



**NORTH CAROLINA COMMUNITY COLLEGE SYSTEM**

**R. Scott Ralls, Ph.D.**

**President**

April 20, 2015

**MEMORANDUM**

TO: Presidents  
Chief Academic Officers

FROM: Wesley E. Beddard, Associate Vice President  
Programs

SUBJECT: State Board Action on April 17, 2015  
New and Revised Curriculum Standards

On April 17, 2015, the State Board of Community Colleges approved the requested revisions to the Mobile Equipment Maintenance and Repair Cluster curriculum standard which includes the following program majors:

Agricultural Systems Tech (A60410)	Collision Repair & Refinishing Tech (A60310)
Alternative Transportation Tech (D60420)	Construction Equipment Systems Tech (A60450)
Automotive Customizing Tech (A60190)	Diesel and Heavy Equipment Tech (A60460)
Automotive Light-Duty Diesel Tech (D60430)	Motorcycle Mechanics (A60260)
Automotive Restoration Tech (D60140)	Recreational Vehicle Maintenance & Repair Tech (D60310)
Automotive Systems Tech (A60160)	

Please be aware that you must implement the revised standard no later than one year after the effective term. You must update your college's electronic programs of study and receive approval from the System Office prior to implementation of the revised programs.

In addition, the State Board of Community Colleges approved curriculum courses and a curriculum standard for the following new curriculum program:

Mission Critical Operations (A40430)

*A Tier funding classification of 1A for the new Mission Critical Operations (MCO) curriculum prefix has been approved.*

If you have any questions concerning the State Board action items, please contact Ms. Jennifer Frazelle at 919.807.7120 or [frazellej@nccommunitycolleges.edu](mailto:frazellej@nccommunitycolleges.edu). An outline of the specific curriculum standard revisions, revised standard, new courses, and new curriculum standard are attached for your convenience. You may view all curriculum standards and courses by visiting the Programs website at:

<http://www.nccommunitycolleges.edu/Programs/index.html>

WB/JF/gr

Attachments

c: Dr. Lisa M. Chapman  
Ms. Jennifer Frazelle

Ms. Elizabeth Self  
Program Coordinators

CC15-014  
Email

**Outline of Curriculum Standard Revisions  
State Board of Community Colleges – April 17, 2015**

**Mobile Equipment Maintenance and Repair Transportation Cluster Standard**

**Proposed Revisions:**

Added the following course options to the Technical Core of the Mobile Equipment Maintenance and Repair standard:

- TRN 111 Chassis Maint/Light Repair
- TRN 112 Powertrain Maint/Light Repair

From the Automotive Customizing Technology (A60190) Program Major course area:

- Removed AUC 115 Glass Customization Methods
- Added AUB 111 Painting and Refinishing I

*Please note that the addition in courses resulted in a change of hours from 17-20 to 17-21 SHC (Diploma) and from 19-26 to 19-27 SHC (AAS).*

## Curriculum Standard for Mobile Equipment Maintenance and Repair

**Career Cluster:** Transportation, Distribution and Logistics \*\*

**Cluster Description:** The planning, management, and movement of people, materials, and goods by road, pipeline, air, rail and water and related professional and technical support services such as transportation infrastructure planning and management, logistics services, mobile equipment and facility maintenance.

**Pathway:** Mobile Equipment Maintenance and Repair

**Effective Term:** Fall 2015 (2015\*03)

### Program Majors Under Pathway

Program Major / Classification of Code	Instruction Programs (CIP)	Credential Level(s) Offered	Program Major Code
Agricultural Systems Technology	CIP Code 01.0205	AAS/Diploma/Certificate	A60410
Alternative Transportation Technology	CIP Code: 47.0614	Diploma/Certificate	D60420
Automotive Customizing Technology	CIP Code 47.0603	AAS/Diploma/Certificate	A60190
Automotive Light-Duty Diesel Technology	CIP Code 47.0605	Diploma/Certificate	D60430
Automotive Restoration Technology	CIP Code 47.0603	Diploma/Certificate	D60140
Automotive Systems Technology	CIP Code 47.0604	AAS/Diploma/Certificate	A60160
Collision Repair and Refinishing Technology	CIP Code 47.0603	AAS/Diploma/Certificate	A60130
Construction Equipment Systems Technology	CIP Code 47.0302	AAS/Diploma/Certificate	A60450
Diesel and Heavy Equipment Technology	CIP Code 47.0613	AAS/Diploma/Certificate	A60460
Motorcycle Mechanics	CIP Code 47.0611	AAS/Diploma/Certificate	A60260
Recreational Vehicle Maintenance and Repair Technology	CIP Code 47.0618	Diploma/Certificate	D60310

