Systems Based Automation Control Technology
Mississippi Curriculum Framework

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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

The Electronics Technicians Association, International (ETA® International) was created in 1978. The association was established to represent the electronics industry, from the technician and educator to the corporate institution. For assessment purposes, ETA provides third-party assessment through its own certification programs in an effort to verify that fellow electronic technicians have sufficient training in industry standards, including troubleshooting techniques, knowledge of test equipment, and installation procedures. Covering more than 80 certification programs in a variety of technology fields, over 150,000 technical certifications has been issued by ETA.

Permission was granted by the Electronics Technicians Association, International to include the competencies and objectives in this curriculum. More information related to these standards can be found at the following website:

https://www.eta-i.org/

INDUSTRY JOB PROJECTION DATA

The System Based Automation Control 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
Electro-mechanical technicians	Associate Degree

Table 2: Occupational Overview

	Region	State	United States
2016 Occupational Jobs	39	39	12,780
2026 Occupational Jobs	39	39	12,796
Total Change	0	0	16
Total % Change	0.00%	0.00%	0.13%
2016 Median Hourly Earnings	$26.74	$26.74	$26.74
2016 Median Annual Earnings	$55,619	$55,619	$55,619
Annual Openings	0	0	605

Table 3: Occupational Breakdown

Description	2014 Jobs	2024 Jobs	Annual Openings	2014 Hourly Earnings	2014 Annual Earnings 2,080 Work Hours
Electro-mechanical technicians	39	39	0	$26.74	$55,619

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Electro-mechanical technicians	0	0.00%	0.00%	0.13%

ARTICULATION

There is no secondary program in System Based 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**	
TBD	TBD	
Level	**Standard Assessment**	**Alternate Assessment**
Career	Electronics Technicians Association, International (ETA International)	
Level	**Standard Assessment**	**Alternate Assessment**
Technical/AAS	Electronics Technicians Association, International (ETA International)	

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 System Based Automation Control program. A follow-up webinar was held in October 2018 in an effort to receive additional information from the administrators, faculty, and industry members.

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.

Revision History:

2018 Mississippi Community College Board

PROGRAM DESCRIPTION

Systems Based Automation and Control Technology

Systems Based Automation and Control Technology is a program that prepares individuals to apply technical skills needed for support of the advanced manufacturing industry. This program focuses on electrical, electronic, hydraulic and pneumatic control systems, robotics, instrumentation, and automated processes.

This curriculum is designed as a one- year career certificate, technical certificate and a two-year technical program. Students who graduate from the program will be better prepared to seek employment in the advanced manufacturing industry.

SUGGESTED COURSE SEQUENCE SYSTEMS BASED AUTOMATION AND CONTROL

Accelerated Integrated Career Pathway Systems Based Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
SBA 1313 (or SBE 1113 and 1123)	AC/DC Circuits	3	2	2	60	Electronics Technicians Association, International (ETA International)
SBA 1144 (or IMM 1934)	Manufacturing Skills Basic	4	3	2	75	
	Instructor Approved Electives	8				
	TOTAL	**15**				

Career Certificate Required Courses Systems Based Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
SBA 1313 (or SBE 1113 and 1123)	AC/DC Circuits	3	2	2	60	Electronics Technicians Association, International (ETA International)
SBA 1144 (or IMM 1934)	Manufacturing Skills Basic	4	3	2	75	
SBA 1123	Fluid Power	3	2	2	60	
SBA 1133	Power Distribution	3	2	2	60	
SBA 1163	Motor Controls Systems	3	2	2	60	
SBA 1173 or SBE 2363	Programmable Logic Controllers	3	2	2	60	
SBA 1283 (or IET 1113)	Industrial Instrumentation or Industrial Measurement of Pressure and Level	3	2	2	60	
	Instructor Approved Elective	8				
	TOTAL	**30**				

