

Automation and Control Technology Mississippi Curriculum Framework

**Manufacturing Technology/ Technician - CIP: 15.0613 – (Manufacturing Engineering
Technology/Technician)
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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

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ADOPTION OF NATIONAL CERTIFICATION STANDARDS

Automation and Control

The National Center for Construction Education and Research (NCCER) is a not-for-profit 501(c) (3) Education foundation created in 1996. It was developed with the support of more than 125 construction CEOs and various association and academic leaders who united to revolutionize training for the construction industry. Sharing the common goal of developing a safe and productive workforce, these companies created a standardized training and credentialing program for the industry. This progressive program has evolved into curricula for more than 70 craft areas and a complete series of more than 70 assessment offered in over 4,000 NCCER-accredited training and assessment locations across the United States.

NCCER develops standardized construction and maintenance curricula and assessments with portable credentials. These credentials are tracked through NCCER's National Registry which allows organizations and companies to track the qualifications of their craft professionals and/or check the qualifications of possible new hires. The National Registry also assists craft professionals by maintaining their records in a secure database.

NCCER's process of accreditation, instructor certification, standardized curriculum, national registry, assessment, and certification is a key component in the industry's workforce development efforts. NCCER also drives multiple initiatives to enhance career development and recruitment efforts for the industry. NCCER is headquartered in Alachua, FL, and is affiliated with the University of Florida's M.E. Rinker, Sr. School of Building Construction.

As the accrediting body for the industry, NCCER establishes the benchmark for quality training and assessments. By partnering with industry and academia, NCCER has developed a system for program accreditation that is similar to those found in institutions of higher learning. This process fosters national unity among the construction industry while providing a defined career path with industry-recognized credentials.

NCCER's accreditation process assures that students and craft professionals receive quality training based on uniform standards and criteria. These standards are outlined in the NCCER Accreditation Guidelines and must be adhered to by all NCCER Accredited Training Sponsors and Accredited Assessment Centers.

INDUSTRY JOB PROJECTION DATA

The Automation and Control Technology occupations require an education level of short-term on-the-job training or work experience in a related field. There is expected to be a 10.87% increase in occupational demand at the regional level and 10.77% increase at the state level. Median annual income for this occupation is \$27,145.63 at the state level. A summary of occupational data from the State Workforce Investment Board Data Center is displayed below:

Table 1: Education Level

Program Occupations	Education Level
Industrial Engineering Technicians	Associate Degree

Table 2: Occupational Overview

	Region	State	United States
2014 Occupational Jobs	361	361	66056
2024 Occupational Jobs	353	353	65668
Total Change	-8	-8	-388
Total % Change	-2.22%	-2.22%	-0.59%
2014 Median Hourly Earnings	\$23.98	\$23.98	\$25.66
2014 Median Annual Earnings	\$49,878.40	\$49,878.40	\$53,372.80
Annual Openings	0	0	-38

Table 3: Occupational Breakdown

Description	2014 Jobs	2024 Jobs	Annual Openings	2014 Hourly Earnings	2014 Annual Earnings 2,080 Work Hours
Industrial Engineering Technicians	361	353	0	\$23.98	\$49,878.40

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Industrial Engineering Technicians	-8	-2.22%	-2.22%	-0.59%

ARTICULATION

There is no secondary program in Automation and Controls to articulate to this program of study.

TECHNICAL SKILLS ASSESSMENT

Colleges should report the following for students who complete the program with a career certificate, technical certificate, or an Associate of Applied Science Degrees for technical skills attainment. To use the approved Alternate Assessment for the following programs of study, colleges should provide a Letter of Notification to the Director of Career Technical Education at the MS Community College Board. Please see the following link for further instructions: <http://www.mccb.edu/wkfEdu/CTDefault.aspx>.

CIP Code	Program of Study	
15.0613	Manufacturing Technology/Technicians	
Level	Standard Assessment	Alternate Assessment
Career	NCCER Core	MS-CPAS 3- Postsecondary Automation and Control
Level	Standard Assessment	Alternate Assessment
Technical/AAS	NCCER Level I Instrumentation	MS-CPAS-3 Postsecondary Automation and Control

ONLINE AND BLENDED LEARNING OPPORTUNITIES

Course content includes lecture and laboratory semester credit hours. Faculty members are encouraged to present lecture related content to students in an online or blended learning environment. Training related to online and blended learning will be available to faculty members through the MS Community College Board.

INSTRUCTIONAL STRATEGIES

Instructional strategies for faculty members implementing the curriculum can be found through the Office of Curriculum and Instruction's professional development.

ASSESSMENT STRATEGIES

The Office of Curriculum and Instruction's professional development offer assessment strategies to faculty members implementing the curriculum. Additionally, standards were included in course content when appropriate.

RESEARCH ABSTRACT

In the spring of 2018, the Office of Curriculum and Instruction (OCI) met with the different industry members who made up the advisory committees for the Brick, Block Stone and Masonry program. An industry questionnaire was used to gather feedback concerning the trends and needs, both current and future, of their field. Program faculty, administrators, and industry members were consulted regarding industry workforce needs and trends.

Industry advisory team members from the college involved with this program were asked to give input related to changes to be made to the curriculum framework. Specific comments related to soft skills needed in this program include having time management, be able to work in different climates, flexible schedule, demonstrate work safety.