### Pathway Description:

Curriculums in the Mobile Equipment Maintenance and Repair pathway prepare individuals for employment as entry-level transportation service technicians. The program provides an introduction to transportation industry careers and increases student awareness of the diverse technologies associated with this dynamic and challenging field.

Course work may include transportation systems theory, braking systems, climate control, design parameters, drive trains, electrical/electronic systems, engine repair, engine performance, environmental regulations, materials, product finish, safety, steering/suspension, transmission/transaxles, and sustainable transportation, depending on the program major area chosen.

Graduates of this pathway should be prepared to take professional licensure exams, which correspond to certain programs of study, and to enter careers as entry-level technicians in the transportation industry.

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

**Agricultural Systems Technology:** A program that prepares individuals to maintain and repair specialized farm, ranch, and agribusiness power equipment and vehicles. Includes instruction in the principles of diesel, combustion, electrical, steam, hydraulic, and mechanical systems and their application to the maintenance of terrestrial and airborne crop-spraying equipment; tractors and hauling equipment; planting and harvesting equipment; cutting equipment; power sources and systems for silos; irrigation and pumping equipment; dairy, feeding, and shearing operations; and processing systems.

\*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.

Approved by the State Board of Community Colleges on August 16, 2012; Editorial Revision 09/05/12; Editorial Revision 12/14/12; Editorial Revision 08/21/13; Editorial Revision 03/11/14; Revised SBCC 04/17/15.

**Alternative Transportation Technology:** A program that prepares individuals to apply technical knowledge and skills to the maintenance of alternative fuel vehicles (AFV), hybrid electric vehicles and the conversion of standard vehicles to AFV status. Includes instruction in electrical vehicles, hybrid electric vehicles, liquefied petroleum gas (LPG) vehicles, compressed natural gas (CNG) vehicles, hybrid fuel technology, electrical and electronic systems, engine performance, diagnosis and repair, and conversion/installation.

**Automotive Customizing Technology:** A program that prepares individuals to modify existing automotive vehicle components, fabrication techniques to create custom vehicle components, non-structural damage repair, custom painting and refinishing techniques, custom upholstery and glass removal/replacement/custom modifications, and other automotive technology related systems.

**Automotive Light-Duty Diesel Technology:** A program that prepares individuals to apply technical knowledge and skills to diagnose, adjust, repair, or overhaul light duty diesel vehicles under one ton classification. Includes instruction in electrical systems, diesel-electric drive, engine performance, engine repair, emission systems, and all types of diesel engines related to the light duty diesel vehicle. Includes technicians working primarily with automobile diesel engines.

**Automotive Restoration Technology:** A program that prepares individuals to apply technical knowledge and skills to repair, reconstruct, finish and restore automobile bodies, fenders, and external features of a wide range of classic vehicles typically from year models 1900 - 1970. Includes instruction in internal combustion engines, transmissions, brakes, restoring original sheet metal, upholstery, and wood components, rebuilding starters, generators, and painting and refinishing techniques.

**Automotive Systems Technology:** A program that prepares individuals to apply technical knowledge and skills to repair, service, and maintain all types of automobiles. Includes instruction in brake systems, electrical systems, engine performance, engine repair, suspension and steering, automatic and manual transmissions and drive trains, and heating and air condition systems

**Collision Repair and Refinishing Technology:** A program that prepares individuals to apply technical knowledge and skills to repair, reconstruct and finish automobile bodies, fenders, and external features. Includes instruction in structure analysis, damage repair, non-structural analysis, mechanical and electrical components, plastics and adhesives, painting and refinishing techniques, and damage analysis and estimating.