Technical Certificate Required Courses Systems Based Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
SBA 1113 (or SBE 2353)	Solid State Motor Controls Systems	3	2	2	60	Electronics Technicians Association, International (ETA International)
SBA 2113	Advanced Programmable Logic Controllers/ Data Acquisition	3	2	2	60	
SBA 2123 (or IET 1313)	Advanced Instrumentation and Process Controls OR Industrial Controls I	3	2	2	60	
	Instructor Approved Electives	6				
	TOTAL	**15**				

Course Listing Systems Based Automation and Control

			SCH Breakdown			Program Certifications
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	
SBA 1113 (or SBE 2353)	Solid State Motor Controls Systems	3	2	2	60	
SBA 1123	Fluid Power	3	2	2	60	
SBA 1133	Power Distribution	3	2	2	60	
SBA 1144 or IMM 1934	Manufacturing Skills Basic	4	3	2	75	
SBA 1163	Motor Controls Systems	3	2	2	60	
SBA 1173 (or SBE 2363)	Programmable Logic Controllers	3	2	2	60	
SBA 1213	Capstone for Systems Based Automation	3	2	2	60	
SBA 1223	Robotics & Automation	3	2	2	60	
SBA 1283 (or IET 1113)	Industrial Instrumentation (or Industrial Measurement of Pressure and Level)	3	2	2	60	
SBA 1313 (or SBE 1113 and 1123)	AC/DC Circuits	3	2	2	60	
SBA 1413	System Based Digital and Solid State Devices	3	2	2	60	
SBA 1513	Wiring for System Based Automation	3	2	2	60	
SBA 2113	Advanced Programmable Logic Controllers/ Data Acquisition	3	2	2	60	
SBA 2123 (or IET 1313)	Advanced Instrumentation and Process Controls (or Industrial Controls I)	3	2	2	60	
SBA 2131-4	Special Project in System Based Automation	1-4	0-3	2	30-75	
PPT 1513	Safety Health & Environment	3	3	0	45	
MMT 2133	Mechatronics Troubleshooting and Repair	3	1	4	75	
MMT 2344	CNC/Computer Assisted Manufacturing	4	2	4	90	
MMT 2364	Industry 4.0 with Data Acquisition	4	2	4	90	
IET 2113	Final Control Devices	3	2	2	60	
IET 2433	Installation Practices	3	1	4	75	
IET 2453	Troubleshooting and Calibrations	3	1	4	75	
SBE 1213	Digital Electronics	3	2	2	60	
SBE 1223	Test and Measurement Fundamentals	3	2	2	60	
	Other Instructor Approved Electives					

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.

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						
	TOTAL	**15**						

[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

SYSTEMS BASED AUTOMATION AND CONTROL TECHNOLOGY COURSES

Course Number and Name: **SBA 1113 (or SBE 2353) Solid State Motor Controls Systems**

Description: Principles and operation of solid state motor control as well as the design, installation, and maintenance of different solid state devices for motor control.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate attitude and behavior required for safe & environmentally sound work habits
2. Demonstrate theory of operation of field devices used in control circuits [ETA 53]
3. Demonstrate knowledge of basic digital logic principles as used in motor controllers
4. Demonstrate theory of operation of variable frequency drives
5. Connect and Operate AC and DC variable speed drives
6. Troubleshoot basic motor control circuits
7. Demonstrate theory of operation and ability to wire 3 phase AC induction motors
8. Demonstrate the ability to network a drive
9. Discuss theory of servo positioning and speed control
10. Discuss solid state motor protection

Electronics Technicians Association, International

ETA 53

Course Number and Name: **SBA 1123 Fluid Power**

Description: This course provides instruction in hydraulics and pneumatics. This course covers actuators, accumulators, valves, pumps, motors, coolers, compression of air, control devices, and circuit diagram. 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. Explain and apply basic safety regulations which must be followed
2. Discuss principles as they apply for fluid power
3. Identify symbols, connect and troubleshoot components for fluid power
4. Design and install a fluid power system to meet given specifications
5. Describe and analyze the operation of pumps and compressors
6. Describe, connect, and troubleshoot the operation of fluid power valves
7. Describe, connect and troubleshoot fluid power actuators
8. Demonstrate, construct, and troubleshoot electro-mechanical controls in fluid power circuits

Course Number and Name: **SBA 1133 Power Distribution**

Description: This course provides information on single and three phase circuits. This includes connecting and calculating values.