Occupation-specific skills stated include knowing how to communicate with the customers, basic math skills, troubleshooting, be able to lift 50 pounds, work safety.

REVISION HISTORY:

2011 Research and Curriculum Unit, Mississippi State University

2018 Mississippi Community College Board

PROGRAM DESCRIPTION

Automation and Control Technology

Automation and Control Technology is an instructional program that provides the student with technical knowledge and skills necessary for gaining employment as an automated manufacturing systems technician in maintenance diagnostics, engineering, or production in an automated manufacturing environment. The focus of this program is on electricity/electronics, fluid power, motors and controllers, programmable controls, interfacing techniques, instrumentation, and automated processes.

This curriculum is designed as a two-year technical program. Students who graduate from the program will be better prepared to continue their education in advanced engineering related fields.

SUGGESTED COURSE SEQUENCE AUTOMATION AND CONTROL

Accelerated Integrated Career Pathway Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
IAT 1113	Introduction to Automation and Control I	3	2	2	60	
IAT 1123	Electrical Wiring for Automation Control Technology	3	2	2	60	
	Instructor Approved Electives	9				
	Total	15				

Career Certificate Required Courses Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	NCCER CORE
IAT 1113	Introduction to Automation and Control I	3	2	2	60	
IAT 1123	Electrical Wiring for Automation Control Technology	3	2	2	60	
IAT 1133	AC/DC Circuits for Automation and Control	3	2	2	60	
IAT 1143	Fluid Power for Automation and Control	3	2	2	60	
IAT 1153	Motor Controls for Automation and Control	3	2	2	60	
IAT 1163	Manufacturing Skills for Automation and Control	3	2	2	60	
IAT 1173	Controls System I for Automation and Control	3	2	2	60	
	Instructor Approved Elective	9				
	TOTAL	30				

Technical Certificate Required Courses Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	NCCER Level I Instrumentation
IAT 2113	Programmable Logic Controllers for Automation and Control	3	2	2	60	
IAT 2123	Control Systems II for Automation and Control	3	2	2	60	
IAT 2133	Solid State Motor Controls for Automation and Control	3	2	2	60	
	Instructor Approved Electives	6				
	TOTAL	15				

General Education Core Courses – Automation and Control Technology

General Education Core Courses

To receive the Associate of Applied Science degree, a student must complete all of the required coursework found in the Career Certificate option, Technical certificate option, and a minimum of 15 semester hours of General Education core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science degree at their college. The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) Section 9 Standard 3 of the *Principles of Accreditation: Foundations for Quality Enhancement*¹ describes the general education core.

Section 9 Standard 3:

3. The institution requires the successful completion of a general education component at the undergraduate level that
 - a) is based on a coherent rationale.
 - b) is a substantial component of each undergraduate degree program. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours of the equivalent; for baccalaureate programs, a minimum of 30 semester hours or the equivalent.
 - c) ensures breadth of knowledge. These credit hours include at least one course from each of the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. These courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

<<<Add any additional general education standards as required for programmatic accreditation here and footnote below.>>>

General Education Courses

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
	Humanities/Fine Arts	3						
	Social/Behavioral Sciences	3						
	Math/Science	3						
	Academic electives	6						

¹ Southern Association of Colleges and Schools Commission on Colleges. (2017). *The Principles of Accreditation: Foundations for Quality Enhancement*. Retrieved from <http://www.sacscoc.org/2017ProposedPrinc/Proposed%20Principles%20Adopted%20by%20BOT.pdf>

AUTOMATION AND CONTROL TECHNOLOGY COURSES

Course Number and Name: IAT 1113 Introduction to Automation and Controls I

Description: This course is designed to introduce students to the fundamental skills associated with safety, basic tools, special tools, equipment.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

NCCER Core

Module 00101-15--Basic Safety

1. Explain the idea of a safety culture and its importance in the construction crafts.
2. Identify causes of accidents and the impact of accident costs.
3. Explain the role of OSHA in job-site safety.
4. Explain OSHA's General Duty Clause and 1926 CFR Subpart C.
5. Recognize hazard recognition and risk assessment techniques.
6. Explain fall protection, ladder, stair, and scaffold procedures and requirements.
7. Identify struck-by hazards and demonstrate safe working procedures and requirements.
8. Identify caught-in-between hazards and demonstrate safe working procedures and requirements.
9. Define safe work procedures to use around electrical hazards.
10. Demonstrate the use and care of appropriate personal protective equipment (PPE).
11. Explain the importance of hazard communications (HazCom) and material safety data sheets (MSDSs).
12. Identify other construction hazards on your job site, including hazardous material exposures, environmental elements, welding and cutting hazards, confined spaces, and fires.

Module 00102-15--Introduction to Construction Math

1. Add, subtract, multiply, and divide whole numbers, with and without a calculator.
2. Use a standard ruler, a metric ruler, and a measuring tape to measure.
3. Add, subtract, multiply, and divide fractions.
4. Add, subtract, multiply, and divide decimals, with and without a calculator.
5. Convert decimals to percentages and percentages to decimals.
6. Convert fractions to decimals and decimals to fractions.
7. Explain what the metric system is and how it is important in the construction trade.
8. Recognize and use metric units of length, weight, volume, and temperature.
9. Recognize some of the basic shapes used in the construction industry and apply basic geometry to measure them.