**Construction Equipment Systems Technology:** A program that prepares individuals to apply technical knowledge and skills in the field maintenance and repair of construction equipment, and in the general maintenance and overhaul of such equipment. Includes instruction in inspection, maintenance, and repair of tracks, wheels, brakes, operating controls, pneumatic and hydraulic systems, electrical circuitry, engines and in techniques of welding and brazing.

**Diesel and Heavy Equipment Technology:** A program that prepares individuals to apply technical knowledge and skills to repair, service, and maintain diesel engines in vehicles such as Heavy Duty Trucks over one ton classification, buses, ships, railroad locomotives, and equipment; as well as stationary diesel engines in electrical generators and related equipment.

**Motorcycle Mechanics:** A program that prepares individuals to apply technical knowledge and skills to repair, service, and maintain motorcycles and other similar powered vehicles. Includes instruction in lubrication and cooling systems, electrical and ignition systems, carburetion, fuel systems and adjustments of moving parts.

**Recreational Vehicle Maintenance and Repair Technology:** A program that prepares individuals to apply technical knowledge and skills to build, test, inspect, repair, service and maintain recreational vehicles, systems, and interior and exterior components. Includes instruction in brake, hydraulic, and towing systems; electrical systems; propane systems and propane and electric appliances; carpentry; plumbing; welding; and structural frames.

### **I. General Education Academic Core**

*[Curriculum Requirements for associate degree, diploma, and certificate programs in accordance with ID SBCCC 400.97 (3)]: 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.*

## Mobile Equipment Maintenance and Repair

Recommended General Education Academic Core	AAS	Diploma	Certificate
<b>Minimum General Education Hours Required:</b>	<b>15 SHC</b>	<b>6 SHC</b>	<b>0 SHC</b>
<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><b>Communication:</b></p> <ul style="list-style-type: none"> <li>*COM 101 Workplace Communication 3 SHC</li> <li>COM 110 Introduction to Communications 3 SHC</li> <li>COM 120 Intro Interpersonal Com 3 SHC</li> <li>COM 231 Public Speaking 3 SHC</li> <li>*ENG 101 Applied Communications I 3 SHC</li> <li>*ENG 102 Applied Communications II 3 SHC</li> <li>ENG 110 Freshman Composition 3 SHC</li> <li>ENG 111 Expository Writing 3 SHC</li> <li>ENG 114 Prof Research &amp; Reporting 3 SHC</li> <li>ENG 116 Technical Report Writing 3 SHC</li> </ul>	<b>6 SHC</b>	<b>3-6 SHC</b>	<b>Optional</b>
<p><b>Humanities/Fine Arts:</b></p> <ul style="list-style-type: none"> <li>*HUM 101 Values in the Workplace 2 SHC</li> <li>HUM 110 Technology and Society 3 SHC</li> <li>HUM 115 Critical Thinking 3 SHC</li> <li>HUM 230 Leadership Development 3 SHC</li> <li>PHI 230 Introduction to Logic 3 SHC</li> <li>PHI 240 Introduction to Ethics 3 SHC</li> </ul>	<b>3 SHC</b>	<b>0-3 SHC</b>	<b>Optional</b>
<p><b>Social /Behavioral Sciences:</b></p> <ul style="list-style-type: none"> <li>ECO 151 Survey of Economics 3 SHC</li> <li>ECO 251 Principles of Microeconomics 3 SHC</li> <li>*SOC 105 Social Relationships 3 SHC</li> <li>SOC 210 Introduction to Sociology 3 SHC</li> <li>SOC 215 Group Process 3 SHC</li> <li>*PSY 101 Applied Psychology 3 SHC</li> <li>*PSY 102 Human Relations 2 SHC</li> <li>PSY 118 Interpersonal Psychology 3 SHC</li> <li>PSY 135 Group Processes 3 SHC</li> <li>PSY 150 General Psychology 3 SHC</li> </ul>	<b>3 SHC</b>	<b>0-3 SHC</b>	<b>Optional</b>
<p><b>Natural Sciences/Mathematics:</b></p> <ul style="list-style-type: none"> <li>*MAT 101 Applied Mathematics I 3 SHC</li> <li>MAT 110 Mathematical Measurements 3 SHC</li> <li>MAT 115 Mathematical Models 3 SHC</li> <li>MAT 120 Geometry and Trigonometry 3 SHC</li> <li>MAT 121 Algebra/Trigonometry 3 SHC</li> <li>PHY 110 Conceptual Physics 3 SHC</li> <li>PHY 121 Applied Physics I 4 SHC</li> </ul>	<b>3 SHC</b>	<b>0-3 SHC</b>	<b>Optional</b>