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
2. Apply basic knowledge of single phase components [ETA 14, 28, 39]
3. Apply basic knowledge of three phase components

Electronics Technicians Association, International
ETA 14, 28, 39

Course Number and Name: **SBA 1144 (or IMM 1934) Manufacturing Skills Basic**

Description: Manufacturing Skills Basic 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
4	3	2	75

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

Course Number and Name: **SBA 1163 Motor Controls Systems**

Description: This course covers 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. Explain and apply basic safety regulations which must be followed [ETA 1]
2. Install different control circuits and devices [ETA 13, 42, 43, 55, 60, 70, 72]
3. Troubleshoot different control circuits and devices [ETA 40, 59, 71, 73]
4. Install and troubleshoot overload devices

Electronics Technicians Association, International

ETA 1, 13, 40, 42, 43, 55, 59, 60, 70, 71, 72, 73

Course Number and Name: **SBA 1173 (or SBE 2363) Programmable Logic Controllers**

Description: Principles and operation of Programmable Logic Controllers (PLCs) in modern industrial settings as well as the operating principles of PLCs and practice in the programming, installation, and maintenance of PLCs.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate ladder logic programming [ETA 35, 41, 44, 45, 46, 50, 58, 68]
2. Demonstrate operation of field devices that are used in Control Circuits
3. Understand theory of operation of field devices [ETA 38]
4. Demonstrate knowledge of basic digital logic principles [ETA 16, 26, 27, 30, 31, 32, 33, 34, 51, 52]
5. Troubleshoot PLC Control Circuits
6. Demonstrate attitude and behavior required for safe & environmentally sound work habits [ETA 10]
7. Connect and Operate Programmable Logic Controller [ETA 36, 37]

Electronics Technicians Association, International

ETA 10, 16**,** 26, 27, 30, 31, 32, 33, 34, 35, 36, 37, 38, 41, 44, 45, 46, 50, 51, 52, 68

Course Number and Name: **SBA 1213** **Capstone for Systems Based Automation**

Description: This course allows practical application of all skills and knowledge. The instructor works closely with student to ensure that the selection of the project will enhance the student's learning experience.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Develop a plan for systems based automation project
2. Implement a plan for a systems based automation project

Course Number and Name: **SBA 1223** **Robotics & Automation**

Description: This course includes a history of automation as well as identifying components of a robot. Includes programming and troubleshooting of the robot system.

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
2. Describe and identify major components of associated with robotic applications [ETA 69]
3. Demonstrate the ability to program a robot process
4. Demonstrate the ability to troubleshoot and maintain robotic equipment
5. Describe and discuss the application of end effectors

Electronics Technicians Association, International
ETA 69

Course Number and Name: **SBA 1283 (or IET 1113) Industrial Instrumentation**

Description: A study of the concepts, principles and devices for the measurement of industrial pressure, level, temperature and flow variables. The student will learn to apply the principles of process instruments and devices as applied to control and detection of variables. The student will perform industrial pressure, level, temperature and flow measurements.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate attitude and behavior required for safe & environmentally sound work habits
2. Calculate and convert pressure, level, temperature, and flow measurements
3. Describe the necessity for measurements in industry
4. Install and troubleshoot temperature and flow sensing devices[ETA 54]
5. Install and troubleshoot pressure and level sensing devices
6. Perform measurements of pressure, temperature, level and flow
7. Describe and demonstrate a knowledge of analytical measured process variables
8. Identify the requirements of instrument air systems
9. Demonstrate the ability to understand and interpret P&ID drawings
10. Identify common signals, calibration, wiring, shielding

