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:** Fall 2023 (2023*03)

Program Majors Under Pathway

Program Major / Classification of Instruction Programs (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.

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

**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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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

Recommended General Education Academic Core					AAS	Diploma	Certificate
Minimum General Education Hours Required:					**15 SHC**	**6 SHC**	**0 SHC**
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. **Recommended certificate and diploma level curriculum courses. These courses may not be included in associate degree programs.*							
Communications:							
*	COM	101	Workplace Communication	3 SHC	**6 SHC**	**3-6 SHC**	**Optional**
	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			
Humanities/Fine Arts:							
*	HUM	101	Values in the Workplace	2 SHC	**3 SHC**	**0-3 SHC**	**Optional**
	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			
Social/Behavioral Sciences:							
	ECO	151	Survey of Economics	3 SHC	**3 SHC**	**0-3 SHC**	**Optional**
	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			
	PSY	118	Interpersonal Psychology	3 SHC			
	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			

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Natural Sciences/Mathematics:				**3 SHC**	**0-3 SHC**	**Optional**
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**
*Courses required for a diploma are designated with **				**15-45 SHC**	**15-25 SHC**	
A. Technical Core:						
* **Computer Applications** – *Choose one:*						
CIS	110	Introduction to Computers	3 SHC			
EGR	111	Engineer Comp and Careers	3 SHC			
EGR	125	Appl Software for Tech	2 SHC			
ELC	127	Software for Technicians	2 SHC			
DFT	119	Basic CAD	2 SHC			
DFT	154	Intro Solid Modeling	3 SHC			
* **Safety** – *Choose one:*						
ISC	110	Workplace Safety	1 SHC			
ISC	112	Industrial Safety	2 SHC			
ISC	115	Construction Safety	2 SHC			
ISC	121	Envir Health & Safety	3 SHC			
B. Program Major(s):						
For AAS Degree select one program major.						
Applied Engineering Technology						
* **Computers** – *Choose one:*						
DFT	119	Basic CAD	2 SHC			
ELC	127	Software for Technicians	2 SHC			
* **Electricity** – *Choose one:*						
ELC	112	DC/AC Electricity	5 SHC			
ELC	131	Circuit Analysis I	4 SHC			
ELC	138	DC Circuit Analysis	4 SHC			
ELC	139	AC Circuit Analysis	4 SHC			

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*	**Engineering** – *Choose one:*						
	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** – *Choose one:*						
	ELC	117	Motors and Controls	4 SHC			
	ELC	128	Intro to PLC	3 SHC			
	ELN	260	Prog Logic Controllers	4 SHC			
*	**Specialty** – *Choose one:*						
	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			
	TEX	110	Fund of Textiles	3 SHC			
	<u>Automation Engineering Technology</u>						
*	ATR	112	Intro to Automation	3 SHC			
*	ATR	215	Sensors and Transducers	3 SHC			
	ELN	133	Digital Electronics	4 SHC			
	PCI	171	Fieldbus Systems	4 SHC			
*	**Basic Electricity** – *Choose one set:*						
	ELC	131	Circuit Analysis I	4 SHC			
	ELC	133	Circuit Analysis II	4 SHC			
		OR					
	ELC	138	DC Circuit Analysis	4 SHC			
	ELC	139	AC Circuit Analysis	4 SHC			
*	**Programmable Logic Controllers** – *Choose one:*						
	ELC	128	Intro to PLC	3 SHC			
	ELN	260	Prog Logic Controllers	4 SHC			
	Specialty – *Choose one:*						
	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** – *Choose one course or set:*						
	ELC	111	Intro to Electricity	3 SHC			
		OR					
	ELC	112	DC/AC Electricity	5 SHC			
		OR					
	ELC	131	Circuit Analysis I	4 SHC			
		OR					
	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			
	AND						
	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, PLA (A40350), PMT, PTC, RCT, RVM, SEC, SST, TCT, TDP, TEL, TEX, TNE, TRN, UAS (A40130), WAT, WBL, WEB, and WLD

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

Three semester hour credits may be selected from PTE.

Up to three semester hour credits may be selected from the following prefixes: ARA, ASL, CHI, FRE, GER, IRI, 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.

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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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