**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 each prefix listed, with the exception of prefixes listed in the core.

<b>Mobile Equipment Maintenance and Repair</b>	<b>AAS</b>	<b>Diploma</b>	<b>Certificate</b>																																												
<b>Minimum Major Hours Required:</b>	<b>49 SHC</b>	<b>30 SHC</b>	<b>12 SHC</b>																																												
<p><b>A. Technical Core:</b>  <i>Courses required for the diploma program major are designated with an asterisk (*).</i></p> <p><b>*Fundamental Transportation Skills. Choose one minimum:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">TRN</td><td style="width: 10%;">110</td><td style="width: 70%;">Intro to Transport Tech</td><td style="width: 10%; text-align: right;">2 SHC</td></tr> <tr><td>TRN</td><td>111</td><td>Chassis Maint/Light Repair</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>TRN</td><td>112</td><td>Powertrain Maint/Light Repair</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>TRN</td><td>170</td><td>PC Skills for Transp</td><td style="text-align: right;">2 SHC</td></tr> <tr><td>HET</td><td>134</td><td>Diesel Fuel and Power Sy</td><td style="text-align: right;">3 SHC</td></tr> </table> <p><b>*Intermediate Transportation Skills. Choose one minimum:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">TRN</td><td style="width: 10%;">120</td><td style="width: 70%;">Basic TranspElectricity</td><td style="width: 10%; text-align: right;">5 SHC</td></tr> <tr><td>TRN</td><td>130</td><td>Intro to Sustainable Transp</td><td style="text-align: right;">3 SHC</td></tr> <tr><td>TRN</td><td>180</td><td>Basic Welding for Transp</td><td style="text-align: right;">3 SHC</td></tr> </table> <p><b>Specialized Transportation Skills. Choose one minimum:</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">TRN</td><td style="width: 10%;">140</td><td style="width: 70%;">Transp Climate Control</td><td style="width: 10%; text-align: right;">2 SHC</td></tr> <tr><td>TRN</td><td>145</td><td>Adv Transp Electronics</td><td style="text-align: right;">3 SHC</td></tr> <tr><td>WLD</td><td>110</td><td>Cutting Processes</td><td style="text-align: right;">2 SHC</td></tr> </table>	TRN	110	Intro to Transport Tech	2 SHC	TRN	111	Chassis Maint/Light Repair	4 SHC	TRN	112	Powertrain Maint/Light Repair	4 SHC	TRN	170	PC Skills for Transp	2 SHC	HET	134	Diesel Fuel and Power Sy	3 SHC	TRN	120	Basic TranspElectricity	5 SHC	TRN	130	Intro to Sustainable Transp	3 SHC	TRN	180	Basic Welding for Transp	3 SHC	TRN	140	Transp Climate Control	2 SHC	TRN	145	Adv Transp Electronics	3 SHC	WLD	110	Cutting Processes	2 SHC	<b>19-27 SHC</b>	<b>17-21 SHC</b>	