Electronics Technicians Association, International

ETA 54

Course Number and Name: **SBA 1313 (or SBE 1113 and SBE 1123) AC/DC Circuit**

Description: Principles and theories with AC/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 [ETA 1-8]
2. Define basic electronics terms as they apply to DC and AC circuits [ETA 15, 56, 57, 75]
3. Demonstrate the ability to measure values in DC and AC Circuits using various metering devices [ETA 24, 48, 66]
4. Demonstrate and apply understanding of a basic DC and AC electronic circuits [ETA 18, 64, 74]
5. Analyze and evaluate parameters of series, parallel, and series parallel circuits [ETA 17, 19, 20, 21, 22, 25, 47, 61, 62, 63, 65, 67]
6. Analyze inductance and capacitance in DC and AC series and parallel circuits [ETA 9, 23, 29,49]

Electronics Technicians Association, International

ETA 1-8, 9, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 29, 47, 48, 49, 56, 57, 61, 62, 63, 64, 65, 66, 67, 74, 75

Course Number and Name: **SBA 1413 Systems Based Digital and Solid State Devices**

Description: Numbering systems, logic gates as used in the automation industry. Also includes diodes, transistors and thyristors.

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
2. Perform mathematical operations in various numbering systems with use of a calculator
3. Analyze logic circuits
4. Explain diode theory and apply it to diode and rectifier circuits [ETA 12]
5. Demonstrate an understanding of the use and operation of transistors
6. Demonstrate an understanding of the operation of thyristors
7. Describe and demonstrate test procedures to diagnose failed solid state components

Electronics Technicians Association, International
ETA 12

Course Number and Name: **SBA 1513** **Wiring for Systems Based Automation**

Description: This course provides instruction and practice in the installation of industrial electrical services. This course includes types of conduit and other raceways, National Electrical Code, and three phase power distribution networks.

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
2. Demonstrate basic conduit bends
3. Calculate box and conduit fill for given conditions
4. Identify NEC requirements for proper conductor selection [ETA 11]
5. Perform termination of various components
6. Install three phase service entrances, feeder circuits, and branch circuits per NEC for a specified system

Electronics Technicians Association, International

ETA 11

Course Number and Name: SBA 2113 **Advanced Programmable Logic Controllers/**Data Acquisition

Description: This is an advanced PLC course that provides instruction in the various operations and installations of advanced electrical control systems utilizing programmable logic controllers. This will include areas such as sequencer control, introduction to Human Machine Interfaces, along with Data Acquisition and networking.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Program all types of high order instructions
2. Troubleshoot advanced PLC controls
3. Explain data communication components used in automatic systems
4. Use data communication software, PLC and a computer to connect a network
5. Use computers, sensors, and controllers for data acquisition
6. Explain the importance of proper termination of communication media such as cables

Course Number and Name: **SBA 2123 (or IET 1313) Advanced Instrumentation and Process Controls**

Description: A study of process controllers, implementing PID (Proportional, Integral, Derivative) feedback, cascade, ratio, feed forward and auto select/override and introduce other advanced control strategies; study techniques for loop tuning and calibrating process loop components including smart transmitters using field communicators. Use of Loop documentation and drawings.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate hookup, communication protocol, calibration and run diagnostics, on I/P, press XMTR with hart
2. Demonstrate and troubleshoot PID open loop process control system
3. Demonstrate and troubleshoot closed loop process control system
4. Calibrate process loop components
5. Demonstrate and trouble shoot loop tuning techniques to stabilize a process operation
6. Demonstrate knowledge of the basics of PLC and distributed control system
7. Calibrate process with pressure module
8. Demonstrate attitude and behavior required for safe & environmentally sound work habits.

Course Number and Name: **SBA 213(1-4) Special Project in System Based Automation**

Description: This course allows practical application of all skills and knowledge. The instructor works closely with student to ensure that the selection of the project will enhance the student's learning experience.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1	0	2	30
2	1	2	60
3	2	2	60
4	3	2	75

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Develop a plan for systems based automation project
2. Implement a plan for a systems based automation project

Course Number and Name: **PPT 1513 Safety, Health, and Environment**

Description: This course is designed to provide a development of knowledge and skills to reinforce attitudes and behaviors required for safe and environmentally sound work habits. Emphasis is placed on safety, health, and environmental issues in the performance of all job tasks and regulatory compliance issues.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	3	0	45

