

**Curriculum Standard for Engineering and Technology:
Applied, Automation, Mechatronics Engineering Technology**

Career Cluster: Science, Technology, Engineering, Mathematics**

Cluster Description: Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, and engineering) including laboratory and testing services, and research and development services.

Pathway: Engineering and Technology

Effective Term: Spring 2017 (2017*01)

Program Majors Under Pathway

Program Major / Classification of Instruction Programs (CIP) Code	CIP Code	Credential Level(s) Offered	Program Major Code
Applied Engineering Technology	CIP Code: 15.0000	AAS/Diploma/Certificate	A40130
Automation Engineering Technology	CIP Code: 15.0406	AAS/Diploma/Certificate	A40120
Mechatronics Engineering Technology	CIP Code: 15.0403	AAS/Diploma/Certificate	A40350
Mission Critical Operations	CIP Code: 15.0406	AAS/Diploma/Certificate	A40430

Pathway Description: These curriculums are designed to prepare students through the study and application of principles from mathematics, natural sciences, and technology and applied processes based on these subjects.

Course work includes mathematics, natural sciences, engineering sciences and technology.

Graduates should qualify to obtain occupations such as technical service providers, materials and technologies testing services, process improvement technicians, engineering technicians, industrial and technology managers, or research technicians.

Program Description: Choose one of the following 4th paragraphs to use in conjunction with the first three paragraphs of the pathway description above for documentation used to identify each Program Major:

Applied Engineering Technology: A course of study that prepares the students to use basic engineering principles and technical skills to solve technical problems in various types of industry. The course work emphasizes analytical and problem-solving skills. The curriculum includes courses in safety, math, physics, electricity, engineering technology, and technology-specific specialty areas. Graduates should qualify for employment in a wide range of positions in research and development, manufacturing, sales, design, inspection, or maintenance. Employment opportunities exist in automation, computer, electrical, industrial, or mechanical engineering fields, where graduates will function as engineering technicians.

Automation Engineering Technology: A course of study that prepares the students to use basic engineering principles and technical skills to develop, install, calibrate, modify and maintain automated systems. Includes instruction in computer systems; electronics and instrumentation; programmable logic controllers (PLCs); electric, hydraulic and pneumatic control systems; actuator and sensor systems; process control; robotics; applications to specific industrial tasks. The graduates of this curriculum will be prepared for employment in industries that utilize control systems, computer hardware and software, electrical, mechanical and electromechanical devices in their automation systems.

Mechatronics Engineering Technology: A course of study that prepares the students to use basic engineering principles and technical skills in developing and testing automated, servomechanical, and other electromechanical systems. Includes instruction in prototype testing, manufacturing and operational testing, systems analysis and maintenance procedures. Graduates should be qualified for employment in industrial maintenance and manufacturing including assembly, testing, startup, troubleshooting, repair, process improvement, and control systems, and should qualify to sit for Packaging Machinery Manufacturers Institute (PMMI) mechatronics or similar industry examinations.

**Within the degree program, the institution shall include opportunities for the achievement of competence in reading, writing, oral communication, fundamental mathematical skills, and basic use of computers.*

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Mission Critical Operations: The Mission Critical Operations curriculum prepares graduates for employment in a wide range of positions in specific mission critical environments, operations technology, and maintenance. Course work includes the development of a student’s ability to maintain technically sophisticated systems for business continuity and near continuous uptime using engineering, information technology, and industrial management and maintenance skills. The course work emphasizes analytical and problem-solving skills required to sustain high availability national security interests and includes instruction in electromechanical systems, networking, automation, cybersecurity, emergency management and systems integration. Graduates should qualify for employment as entry-level technicians with businesses, industries, educational systems, and governmental agencies in national critical infrastructure areas including, but not limited to, communications, emergency services, energy, financial services, healthcare, information technology, and transportation.

I. General Education Academic Core

[Curriculum Requirements for associate degree, diploma, and certificate programs in accordance with 1D SBCCC 400.10]: Degree programs must contain a minimum of 15 semester hours including at least one course from each of the following areas: humanities/fine arts, social/behavioral sciences, and natural sciences/mathematics. Degree programs must contain a minimum of 6 semester hours of communications. Diploma programs must contain a minimum of 6 semester hours of general education; 3 semester hours must be in communications. General education is optional in certificate programs.