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Module 00103-15--Introduction to Hand Tools

1. Recognize and identify some of the basic hand tools and their proper uses in the construction trade.
2. Visually inspect hand tools to determine if they are safe to use.
3. Safely use hand tools.

Module 00104-15--Introduction to Power Tools

1. Identify power tools commonly used in the construction trades.
2. Use power tools safely.
3. Explain how to maintain power tools properly.

Module 00105-15--Introduction to Construction Drawings

1. Recognize and identify basic construction drawing terms, components, and symbols.
2. Relate information on construction drawings to actual locations on the print.
3. Recognize different classifications of construction drawings.
4. Interpret and use drawing dimensions.

Module 00106-15--Basic Rigging

1. Identify and describe the use of slings and common rigging hardware.
2. Describe basic inspection techniques and rejection criteria used for slings and hardware.
3. Describe basic hitch configurations and their proper connections.
4. Describe basic load-handling safety practices.
5. Demonstrate proper use of American National Standards Institute (ANSI) hand signals.

Module 00107-15--Basic Communication Skills

1. Interpret information and instructions presented in both verbal and written form.
2. Communicate effectively in on-the-job situations using verbal and written skills.
3. Communicate effectively on the job using electronic communication devices.

Module 00108-15--Basic Employability Skills

1. Explain your role as an employee in the construction industry.
2. Demonstrate critical thinking skills and the ability to solve problems using those skills.
3. Demonstrate knowledge of computers systems and explain common uses for computers in the construction industry.
4. Define effective relationship skills.
5. Recognize workplace issues such as sexual harassment, stress, and substance abuse.

Module 00109-15--Introduction to Materials Handling

1. Define a load.
 2. Establish a pre-task plan prior to moving a load.
 3. Use proper materials-handling techniques.
 4. Choose appropriate materials-handling equipment for the task.
5. Recognize hazards and follow safety procedures required for materials handling

Course Number and Name: IAT 1123 Electrical Wiring for Automation Control Technology for Automation and Control

Description: Basic electrical wiring for automation and controls including safety practices; installation and maintenance of raceways, conduit, and fittings; and three-phase service entrances, metering devices main panels, raceways or ducts, subpanels, feeder circuits and branch circuits according to electrical codes.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Apply general safety rules.
 - a. Explain and demonstrate safety rules and regulations for working near or on load centers and safety switches.
 - b. Explain and demonstrate the ability of safe lifting and work habits.
2. Install and maintain raceways, conduit, and fittings.
 - a. Identify types of raceways, conduit, and fittings.
 - b. Apply usage of raceways, conduit, and fittings as required by electrical codes.
 - c. Demonstrate the use of mechanical and hydraulic conduit benders to make specified bends to different sizes and types of conduit.
 - d. Identify other types of raceways and their associated bodies.
3. Explain different types of three-phase service entrances, metering devices, main panels, raceways or ducts, subpanels, feeder circuits, and branch circuits according to electrical codes.
 - a. Explain the codes (NEC and local) for the installation of a service entrance.
 - b. Explain safety cautions to be used when installing a service entrance.
 - c. Construct a sketch to install a service entrance.
 - d. Explain terms associated with a service entrance.
 - e. Identify components of a service entrance.

NCCER Level I Instrumentation

Module 12116-14-Electrical Systems for Instrumentation

1. State how electrical power is created and distributed.
2. State general safety practices associated with electricity.
3. Describe the difference between alternating current and direct current.
4. Define *voltage*, *current*, *resistance*, and *power* and describe how they are related.
5. Use Ohm's law to calculate the current, voltage, and resistance in circuit.
6. Use the power formula to calculate how much power is consumed by a circuit.
7. Describe the differences between series and parallel circuits and calculate circuit loads for each type.
8. Identify various types and ratings of wiring by size, jacket, and rating.
9. Describe the purpose of electrical system grounding.

Module 12117-14-Steel piping practices

1. Identify the characteristics and uses of steel pipe.
2. Describe how pipe threads are classified and measured.
3. Identify the various types of fittings used on steel pipe and describe how they are used.
4. Describe how to measure lengths of steel pipe.
5. Identify pipe cutting and reaming tools and describe how they are used.
6. Identify threading tools and describe how they are used.
7. Explain and demonstrate the methods and use of the tools to connect threaded pipe.
8. Describe how to assemble flanged steel pipe.

