enables students to rig a load in a safe and controlled manner.

In my opinion, the mechanical curriculum covers all fundamentals needed by students to be successful as a mechanical maintenance technician in industry. I agree with the recommendation of the previous audit, to continue covering hydraulics and pneumatics equally as part of this course since both are heavily utilized, depending on the product manufactured.

b. Electrical Curriculum

The electrical curriculum starts out with the fundamentals, covering Ohm's Law and other electrical laws of physics. There are multiple labs that couple electrical theory with practical application. Students learn to wire, test and troubleshoot basic electrical control circuits which include relays, starter, switches and push buttons. The theory, practical application and basic wiring and programming of Variable Frequency Drives (VFDs) is covered. There is room for improvement, covering more advanced setup and communications, as most VFDs are connected to an Industrial Network these days.

The Electrical Laboratory is satisfactorily outfitted with equipment to learn the wiring and troubleshooting of hardwired electrical control circuits. While electrical controls equipment such as relays, starters and switches have not conceptually changed over the years, there is room for improvement by updating basics. For example, some of the equipment is mounted to wood boards that date back to the Bethlehem Steel days. Updating some of that equipment might give the lab a more modern look to attract more students.

c. Automation and Instrumentation

The automation curriculum couples the student's mechanical and electrical knowledge by teaching them to combine mechanical components with electrical controls. The lab is outfitted with Allen-Bradley Control Logix platform with relatively current Allen Bradley Panel View Human Machine Interfaces (HMIs). There is also some Siemens equipment to accommodate students working with equipment delivered from Europe, where Siemens is the main Process Control System supplier.

The automation laboratory is an accurate representation of industrial automation that is commonly found in manufacturing facilities in the Lehigh Valley and beyond. The equipment allows the student to study all aspects of modern process control systems. The limitation is due to the fact that there is just not enough time to cover more advanced concepts of configuration, networking and programming of these devices. I agree with the previous audit recommendation to continue teaching legacy process control system specific communication protocols since they are still widely in service and relied upon by local manufacturers.

Instrumentation

The instrumentation curriculum starts with students learning to read Process and Instrumentation Diagrams (P&IDs) and more detailed Instrumentation drawings. Students get introduced to the most common principles of measuring temperature, pressure, flow and levels on training skids. The laboratory is also equipped with instrument calibrators that allow students to learn the basic communication setup for instruments and basic concepts of instrument calibration. The students then utilize their knowledge in P&ID reading to configure the trainers by connecting hoses, analog and discrete instrumentation including wiring. They are then also taught to tune PID loops and troubleshoot the system as required by the class curriculum.

The trainers and other equipment in this lab are impressive, well equipped, and well designed. They have everything needed to truly challenge students by allowing comprehensive studies of mechanical, electrical, instrumentation and process control skills. There is very little students that will encounter in local manufacturing facilities upon graduation that could not be simulated with these trainers. As stated before, the trainers allow for the opportunity to teach very advanced concepts, but the limiting factor is simply the ceiling on credits in the program.

3. Offer recommendations for improvement based on economy, efficiency and effectiveness of the academic program.

Before offering specific recommendations, I must come back to the dilemma stated in Section 1 and would challenge the School of Business & Industry to determine who they see as the target employer for graduates of this program. For companies with limited staff, within the credit ceiling, the program does a fantastic job teaching all aspects of generalist maintenance mechanic needs to be quickly successful upon entering full-time employment. For larger employers with specialized job functions, an automation or instrument technician will (most likely) never use some of the mechanical curriculum taught in the program, like machining parts, rigging, or aligning shafts. If eliminating those classes would free up some credits for automation/instrumentation specialist, below are some recommendations:

As part of the industry 4.0, there is a convergence of Information Technology and Operational Technology (IT/OT), meaning that process control system instrumentation and equipment is now being networked and the knowledge to establish and maintain that infrastructure is no longer handled by the IT department but by automation groups. While network design and configuration are definitely in the realm of a four-year degree, understanding established architecture and troubleshooting would eliminate having to learn all this on the job.

The same concept is true for robotics. An increasing number of manufacturers are using or implementing machinery utilizing motion control and/or robotics. Nobody would expect a graduate from this program to be a robotics expert. However, it would benefit the students to have basic understanding of motion control terminology and the devices and instrumentation used in this type of machinery.

Just like networking, based on Industry 4.0 and the convergency of IT/OT, Automation technicians require a higher level of programming skills than in the past. It would be

helpful to introduce students to Statement logic, Sequential Function Chart (SFC) logic, Function Blocks, HMI configuration and programming, Variable Frequency Drives configuration and programming.

As stated before, some lab instrumentation and equipment are functional but refreshing and updating that equipment might give the laboratories a more modern look which could potentially help attract more students.

During the pandemic, schools were forced to teach as much content as possible online out of the necessity to social distance. Based on my personal experience and the feedback received from the student who graduated from the program, this program derives its benefits from being very hands-on and does not lend itself to remote teaching. Hands-on learning with the laboratory equipment, building team working skills in the classrooms and working with an instructor, are all important building blocks to the successful learning outcome of this program. I would not recommend creating more online content as part of this program.

Conclusion:

I am happy to echo the conclusion of the previous audit, in that I confidently believe that graduates from the Electromechanical Technology Degree Program at Northampton Community College are very well prepared for an entry level position into a maintenance department at any local manufacturing company.

As stated in Section 1, Northampton Community College is delivering a great service to students by providing them with a program with hands-on experience that will help them perform well immediately upon hire and also the manufacturing community in the Lehigh Valley and beyond, by teaching a critical skill set that is great demand and fills immediate labor needs.

I commend the department for the variety of educational level students can acquire from a Specialized Diploma to a full Associates Degree.

I am also very impressed by the program's full-time and adjunct staff, their dedication to their students and willingness to educate themselves to allow for the curriculum to reflect current best practices.

My charge for Northampton Community College administrators is to invest into strategies and to explore diverse approaches to attract more students to this fantastic program.

Sincerely,

Peter Bernsdorf