Engineering and Technology: Applied, Automation and Mechatronics Engineering Technology

General Education Academic Core	AAS	Diploma	Certificate
Minimum General Education Hours Required:	15 SHC	6 SHC	0 SHC
<p><i>Courses listed below are recommended general education courses for this curriculum standard. Colleges may choose to include additional or alternative general education courses to meet local curriculum needs.</i></p> <p><i>*Recommended certificate and diploma level curriculum courses. These courses may <u>not</u> be included in associate degree programs.</i></p> <p>Communications:</p> <ul style="list-style-type: none"> * COM 101 Workplace Communication 3 SHC COM 110 Introduction to Communication 3 SHC COM 120 Intro Interpersonal Com 3 SHC COM 231 Public Speaking 3 SHC * ENG 101 Applied Communications I 3 SHC * ENG 102 Applied Communications II 3 SHC ENG 110 Freshman Composition 3 SHC ENG 111 Writing and Inquiry 3 SHC ENG 114 Professional Research & Reporting 3 SHC ENG 116 Technical Report Writing 3 SHC <p>Humanities/Fine Arts:</p> <ul style="list-style-type: none"> * HUM 101 Values in the Workplace 2 SHC HUM 110 Technology and Society 3 SHC HUM 115 Critical Thinking 3 SHC HUM 230 Leadership Development 3 SHC PHI 230 Introduction to Logic 3 SHC PHI 240 Introduction to Ethics 3 SHC <p>Social/Behavioral Sciences:</p> <ul style="list-style-type: none"> ECO 151 Survey of Economics 3 SHC ECO 251 Prin of Microeconomics 3 SHC GEO 110 Introduction to Geography 3 SHC GEO 111 World Regional Geography 3 SHC GEO 131 Physical Geography I 4 SHC * PSY 101 Applied Psychology 3 SHC * PSY 102 Human Relations 2 SHC 	6 SHC	3-6 SHC	Optional
	3 SHC	0-3 SHC	Optional
	3 SHC	0-3 SHC	Optional

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PSY	118	Interpersonal Psychology	3 SHC	3 SHC	0-3 SHC	Optional
PSY	135	Group Processes	3 SHC			
PSY	150	General Psychology	3 SHC			
* SOC	105	Social Relationships	3 SHC			
SOC	210	Introduction to Sociology	3 SHC			
SOC	215	Group Process	3 SHC			
Natural Sciences/Mathematics:						
MAT	110	Math Measurement & Literacy	3 SHC			
MAT	121	Algebra/Trigonometry I	3 SHC			
MAT	143	Quantitative Literacy	3 SHC			
MAT	152	Statistical Methods I	4 SHC			
MAT	171	Precalculus Algebra	4 SHC			
MAT	223	Applied Calculus	3 SHC			
MAT	271	Calculus I	4 SHC			

II. Major Hours. AAS, diploma, and certificate programs must include courses which offer specific job knowledge and skills. Work-based learning may be included in associate in applied science degrees up to a maximum of 8 semester hours of credit; in diploma programs up to a maximum of 4 semester hours of credit; and in certificate programs up to a maximum of 2 semester hours of credit. Below is a description of each section under Major Hours.

- A. Technical Core.** The technical core is comprised of specific courses which are required for all Program Majors under this Curriculum Standard. A diploma program offered under an approved AAS program standard or a certificate which is the highest credential level awarded under an approved AAS program standard must include a minimum of 12 semester hours credit derived from the curriculum core courses or core subject area of the AAS program.
- B. Program Major(s).** The Program Major must include a minimum of 12 semester hours credit from required subjects and/or courses. The Program Major is in addition to the technical core.
- C. Other Major Hours.** Other major hours must be selected from prefixes listed on the curriculum standard. A maximum of 9 semester hours of credit may be selected from any prefix listed, with the exception of prefixes listed in the core.