9. Describe the welding methods used to join steel pipe.

10. Describe how to correctly install steel pipe.

NCCER Level II Instrumentation

Module 12214-15-Raceways for Instrumentation

1. Identify various types of metallic conduit and fittings and state their uses.

2. Identify types of nonmetallic conduit and fittings and state their uses.

3. Identify raceway supports and their uses.

4. Prepare various types of conduit for installation.

5. Describe wireways and cable trays and their associated fittings.

Course Number and Name: IAT 1133 AC/DC Circuits for Automation and Control

Description: Principles and theories with DC and AC circuits used in the automation trade. Includes the study of electronic circuits, laws and formulas, and the use of test equipment to analyze AC and DC circuits.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Explain and apply basic safety regulations which must be followed.
 - a. Discuss required safety regulations for the lab and industrial settings.
 - b. Discuss and apply safe working habits
 - c. Demonstrate and practice general safety procedures
2. Define basic electronics terms
 - a. Define terms as they apply to DC circuits, voltage, current, resistance, power, etc.
 - b. Define terms as they apply to AC circuits, peak voltage, peak-to-peak voltage, V_{rms} , frequency, period, cycle, etc.
3. Measure values in DC and AC Circuits
 - a. Apply knowledge to measure voltage, resistance, and current in DC and AC circuits
 - b. Demonstrate ability to select and use various metering devices (DMM, Oscilloscope, etc.)
4. Demonstrate and apply understanding of a basic DC and AC electronic circuit
 - a. Identify and determine values of resistors, capacitors, and inductors
 - b. Calculate and solve for resistance, voltage, current, and power
 - c. Demonstrate knowledge of schematic symbols in DC and AC
5. Analyze and evaluate parameters of series, parallel, and series parallel circuits
 - a. Compute values of voltage, current, resistance, and power
 - b. Measure values of voltage, current, and resistance
 - c. Define and calculate voltage divider network
 - d. Construct voltage divider network to achieve a desired output voltage
6. Analyze inductance and capacitance in DC and AC series and parallel circuits
 - a. Calculate inductive reactance and solve for circuit values in AC circuits
 - b. Calculate capacitive reactance and solve for circuit values in AC circuits
 - c. Calculate values in RLC circuits
 - d. Define RLC resonant and non-resonant circuits

Course Number and Name: IAT 1143 Fluid Power for Automation and Control

Description: This basic course provides instruction in hydraulics and pneumatics. This course covers actuators, accumulators, valves, pumps, motors, coolers, compression of air, control devices, and circuit diagrams. Emphasis is placed on the development of control circuits and troubleshooting techniques.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Define and describe basic laws governing fluids.
 - a. Describe the concept of force, flow, and pressure.
 - b. Analyze the relationship of force and pressure in a circuit.
 - c. Explain what causes flow in a circuit.
 - d. Calculate area, pressure, velocity, and rate of flow.
 - e. Explain and apply the ideal gas laws, Boyle's Law and Charles' Law, in fluid systems.
2. Identify and draw symbols for hydraulics and pneumatics.
 - a. Explain the logic for drawing symbols for hydraulic components.
 - b. Draw individual hydraulic and pneumatic components.
3. Describe operation and nomenclature of various pumps and compressors.
 - a. Analyze the operation of vane, gear, and piston pumps in hydraulics.
 - b. Analyze the operation of air compressors.
4. Explain fluids as pertaining to the transmission of energy.
 - a. Describe various types of hydraulic fluids.
 - b. Explain the purpose of the fluid reservoir, the filtration system, and the heat exchanger in hydraulics.
 - c. Explain the purpose of the receiver in pneumatics.)
 - d. Explain the purpose of trio units in compressed air.
5. Describe the operation of flow, pressure, and directional control valves.
 - a. Explain basic design features used in each type of control valve.
 - b. Demonstrate how flow, pressure, and directional valves are used in hydraulics and pneumatics.
6. Explain the types of actuators used in pneumatics and hydraulics.
 - a. List important cylinder design features.
 - b. Explain basic design features of hydraulic motors and other rotary actuators.
 - c. Identify common types of air motors.
7. Explain, construct, and troubleshoot various hydraulic and pneumatic circuits.
 - a. Explain the purpose of a sequence circuit.
 - b. Construct and troubleshoot a sequence circuit.
8. Demonstrate the use of electro-mechanical controls in hydraulic and pneumatic circuits.
 - a. Explain the construction and use of solenoids in directional controls.
 - b. Construct a hydraulic or pneumatic circuit that is controlled electrically.

Level 1 NCCER Instrumentation

Module 12111-14 Tubing

1. Describe the general sizing of tubing.
2. Identify the various materials used in tubing and state their applications.
3. Describe various standards that apply to tubing products.
4. Describe the methods of properly handling and storing tubing.
5. Identify various tube-cutting tools and explain how they are used.
6. Identify various bend types and the flaws that must be avoided during bending.

7. Identify various bending devices and explain how they are used.
8. Identify various types of compression fittings and describe how to assemble a compression fitting.
9. Identify flare fittings and describe how to form a flare
10. Describe fittings used for welding and brazing.
11. Describe the method used to join PVC tube.

Module 12113-14 Hoses

1. Identify relevant hose standards and common sizing/pressure rating conventions.
2. Identify and describe various types of metallic hoses.
3. Identify and describe various types of non-metallic hoses.
4. Describe methods used in storing and handling hoses.
5. Describe the various approaches to hose construction and identify their applications.
6. Identify various fittings used to assemble hoses and describe their uses.
7. Explain how to install a standard reusable hose fitting.

Course Number and Name: IAT 1153 Motor Control for Automation and Control

Description: This course includes the installation of different motor control circuits and devices. Emphasis is placed on developing the student's ability to diagram, wire, and troubleshoot the different circuits and mechanical control devices.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Install different control circuits and devices.
 - a. Diagram and wire a two-wire and three-wire motor control circuit with indicating pilot lights.
 - b. Diagram, wire, and troubleshoot an on-delay and off-delay timer circuit.
 - c. Diagram and wire multi-control manual station.
 - d. Diagram and wire a "hands-off-automatic" control station.
 - e. Diagram and wire a jog-forward/jog-reverse control.
2. Troubleshoot different control circuits and devices.
 - a. Troubleshoot a two-wire and three-wire motor control circuit with indicating pilot lights.
 - b. Troubleshoot an on-delay and off-delay timer circuit.
 - c. Troubleshoot a multi-control manual station.
 - d. Troubleshoot a "hands-off-automatic" control station.
 - e. Troubleshoot a jog-forward/jog-reverse control.