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<p><b>B. Program Major(s).</b>  <i>For both AAS Degree and Diploma, select one program major plus additional courses from the prefixes listed within the same program major for a minimum of (12) semester hours of credits.</i></p> <p><b>Agricultural Systems Technology</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">ELN</td><td style="width: 10%;">112</td><td style="width: 70%;">Diesel Electronics System</td><td style="width: 10%; text-align: right;">4 SHC</td></tr> <tr><td>PME</td><td>111</td><td>Harvest and Spraying Equip</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>PME</td><td>112</td><td>Consumer Products</td><td style="text-align: right;">2 SHC</td></tr> <tr><td>PME</td><td>121</td><td>Component Controls</td><td style="text-align: right;">2 SHC</td></tr> </table> <p><b>Alternative Transportation Technology</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">ATT</td><td style="width: 10%;">115</td><td style="width: 70%;">Green Trans Safety and Service</td><td style="width: 10%; text-align: right;">2 SHC</td></tr> <tr><td>ATT</td><td>125</td><td>Hybrid-Electric Transportation</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>ATT</td><td>140</td><td>Emerging Transp Techn</td><td style="text-align: right;">3 SHC</td></tr> </table>	ELN	112	Diesel Electronics System	4 SHC	PME	111	Harvest and Spraying Equip	4 SHC	PME	112	Consumer Products	2 SHC	PME	121	Component Controls	2 SHC	ATT	115	Green Trans Safety and Service	2 SHC	ATT	125	Hybrid-Electric Transportation	4 SHC	ATT	140	Emerging Transp Techn	3 SHC																			
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<b>Automotive Customizing Technology</b>			
AUC	111	Auto Customizing Research	3 SHC
AUC	112	Auto Custom Fabrication	4 SHC
AUB	111	Painting and Refinishing I	4 SHC
<b>Automotive Restoration Technology</b>			
ARS	112	Auto Restoration Research	3 SHC
ARS	113	Automotive Upholstery	4 SHC
ARS	114	Restoration Skills I	4 SHC
<b>Automotive Systems Technology</b>			
AUT	141	Suspension and Steering	3 SHC
AUT	151	Brake Systems	3 SHC
AUT	181	Engine Performance I	3 SHC
<b>Automotive Light-Duty Diesel Technology</b>			
LDD	112	Intro Light-Duty Diesel	3 SHC
LDD	116	Diesel Electric-Drive	4 SHC
LDD	181	LDD Fuel Systems	4 SHC
<b>Collision Repair and Refinishing Technology</b>			
AUB	111	Painting and Refinishing I	4 SHC
AUB	121	Non-Structural Damage I	3 SHC
AUB	131	Structural Damage I	4 SHC
<b>Construction Equipment Systems Technology</b>			
HYD	134	Hyd/Hydrostatic Construction	4 SHC
PME	117	Equipment Braking Systems	3 SHC
PME	118	Undercarriage Components	2 SHC
PME	221	Const Equip Servicing	2 SHC
<b>Diesel and Heavy Equipment Technology</b>			
HET	110	Diesel Engines	6 SHC
HET	114	Power Trains	5 SHC
HET	125	Preventive Maintenance	2 SHC
		Or	
MRN	121	Marine Engines	4 SHC
MRN	147	Marine Power Trains	4 SHC
MRN	150	Adv. Marine Electricity	5 SHC
<b>Motorcycle Mechanics</b>			
MCM	111	Motorcycle Mechanics	7 SHC
MCM	114	Motorcycle Fuel Systems	5 SHC
MCM	115	Motorcycle Chassis	3 SHC
<b>Recreational Vehicle Maintenance and Repair Technology</b>			
RVM	112	RV Preventive Maintenance	2 SHC
RVM	115	Pre-Delivery Inspection	2 SHC
RVM	160	RV Water Systems	4 SHC