Engineering and Technology: Applied, Automation, Mechatronics Engineering Technology	AAS	Diploma	Certificate																																				
Minimum Major Hours Required:	49 SHC	30 SHC	12 SHC																																				
<i>Courses required for a diploma are designated with *</i>	16-44 SHC	16-24 SHC																																					
<p>A. Technical Core:</p> <p>* Computer Applications <i>Choose one:</i></p> <table border="0"> <tr> <td>CIS</td> <td>110</td> <td>Introduction to Computers</td> <td>3 SHC</td> </tr> <tr> <td>EGR</td> <td>111</td> <td>Eng Comp and Careers</td> <td>3 SHC</td> </tr> <tr> <td>EGR</td> <td>125</td> <td>Appl Software for Tech</td> <td>2 SHC</td> </tr> <tr> <td>ELC</td> <td>127</td> <td>Software for Technicians</td> <td>2 SHC</td> </tr> </table> <p>* Safety <i>Choose one:</i></p> <table border="0"> <tr> <td>ISC</td> <td>112</td> <td>Industrial Safety</td> <td>2 SHC</td> </tr> <tr> <td>ISC</td> <td>115</td> <td>Construction Safety</td> <td>2 SHC</td> </tr> </table> <p>B. Program Major(s): <i>For AAS Degree select one program major.</i></p> <p><u>Applied Engineering Technology</u></p> <p>* Computers <i>Choose one:</i></p> <table border="0"> <tr> <td>DFT</td> <td>119</td> <td>Basic CAD</td> <td>2 SHC</td> </tr> <tr> <td>ELC</td> <td>127</td> <td>Software for Technicians</td> <td>2 SHC</td> </tr> </table> <p>* Electricity <i>Choose one:</i></p> <table border="0"> <tr> <td>ELC</td> <td>131</td> <td>Circuit Analysis I</td> <td>4 SHC</td> </tr> </table>	CIS	110	Introduction to Computers	3 SHC	EGR	111	Eng Comp and Careers	3 SHC	EGR	125	Appl Software for Tech	2 SHC	ELC	127	Software for Technicians	2 SHC	ISC	112	Industrial Safety	2 SHC	ISC	115	Construction Safety	2 SHC	DFT	119	Basic CAD	2 SHC	ELC	127	Software for Technicians	2 SHC	ELC	131	Circuit Analysis I	4 SHC			
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ISC	115	Construction Safety	2 SHC																																				
DFT	119	Basic CAD	2 SHC																																				
ELC	127	Software for Technicians	2 SHC																																				
ELC	131	Circuit Analysis I	4 SHC																																				

ELC	138	DC Circuit Analysis	4 SHC			
ELC	139	AC Circuit Analysis	4 SHC			
* Engineering						
<i>Choose one:</i>						
HYD	110	Hydraulics/Pneumatics I	3 SHC			
HYD	112	Hydraulics/Med/Heavy Duty	2 SHC			
HYD	115	Industrial Hydraulics	3 SHC			
MNT	165	Mechanical Industrial Sys	2 SHC			
* Motors and Controls						
<i>Choose one:</i>						
ELC	117	Motors and Controls	4 SHC			
ELC	128	Intro to PLC	3 SHC			
* Specialty						
<i>Choose one:</i>						
ATR	112	Intro to Automation	3 SHC			
CET	110	Intro to CET	1 SHC			
ELN	131	Analog Electronics I	4 SHC			
MEC	110	Intro to CAD/CAM	2 SHC			
<u>Automation Engineering Technology</u>						
* ATR	112	Intro to Automation	3 SHC			
* ATR	215	Sensors and Transducers	3 SHC			
* ELC	128	Intro to PLC	3 SHC			
ELN	133	Digital Electronics	4 SHC			
PCI	171	Fieldbus Systems	4 SHC			
* Basic Electricity						
<i>Choose one set:</i>						
ELC	131	Circuit Analysis I	4 SHC			
ELC	133	Circuit Analysis II	4 SHC			
<i>OR</i>						
ELC	138	DC Circuit Analysis	4 SHC			
ELC	139	AC Circuit Analysis	4 SHC			
Specialty						
<i>Choose one:</i>						
ATR	121	Intro to Machine Vision	4 SHC			
BAT	111	Building Automation Systems	2 SHC			
HYC	110	Hydraulics/Pneumatics I	3 SHC			
MEC	130	Mechanisms	3 SHC			
MNT	250	PLC Interfacing	4 SHC			
<u>Mechatronics Engineering Technology</u>						
* ATR	112	Intro to Automation	3 SHC			
* ELC	213	Instrumentation	4 SHC			
* Basic Electricity						
<i>Choose one course or set:</i>						
ELC	111	Intro to Electricity	3 SHC			
<i>OR</i>						
ELC	112	DC/AC Electricity	5 SHC			
<i>OR</i>						
ELC	131	Circuit Analysis I	4 SHC			
<i>OR</i>						
ELC	138	DC Circuit Analysis	4 SHC			
ELC	139	AC Circuit Analysis	4 SHC			

Drawing*Choose one:*

DFT	119	Basic CAD	2 SHC
DFT	151	CAD I	3 SHC
DFT	154	Intro Solid Modeling	3 SHC
DFT	170	Engineering Graphics	3 SHC
EGR	120	Eng and Design Graphics	3 SHC
ELC	132	Electrical Drawings	2 SHC

Fluid Mechanics*Choose one:*

HYD	110	Hydraulics/Pneumatics I	3 SHC
HYD	180	Pneumatics in Automation	3 SHC
MEC	265	Fluid Mechanics	3 SHC