Course Number and Name: IAT 1163 **Manufacturing Skills for Automation and Control**

Description: Manufacturing skills is the initial course designed to provide the student with the basic skills needed to be successful in a high-performance manufacturing environment. The course covers 5 major areas of knowledge that are considered critical for employment in a high-performance manufacturing company. The topics covered include: Basic Computer Literacy, Blueprint Reading, Precision Measurement, and an introduction to manufacturing improvement methods that covers Lean Manufacturing, Quick Changeover, 5S, Teamwork and Problem-solving.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Apply skills needed to read industrial blueprints.
 - a. Read an orthographic drawing.
 - b. Read various different types of drawings used in manufacturing such as isometric, auxiliary and sectional views.
 - c. Determine dimensions from various mechanical drawings.
 - d. Demonstrate the ability to recognize symbols used in different types of drawings.
2. Apply precision measurement skills.
 - a. Recognize precision measuring instruments.
 - b. Demonstrate the proper use and care of precision measuring instruments.
 - c. Demonstrate the ability to measure accurately with English measurement scales.
 - d. Demonstrate the ability to measure accurately with metric measurement scales.
 - e. Apply precision measurement devices in simulated job tasks.
3. Apply techniques used in high-performance manufacturing.
 - a. Demonstrate Teamwork and problem-solving skills.
 - b. Describe High-Performance manufacturing procedures to include:
 - i. Lean manufacturing
 - ii. 5S
 - iii. SMED
 - iv. Identifying customers and their needs
 - v. Quality control
 - vi. Understanding of ISO
 - vii. Value stream mapping
 - c. Research and present a manufacturing topic.
4. Apply basic interviewing skills.
 - a. Perform interviewing skills.
 - b. Create a resume for a job interview.
5. Perform basic computer literacy skills.
 - a. Run a program from the desktop and the Start Menu.
 - b. Demonstrate how to operate a browser.
 - c. Demonstrate entering a website by entering the URL.
 - d. Demonstrate how to save a website URL as a favorite or bookmark.
 - e. Demonstrate how to use a search engine
 - f. Establish and use an email account
 - g. Demonstrate how to create and save a word processing file.
 - h. Create and save a spreadsheet file.
 - i. Demonstrate send, receive, save and open an attachment using an email account.

Level 1 NCCER Instrumentation

Module 12108-14 Gaskets O-Rings and Packing

1. Describe the different types of flange facings.
2. Describe how gaskets are used and the importance of compatibility.
3. Identify the various types of gaskets and describe their applications.
4. Describe how to properly install gaskets.
5. Identify and describe various types of O-rings and how they are installed.
6. Identify and describe various types of packing and how they are installed.

Module 12106-14 Fasteners

1. Identify various types and uses of threaded fasteners.
2. Explain how to install and torque fasteners to a specific value.
3. Identify and describe the installation of various types of anchors and anchor bolts.
4. Identify various types of retainers and pins and describe the installation of blind rivets.
5. Identify and describe the use of various devices used to secure instrumentation tubing and hoses.

Module 12109-14 Lubricants, Sealants, and Cleaners

1. Identify various cutting fluids and explain how they are used.
2. Identify other common lubricants and explain how they are used.
3. Describe the safe handling and storage requirements for lubricants.
4. Identify and describe various pipe and hardware sealants and adhesives.
5. Identify and describe various other sealants and adhesives.
6. Describe the safe handling and storage requirements for sealants and adhesives.
7. Identify cleaning tools and materials used in instrumentation work and describe their use.
8. Identify and describe various cleaning liquids used in and around instrumentation work.
9. Describe the safe handling and storage requirements for cleaners and solvents.

Module 12304-14 Inspect handle and store instrumentation materials

1. Explain how to inspect and handle arriving instrumentation materials.
2. Explain how to properly identify and verify instrumentation materials.
3. Identify the various categories of instrumentation materials relative to storage.
4. Describe the storage conditions for the various categories of instrumentation materials.

Course Number and Name: IAT 1173 Control Systems I for Automation and Control

Description: This is an introductory course to provide information on various instrumentation components and processes. Topics include analyzing pressure processes, temperatures, flow, and level.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Explain and apply basic safety regulations which must be followed.
 - a. Discuss required safety regulations for the lab and industrial settings.
 - b. Discuss and apply safe working habits.
2. Describe and interpret block diagrams, instrument tags, loop drawings, and piping and instrument diagrams (P&ID).
 - a. Identify symbols associated with block diagrams, instrument tags, loop drawings, and piping and instrument diagrams (P&ID).
 - b. Interpret function blocks and describe their relationship to the overall process.
2. Describe and discuss temperature measurement devices.
 - a. Discuss heat transfer.
 - b. Discuss temperature measurement principles.
 - c. Identify devices used to measure and control temperature.
 - d. Analyze and calibrate signals from temperature measurement devices.
3. Describe and discuss pressure measurement devices and their use.
 - a. Identify and describe a manometer and its use.
 - b. Identify and describe pressure elements and their use.
 - c. Identify and describe measuring devices and their use.
 - d. Analyze and calibrate pressure measurement devices.
4. Describe and discuss level measurement devices and their use.
 - a. Identify and describe direct level measurement devices and their use.
 - b. Identify and describe indirect level measurement devices and their use.
 - c. Analyze and calibrate level measurement devices.
5. Describe flow measurement devices and their use.
 - a. Identify and describe flow rate meters.
 - b. Identify and describe total flow meters.
 - c. Analyze and calibrate flow measurement devices.
6. Describe sensors used in process analysis.
 - a. Discuss analyzers used in instrumentation.
 - b. Describe and discuss analytical measurement fundamentals.
 - c. Troubleshoot the various sensors.
7. Describe information transmission pertaining to process control.
 - a. Discuss and describe pneumatic transmission characteristics.
 - b. Explain electrical transmission characteristics.