### C. Other Major Hours.

*To be selected from the following prefixes:*

ACC, ARS, ATR, ATT, AUB, AUC, AUM, AUT, BMS, BPR, BTB, BUS, CIS, CSC, CTS, DBA, DDF, DEA, DFT, ELC, ELN, FBG, GRA, HET, HYD, ISC, LDD, LOG, MAC, MCM, MEC, MKT, MPS, MRN, MSM, NOS, PHY, PME, RCT, RVM, SST, TDP, TRN, WBL, WEB, and WLD

*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](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:

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



**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 2015 (2015\*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 4<sup>th</sup> 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.

Approved by the State Board of Community Colleges on August 16, 2012; Editorial Revision 09/08/12; Editorial Revision 12/14/12; CRC Revised—Electronic Only 05/29/13; Editorial Revision 08/21/13; Editorial Revision 01/17/14; Editorial Revision 10/16/14; SBCC Revised 03/20/15; SBCC Revised 04/17/15.

**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 400.97 (3)]: 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																																																																																							
<b>Minimum General Education Hours Required:</b>	<b>15 SHC</b>	<b>6 SHC</b>	<b>0 SHC</b>																																																																																							
<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><b>Communications:</b></p> <table border="0"> <tr><td>*COM 101</td><td>Workplace Communication</td><td>3 SHC</td></tr> <tr><td>COM 110</td><td>Introduction to Communication</td><td>3 SHC</td></tr> <tr><td>COM 120</td><td>Intro Interpersonal Com</td><td>3 SHC</td></tr> <tr><td>COM 231</td><td>Public Speaking</td><td>3 SHC</td></tr> <tr><td>*ENG 101</td><td>Applied Communications I</td><td>3 SHC</td></tr> <tr><td>*ENG 102</td><td>Applied Communications II</td><td>3 SHC</td></tr> <tr><td>ENG 110</td><td>Freshman Composition</td><td>3 SHC</td></tr> <tr><td>ENG 111</td><td>Writing and Inquiry</td><td>3 SHC</td></tr> <tr><td>ENG 114</td><td>Professional Research &amp; Reporting</td><td>3 SHC</td></tr> <tr><td>ENG 116</td><td>Technical Report Writing</td><td>3 SHC</td></tr> </table> <p><b>Humanities/Fine Arts:</b></p> <table border="0"> <tr><td>*HUM 101</td><td>Values in the Workplace</td><td>2 SHC</td></tr> <tr><td>HUM 110</td><td>Technology and Society</td><td>3 SHC</td></tr> <tr><td>HUM 115</td><td>Critical Thinking</td><td>3 SHC</td></tr> <tr><td>HUM 230</td><td>Leadership Development</td><td>3 SHC</td></tr> <tr><td>PHI 230</td><td>Introduction to Logic</td><td>3 SHC</td></tr> <tr><td>PHI 240</td><td>Introduction to Ethics</td><td>3 SHC</td></tr> </table> <p><b>Social/Behavioral Sciences:</b></p> <table border="0"> <tr><td>ECO 151</td><td>Survey of Economics</td><td>3 SHC</td></tr> <tr><td>ECO 251</td><td>Prin of Microeconomics</td><td>3 SHC</td></tr> <tr><td>GEO 110</td><td>Introduction to Geography</td><td>3 SHC</td></tr> <tr><td>GEO 111</td><td>World Regional Geography</td><td>3 SHC</td></tr> <tr><td>GEO 131</td><td>Physical Geography I</td><td>4 SHC</td></tr> <tr><td>*PSY 101</td><td>Applied Psychology</td><td>3 SHC</td></tr> <tr><td>*PSY 102</td><td>Human Relations</td><td>2 SHC</td></tr> <tr><td>PSY 118</td><td>Interpersonal Psychology</td><td>3 SHC</td></tr> <tr><td>PSY 135</td><td>Group Processes</td><td>3 SHC</td></tr> <tr><td>PSY 150</td><td>General Psychology</td><td>3 SHC</td></tr> <tr><td>*SOC 105</td><td>Social Relationships</td><td>3 SHC</td></tr> <tr><td>SOC 210</td><td>Introduction to Sociology</td><td>3 SHC</td></tr> <tr><td>SOC 215</td><td>Group Process</td><td>3 SHC</td></tr> </table>	*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	*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	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	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	<b>6 SHC</b>	<b>3-6 SHC</b>	<b>Optional</b>
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<b>Natural Sciences/Mathematics:</b> MAT 120 Geometry and Trigonometry 3 SHC MAT 121 Algebra/Trigonometry I 3 SHC MAT 161 College Algebra 3 SHC MAT 171 Precalculus Algebra 3 SHC MAT 175 Precalculus 4 SHC MAT 223 Applied Calculus 3 SHC MAT 271 Calculus I 4 SHC	<b>3 SHC</b>	<b>0-3 SHC</b>	<b>Optional</b>																																																			
<p><b>II. Major Hours.</b> 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.</p> <p><b>A. Technical Core.</b> 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.</p> <p><b>B. Program Major(s).</b> 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.</p> <p><b>C. Other Major Hours.</b> 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.</p>																																																						