Mechanical Drives*Choose one:*

MEC	130	Mechanisms	3 SHC
MEC	275	Engineering Mechanisms	3 SHC

Machines*Choose one course or set:*

ELC	117	Motors and Controls	4 SHC
ELC	130	Advanced Motors/Controls	3 SHC
ELC	135	Electrical Machines I	3 SHC
<i>AND</i>			
ELC	136	Electrical Machines II	4 SHC

Programmable Logic Controllers*Choose one:*

ELC	128	Intro to PLC	3 SHC
ELN	260	Prog Logic Controllers	4 SHC

*** Physics***Choose one:*

PHY	131	Physics-Mechanics	4 SHC
PHY	151	College Physics I	4 SHC

Mission Critical Operations

* MCO	110	Intro to MCO	3 SHC
* MCO	115	MCO Infrastructure	3 SHC
MCO	210	Critical Site Operations	3 SHC

Operations Technology

ATR	112	Intro to Automation	3 SHC
* MNT	222	Industrial Sys Schematics	2 SHC

C. Other Major Hours. To be selected from the following prefixes:

AHR, ALT, ATR, BAT, BPM, BPR, BTB, BTC, BUS, CCT, CEG, CET, CHM, CIS, CIV, CMT, CSC, CTI, CTS, DBA, DDF, DEA, DFT, EGR, ELC, ELN, EPP, EPT, FBG, GRA, HET, HPC, HYD, ISC, LOG, MAC, MAT, MCM, MCO, MEC, MKT, MLG, MNT, MPS, MSM, NET, NOS, NUC, OMT, PCI, PHY, PKG, PMT, PTC, RCT, RVM, SEC, SST, TCT, TDP, TEL, TNE, TRN, WAT, WBL, WEB and WLD

Up to two semester hour credits may be selected from ACA.

Up to three semester hour credits may be selected from the following prefixes: ARA, ASL, CHI, FRE, GER, ITA, JPN, LAT, POR, RUS and SPA.

III. Other Required Hours

A college may include courses to meet graduation or local employer requirements in a certificate (0-1 SHC), diploma (0-4 SHC), or an associate in applied science (0-7 SHC) program. These curriculum courses shall be selected from the Combined Course Library and must be approved by the System Office prior to implementation. Restricted, unique, or free elective courses may not be included as other required hours.

IV. Employability Competencies

Fundamental competencies that address soft skills vital to employability, personal, and professional success are listed below. Colleges are encouraged to integrate these competencies into the curriculum by embedding appropriate student learning outcomes into one or more courses or through alternative methods.

- A. Interpersonal Skills and Teamwork** – The ability to work effectively with others, especially to analyze situations, establish priorities, and apply resources for solving problems or accomplishing tasks.
- B. Communication** – The ability to effectively exchange ideas and information with others through oral, written, or visual means.
- C. Integrity and Professionalism** – Workplace behaviors that relate to ethical standards, honesty, fairness, respect, responsibility, self-control, criticism and demeanor.
- D. Problem-solving** – The ability to identify problems and potential causes while developing and implementing practical action plans for solutions.
- E. Initiative and Dependability** – Workplace behaviors that relate to seeking out new responsibilities, establishing and meeting goals, completing tasks, following directions, complying with rules, and consistent reliability.
- F. Information processing** – The ability to acquire, evaluate, organize, manage, and interpret information.
- G. Adaptability and Lifelong Learning** – The ability to learn and apply new knowledge and skills and adapt to changing technologies, methods, processes, work environments, organizational structures and management practices.
- H. Entrepreneurship** – The knowledge and skills necessary to create opportunities and develop as an employee or self-employed business owner.

*An **Employability Skills Resource Toolkit** has been developed by NC-NET for the competencies listed above. Additional information is located at: <http://www.nc-net.info/employability.php>

**The *North Carolina Career Clusters Guide* was developed by the North Carolina Department of Public Instruction and the North Carolina Community College system to link the academic and Career and Technical Education programs at the secondary and postsecondary levels to increase student achievement. Additional information about Career Clusters is located at: http://www.nc-net.info/NC_career_clusters_guide.php or <http://www.careertech.org>.

Summary of Required Semester Hour Credits (SHC) for each credential:

	AAS	Diploma	Certificate
Minimum General Education Hours	15	6	0
Minimum Major Hours	49	30	12
Other Required Hours	0-7	0-4	0-1
Total Semester Hours Credit (SHC)	64-76	36-48	12-18

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