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Module 12119-14 Craft Related Mathematics

1. Identify units of measure in the inch-pound and metric systems.
2. Describe how to convert length, area, and volume values.
3. Describe how to convert weight values.
4. Describe how to convert pressure and temperature values.
5. Define algebraic equations.

6. Demonstrate an understanding of the sequence of operations.
7. Solve basic algebraic equations.
8. Describe the characteristics of a circle.
9. Identify and describe types of angles.
10. Identify and describe types of polygons.
11. Calculate various values associated with triangles.

Module 12107-14 Instrumentation Drawings and Documents Part I

1. Describe the structure and use of an instrument index.
2. Explain the use and importance of instrument specifications.
3. Describe various types of drawings used in instrumentation projects.
4. Interpret general instrument symbols used on instrumentation drawings.
5. Interpret graphic/pictorial and line symbols used on instrumentation drawings.
6. Describe the methods used to assign instrument tag numbers and identification abbreviations.

Module 12115-14 Instrumentation Safety Practices

1. Describe the effects of electrical shock and how to reduce the risk.
2. Identify and describe common personal and general electrical protective equipment.
3. Identify specific requirements for electrical safety.
4. Describe the various approach boundaries related to electrical hazards.
5. Describe how to conduct a shock hazard analysis.
6. Describe the lockout/tagout procedures for electrical and non-electrical equipment.
7. Describe the voltage testing requirements to be applied before beginning work.
8. Identify basic hand and power tool safety practices.
9. Identify the hazards associated with various process fluids and solvents.
10. Identify safety practices related to batteries.

Course Number and Name: IAT 2113 Programmable Logic Controller for Automation and Control

Description: This course provides instruction in the use of programmable logic controllers (PLCs) in modern industrial settings. The operating principles, installation and basic programming of PLCs will be covered.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Explain principles of PLCs.
 - a. Identify components and operational principles of PLCs.
 - b. Differentiate between a PLC and a computer.
2. Identify different types of PLC hardware.
 - a. Identify and wire different types of input and output modules.
 - b. Identify different types of PLC processor modules, memory capabilities, and programming devices.
3. Explain numbering systems, encoding/decoding, and logical operations.
 - a. Convert numbers from one system to another.
 - b. Explain logical operations using truth tables and ladder logic diagrams.
4. Program all types of internal and discrete instructions.
 - a. Program examine on and off instructions.
 - b. Program on-delay and off-delay instructions.
 - c. Program up-counter and down-counter instructions.
 - d. Program sequencer instructions for real-world output devices.
 - e. Program latch and unlatch instructions.
5. Troubleshoot and maintain different programmable controller systems.
 - a. Identify and troubleshoot the power supply.
 - b. Identify and troubleshoot the inputs and outputs (I/O) cards.
 - c. Identify and troubleshoot real-world inputs and outputs.

Course Number and Name: IAT 2123 Control Systems II for Automation and Control

Description:

This course is a continuation of Control Systems I with special emphasis on application of applied skills along with new skills to develop instrument process controls. The student will be given a process to develop the appropriate instruments and needed diagrams, utilizing various controlling processes and demonstrating loop troubleshooting techniques.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite:

Instructor approved

Student Learning Outcomes:

1. Identify and describe parameters and variables of an operational process control system.
 - a. Discuss and explain terms associated with process control instrumentation.
 - b. Explain how the terms relate to the controlled process and diagrams.
 - c. Describe and demonstrate different control configurations, feed forward, and cascade.
2. Describe control valve characteristics.
 - a. Explain and demonstrate fast-opening, equal-percentage, and proportional control valves.
 - b. Explain control valve positioners.
 - c. Discuss and demonstrate signal conversions techniques.
 - d. Apply maintenance techniques involving control valves.
3. Describe various modes of process control.
 - a. Discuss and demonstrate on-off control.
 - b. Explain and describe proportional, integral, and derivate modes of operation.
 - c. Describe and demonstrate methods for tuning different control modes.
 - d. Describe characteristics of each mode of operation.
 - e. Connect, tune, operate, and troubleshoot various process control configurations.
4. Describe advanced control methods.
 - a. Explain a digital control system.
 - b. Discuss different levels of digital control.
 - c. Describe and explain the computer's role in process control.
 - d. Develop sketches of various control systems.
5. Troubleshoot process control loops.
 - a. Perform standard troubleshooting techniques on process control loops.
 - b. Apply safe troubleshooting techniques.
 - c. Demonstrate and explain integration of system drawings.
6. Demonstrate procedures for handling, storing, and disposing of hazardous materials.
 - a. Recognize signal words and symbols that indicate severity of a hazard.
 - b. Describe methods for reducing hazardous waste.
 - c. Describe procedures for storing hazardous waste.
 - d. Interpret data found on a hazardous material safety data sheet.
 - e. Describe general safe procedures for first aid and clean-up to follow in case of an accident involving hazardous materials.
 - f. Demonstrate procedures for handling, storing, and disposing of hazardous materials.