<b>Engineering and Technology: Applied, Automation, Mechatronics Engineering Technology</b>	<b>AAS</b>	<b>Diploma</b>	<b>Certificate</b>																																																			
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<p><i>Courses required for a diploma are designated with *</i></p> <p><b>A. Technical Core:</b></p> <p style="padding-left: 20px;"><b>*Computer Applications</b> Choose one:</p> <table border="0" style="width: 100%;"> <tr><td>CIS 110</td><td>Introduction to Computers</td><td style="text-align: right;">3 SHC</td></tr> <tr><td>EGR 111</td><td>Eng Comp and Careers</td><td style="text-align: right;">3 SHC</td></tr> <tr><td>EGR 125</td><td>Appl Software for Tech</td><td style="text-align: right;">2 SHC</td></tr> <tr><td>ELC 127</td><td>Software for Technicians</td><td style="text-align: right;">2 SHC</td></tr> </table> <p style="padding-left: 20px;"><b>*Safety</b> Choose one:</p> <table border="0" style="width: 100%;"> <tr><td>ISC 112</td><td>Industrial Safety</td><td style="text-align: right;">2 SHC</td></tr> <tr><td>ISC 115</td><td>Construction Safety</td><td style="text-align: right;">2 SHC</td></tr> </table> <p><b>B. Program Major(s):</b> <i>For AAS Degree select one program major.</i></p> <p style="padding-left: 20px;"><b><u>Applied Engineering Technology</u></b></p> <p style="padding-left: 20px;"><b>*Computers</b> Choose one:</p> <table border="0" style="width: 100%;"> <tr><td>DFT 119</td><td>Basic CAD</td><td style="text-align: right;">2 SHC</td></tr> <tr><td>ELC 127</td><td>Software for Technicians</td><td style="text-align: right;">2 SHC</td></tr> </table> <p style="padding-left: 20px;"><b>*Electricity</b> Choose one:</p> <table border="0" style="width: 100%;"> <tr><td>ELC 131</td><td>Circuit Analysis I</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>ELC 138</td><td>DC Circuit Analysis</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>ELC 139</td><td>AC Circuit Analysis</td><td style="text-align: right;">4 SHC</td></tr> </table> <p style="padding-left: 20px;"><b>*Engineering</b> Choose one:</p> <table border="0" style="width: 100%;"> <tr><td>HYD 110</td><td>Hydraulics/Pneumatics I</td><td style="text-align: right;">3 SHC</td></tr> <tr><td>HYD 112</td><td>Hydraulics/Med/Heavy Duty</td><td style="text-align: right;">2 SHC</td></tr> <tr><td>HYD 115</td><td>Industrial Hydraulics</td><td style="text-align: right;">3 SHC</td></tr> <tr><td>MNT 165</td><td>Mechanical Industrial Sys</td><td style="text-align: right;">2 SHC</td></tr> </table> <p style="padding-left: 20px;"><b>*Motors and Controls</b> Choose one:</p> <table border="0" style="width: 100%;"> <tr><td>ELC 117</td><td>Motors and Controls</td><td style="text-align: right;">4 SHC</td></tr> <tr><td>ELC 128</td><td>Intro to PLC</td><td style="text-align: right;">3 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	ELC 138	DC Circuit Analysis	4 SHC	ELC 139	AC Circuit Analysis	4 SHC	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	ELC 117	Motors and Controls	4 SHC	ELC 128	Intro to PLC	3 SHC	<b>16-44 SHC</b>	<b>16-24 SHC</b>	
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<p><b>*Specialty</b> Choose one:</p> <p>ATR 112 Intro to Automation 3 SHC CET 110 Intro to CET 1 SHC ELN 131 Analog Electronics I 4 SHC ISC 129 Qual Testing Lab Tech 3 SHC MEC 110 Intro to CAD/CAM 2 SHC PCI 150 Process Control Systems 4 SHC</p> <p><b><u>Automation Engineering Technology</u></b></p> <p>*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</p> <p><b>*Basic Electricity</b> Choose one set:</p> <p>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</p> <p><b>Specialty</b> Choose one:</p> <p>ATR 121 Intro to Machine Vision 4 SHC BAT 111 Building Automation Systems 2 SHC HYD 110 Hydraulics/Pneumatics I 3 SHC MEC 130 Mechanisms 3 SHC MNT 250 PLC Interfacing 4 SHC</p> <p><b><u>Mechatronics Engineering Technology</u></b></p> <p>*ATR 112 Intro to Automation 3 SHC *ELC 213 Instrumentation 4 SHC</p> <p><b>*Basic Electricity</b> Choose one course or set:</p> <p>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</p> <p><b>Drawing</b> Choose one:</p> <p>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</p> <p><b>Fluid Mechanics</b> Choose one:</p> <p>HYD 110 Hydraulics/Pneumatics I 3 SHC HYD 180 Pneumatics in Automation 3 SHC MEC 265 Fluid Mechanics 3 SHC</p>			
<p><b>Mechanical Drives</b> Choose one:</p> <p>MEC 130 Mechanisms 3 SHC MEC 275 Engineering Mechanisms 3 SHC</p>			

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<p><b>Machines</b> Choose one course or set:</p> <p>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</p> <p><b>Programmable Logic Controllers (Choose one:)</b></p> <p>ELC 128      Intro to PLC    3 SHC  ELN 260      Prog Logic Controllers                              4 SHC</p> <p><b>*Physics (Choose one:)</b></p> <p>PHY 131      Physics-Mechanics                                  4 SHC  PHY 151      College Physics I                                      4 SHC</p> <p><b><u>Mission Critical Operations</u></b></p> <p>*MCO 110    Intro to MCO    3 SHC  *MCO 115    MCO Infrastructure                                      3 SHC  MCO 210    Critical Site Operations                              3 SHC</p> <p><b>Operations Technology</b></p> <p>ATR 112      Intro to Automation                                  3 SHC  *MNT 222    Industrial Sys Schematics                              2 SHC</p>					
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**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, RCT, RVM, SEC, SST, TCT, TEL, TNE, TRN, WAT, WBL, WEB and WLD

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](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:*

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

## Mission Critical Operations Courses

### **MCO 110 Introduction to Mission Critical Operations**

Class: 2      Lab: 2      Work Experience: 0      Credit: 3

Prerequisites:    None

Corequisites:    None

This course introduces the fundamental aspects of mission critical operations and describes the skills that technicians perform on the job and the environments in which they work. Topics include terminology, challenges in maintaining mission critical operations, mission critical operations technology, mission critical information technology, technology management and the mission critical mindset. Upon completion, students should be able to distinguish between mission critical and non-mission critical scenarios, describe mission critical applications in both operations technology and information technology, demonstrate an awareness of the threats to mission critical operations, and define key mission critical operations terminology.

### **MCO 115 Mission Critical Operations Infrastructure**

Class: 2      Lab: 2      Work Experience: 0      Credit: 3

Prerequisites:    None

Corequisites:    None

This course provides a survey of critical infrastructure and its impact on mission critical operations. Topics include an introduction to concepts, theory, terminology, and best practices regarding critical infrastructure assets essential for the economy and the functioning of society. Upon completion, students should be able to name critical infrastructure sectors, explain relationships between infrastructure sectors, discuss the roles government and private entities play in maintaining critical infrastructure, and their impact on daily life.

### **MCO 210 Critical Site Operations**

Class: 2      Lab: 3      Work Experience: 0      Credit: 3

Prerequisites:    None

Corequisites:    None

This course introduces critical site operations and the multidisciplinary concepts and infrastructure involved in maintaining performance, security, and safety in a high uptime environment. Topics include safety, security, cybersecurity, operating procedures, operating processes, site-wide monitoring, utilities infrastructure, and regulatory agency compliance. Upon completion, students should be able to identify infrastructure systems, discuss infrastructure performance, demonstrate an understanding of infrastructure system interoperability, apply safety and security principles, and generate a cybersecurity framework for critical sites.