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Module 12114-14 Hand and Power tool for instrumentation

1. Identify and describe how to use taps.
2. Identify and describe how to use dies.

3. Identify and describe how to use extractors.
4. Identify and describe the vises used to secure metal parts and pipe.
5. Identify and describe the various types of snips used to cut sheet metal.
6. Identify conduit benders, cutters, and reamers.
7. Identify miscellaneous hand tools used in instrumentation work.
8. Identify and describe how to use hammer drills and rotary hammers.
9. Identify and describe how to use soldering guns and irons.
10. Identify and describe how to use hydraulic knockout punches.
11. Describe the basic concepts of and safety guidelines for propellant-powered tools.

Course Number and Name: IAT 2133 Solid State Motor Controls for Automation and Control

Description: This course provides knowledge of the principles and operation of solid state motor control, and variable frequency drives. The design, installation, and maintenance of different solid state devices for motor control will be introduced.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Apply general safety and safety requirements for working on and around electrical motors.
 - a. Apply principles of safety in the use of electrical motors.
 - b. Describe safety procedures to utilize during connecting and operating electric motors.
2. Troubleshoot solid state motor controls.
 - a. Identify electronic and industrial symbols used to represent logic gates in solid state schematics.
 - b. Describe the operation of the different types of industrial and electronic logic gates.
 - c. Draw a solid state logic circuit to replace a manual control station.
 - d. Troubleshoot and repair/replace solid state devices to include memory devices, flip/flops, adjustable time delays, starting and stopping sequences, and looping.
3. Operate AC and DC variable speed drives.
 - a. Discuss the operation of a DC variable speed drive.
 - b. Discuss the operation of an AC variable speed drive.
 - c. Connect and operate a DC and AC variable speed drive.

Course Number and Name: IAT 291 (1-3) Special Project in Automation and Control Technology

Description: A course to provide students with an opportunity to utilize skills and knowledge gained in other Automation and Control Technology courses. The instructor and student work closely together to select a topic and establish criteria for completion of the project.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1	0	2	75
2	0	4	60
3	0	6	90

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Develop a written plan for the special project.
 - a. Compile a written plan for the special project in cooperation with the instructor which details the work to be accomplished, a schedule for delivery, and specific skills/tasks to be mastered.
2. Prepare a written report of activities and accomplishments.
 - a. Compile a daily log of activities and tasks.
 - b. Submit weekly reports to the instructor summarizing activities and tasks completed.
 - c. Submit a final report of activities and experiences.
3. Follow written guidelines for the special project.
 - a. Complete all required activities in the training program.
 - b. Adhere to all written and oral instructions for the special project.

Course Number and Name: IAT 292 (1-6) Supervised Work Experience in Automation and Control Technology

Description: A course which is a cooperative program between industry and education and is designated to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of one semester hour per 45 industrial contact hours.

Hour Breakdown:

Semester Credit Hours	Lecture	Externship	Contact Hours
1	0	3	45
2	0	6	90
3	0	9	135
4	0	12	180
5	0	15	225
6	0	18	270

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Apply technical skills needed to be a viable member of the workforce.
 - a. Prepare a description of technical skills to be developed in the supervised work experience.
 - b. Develop technical skills needed to be a viable member of the workforce.
2. Apply skills developed in other program area courses.
 - a. Perform skills developed in other program area courses.
3. Apply human relationship skills.
 - a. Use proactive human relationship skills in the supervised work experience.
4. Apply and practice positive work habits and responsibilities.
 - a. Perform assignments to develop work habits and responsibilities.
5. Work with instructor and employer to develop written occupational objectives to be accomplished.
 - a. Perform written occupational objectives in the supervised work experience.
6. Assess accomplishment of objectives.
 - a. Prepare daily written assessment of accomplishment of objectives.
 - b. Present weekly written reports to instructor in activities performed and objectives accomplished.
7. Utilize a set of written guidelines for the supervised work experience.
 - a. Develop and follow a set of written guidelines for the supervised work experience

Course Number and Name: **WBL 191(1-3), WBL 192(1-3), Work-Based Learning I, II, III, IV, V, and VI**
 WBL 193(1-3), WBL 291(1-3),
 WBL 292(1-3), and WBL 293(1-3)

Description: A structured work-site learning experience in which the student, program area teacher, Work-Based Learning Coordinator, and worksite supervisor/mentor develop and implement an educational training agreement. Designed to integrate the student's academic and technical skills into a work environment. Includes regular meetings and seminars with school personnel for supplemental instruction and progress reviews. (1-3 sch: 3-9 hours externship)

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Apply technical skills and related academic knowledge needed to be a viable member of the workforce.
 - a. Apply technical skills needed to be a viable member of the workforce.
 - b. Apply skills developed in other related courses in a work-based setting.
 - c. Perform tasks detailed in an educational training agreement at the work setting.
2. Apply general workplace skills to include positive work habits and responsibilities necessary for successful employment.
 - a. Demonstrate pro-active human relationship skills in the work setting to include conflict resolution, team participation, leadership, negotiation, and customer/client service.
 - b. Demonstrate time, materials, and resource management skills.
 - c. Demonstrate critical thinking skills such as problem solving, decision making, and reasoning.
 - d. Demonstrate acquiring, evaluating, organizing, maintaining, interpreting, and communicating information.
 - e. Demonstrate positive work habits and acceptance of responsibilities necessary for successful employment.

Appendix A: RECOMMENDED TOOLS AND EQUIPMENT

CAPITALIZED ITEMS

1. Analysis trainer (1)
2. Calibration stations (1 per 2 students)
3. Camera, video, with accessories (2)
4. Computer, notebook (for programming controls) (1)
5. Computer process control hardware (1)
6. Computer systems (1 per 2 students)
7. Conveyor system (1)
8. Dead weight tester (1)
9. Drill press, pedestal (1)
10. Educational grade robots (minimum \$10,000), with end effectors (1)
11. Electromechanical trainers (1 per 3 students)
12. Flow process trainer (1)
13. Fluid power training lab trainer (1)
14. Hydraulic test kit (1)
15. MegaMeter (1 per 3 students)
16. Mechanical training lab trainer (1)
17. Meter, noise dosimeter (1)
18. Oscilloscopes (50 Mhz dual trace) (1 per 2 students)
19. Portable calibrators (2)
20. Programmable logic controller trainers with software licenses (1 per 2 students)
21. PLC simulation software
22. Robotic arm with computer software (1)
23. Robot system (SCARA type) (1)
24. Robot arm (fully articulated with computer software and programming station) (1)
25. Robot (welding with 4-9 axes) (1)
26. Special end effectors of robots (1 per robot)
27. Temperature process trainer (1)
28. Industrial grade robots (minimum \$60,000), with end effectors (1)
29. Industrial pneumatics training system (1)
30. Motor Control Station

NON-CAPITALIZED ITEMS

1. Air compressor (5 hp) (1)
2. Automatic tool change system (1)
3. Automatic storage and retrieval system (1)
4. Basic hand tools: Pliers, wire strippers, wrenches, screwdrivers, needle-nose pliers, ruler, safety glasses (20 each)
5. Caliper, digital electronic (2)
6. Current measuring devices (1 per 2 students)
7. Digital volt-ohm-meters (1)
8. Gage, electric readout force with cable (1)
9. Gage, digametic height (1)
10. Gage, set radius (1)
11. Gauging, sets (1)
12. Networked laser printers (1)
13. Level process trainer (1)
14. Meter, air velocity (1)
15. Meter, sound octave bans analyzer (1)
16. Meter, sound level calibration (1)

17. Power tools (1/2" and 3/8" drill motors) (1 each)
18. Pressure gage repair kits (1)
19. Pressure process trainer (1)
20. Rotary actuators with powered slides systems (1)
21. Safety goggles
22. Safety devices, i.e., light curtain safety mats (1 per work station)
23. Tachometers (3)
24. Temperature meters (3)
25. Tester, datacom (1)
26. Tester, checker precision cable LE (1)
27. Vacuum, shop cleaner (1)
28. Vision system (1)
29. Vision system for CIM cell (1)
30. Variable Frequency Drive (Soft start)
31. Routers
32. Switches
33. Calibers
34. Micrometers

APPENDIX B: CURRICULUM DEFINITIONS AND TERMS

- Course Name – A common name that will be used by all community colleges in reporting students
- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students
- Classification – Courses may be classified as the following:
 - Career Certificate Required Course – A required course for all students completing a career certificate.
 - Technical Certificate Required Course – A required course for all students completing a technical certificate.
 - Technical Elective – Elective courses that are available for colleges to offer to students.
- Description – A short narrative that includes the major purpose(s) of the course
- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course
- Corequisites – A listing of courses that may be taken while enrolled in the course
- Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
 - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
 - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
 - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
 - Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career–technical programs
 - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas
- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.

- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:
 - Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
 - Revising or extending the student learning outcomes
 - Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)

Appendix C: COURSE CROSSWALK

Course Crosswalk Automation and Control Technology CIP 15.0613 – Manufacturing Engineering Technology/Technicians					
<i>Note: Courses that have been added or changed in the 2017 curriculum are highlighted.</i>					
Existing			Revised		
2011 MS Curriculum Framework			2018 MS Curriculum Framework		
Course Number	Course Title	Hours	Course Number	Course Title	Hours
MFT 1112	Introduction to Automation and Controls I	2			
MFT 1123	Electrical Wiring for Automation and Control Technology	3			
EET 1114	DC Circuits	4			
EET 1123	AC Circuits	3			
EET 1214	Digital Electronics	4			
EET 1334	Solid State Devices and Circuits	4			
ELT 1413	Motor Control Systems	3			
ELT 2613	Programmable Logic Controllers	3			
INT 1214	Fluid Power	4			
INT 2114	Control Systems I	4			
			IAT 1113	Introduction to Automation and Control I	3
			IAT 1123	Electrical Wiring for Automation Control Technology	3
			IAT 1133	AC/DC Circuits for Automation and Control	3
			IAT 1143	Fluid Power for Automation and Control	3
			IAT 1153	Motor Controls for Automation and Control	3
			IAT 1163	Manufacturing Skills for Automation and Control	3
			IAT 1173	Controls System I for Automation and Control	3
			IAT 2113	Control Systems II for Automation and Control	3
			IAT 2123	Solid State Motor Controls for Automation and Control	3