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Describe various types of physical hazards commonly found in process industries
2. Describe the chemical hazards in process industries
3. Describe the biological, ergonomic and plant specific hazards associated with various processes
4. Describe the environmental hazards in process industries
5. Identify the various Engineering controls used to make process areas safe
6. Discuss the various Administrative controls - Programs and Practices
7. Describe the importance and application of PPE in process industries
8. Describe the important role OSHA plays in the process industries
9. Describe the important role EPA (state and federal) plays in process industries
10. Describe the other regulatory agencies that impact the Process Industry

Chemical/Refining Process Technician Skill Standards

9. Maintain Safe and Healthful Work Environment

9.1 Conduct Preventative SHE Inspections

9.1.1 Area inspections are conducted according to established procedures
9.1.2 Area inspection documentation is complete per company standards
9.1.3 Inspection and audit findings are posted appropriately so that they are accessible to all relevant parties
9.1.4 Inspection findings are remedied according to company policies and procedures

9.2 Conduct SHE incident and hazard investigations

9.2.1 Investigations of incidents and hazards are conducted according to established procedures
9.2.2 Incident and investigation documentation is complete per company standards
9.2.3 Incident and investigation reports and findings are disseminated to designated recipients according to company procedures
9.2.4 Corrective action is taken as specified by company policies and procedures

9.3 Instruct individuals entering operating area in SHE policies and procedures

9.3.1 Area specific safety orientation is provided for employees and contractors entering process unit
9.3.2 All employees have current and continuing training on the SHE policies and procedures

9.4 Comply with company policies and procedures

9.4.1 Employees comply with company safety and environmental policies and procedures
9.4.2 Safety and environmental compliance documentation is complete per company standards
9.4.3 Safety and environmental improvements are submitted per company policies and procedures

9.5 Comply with local, state and federal policies and procedures

9.5.1 Employees comply with local, state and federal policies and procedures

9.5.2 Safety and environmental compliance documentation is complete per local, state and federal standards

Course Number and Name: **MMT 2133 Mechatronics Troubleshooting and Repair**

Description: This course provides a hands-on learning environment to develop and practice the techniques used in troubleshooting complex mechatronics systems.

Hour Breakdown:

Semester Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Overview
    a. Define Troubleshooting
    b. Define and describe Troubleshooting Steps
        i. Preparation
        ii. Observation
        iii. Define Problem Area
        iv. Identify Possible Causes
        v. Determine Most Probable Cause
        vi. Test and Repair
        vii. Follow-up

2. Troubleshooting Techniques
    a. Discuss various troubleshooting techniques and their application

3. System Troubleshooting
    a. Demonstrate how to effectively troubleshoot and repair various machine issues

Course Number and Name: **MMT 2344 CNC/Computer Assisted Manufacturing**

Description: An introduction of computer numerical control (CNC) and computer assisted manufacturing (CAM) techniques and practices. Includes the use of the Cartesian coordinate system, programming codes and command, and tooling requirements for CNC/CAM machines.

Hour Breakdown:

Semester Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss and apply general machine shop safety
    a. Identify, discuss, and test safety procedures
    b. Demonstrate safety procedures

2. Describe CNC machining, uses, and applications of CNC program
    a. Describe the capabilities and limitations of computer numerical control (CNC)/computer assisted manufacturing (CAM) equipment
    b. Describe the Cartesian coordinate system as used in a CNC machine program
    c. Describe the differences in absolute and incremental dimensioning as related to an ISO programming of a CNC machine
    d. Describe procedures for CNC machine start-up

3. Discuss commands for CNC machine codes
    a. List and describe the purpose or function of the preparatory commands for a CNC machine (Gcodes)
    b. Explain the purpose or function of the miscellaneous commands used with a CNC machine (Mcodes)
    c. State the purpose of other alphabetical commands used in programming operations of a CNC machine

4. Discuss tooling for CNC operations, and safely use CNC mill, CNC lathe, and CNC machine centers to project specifications
    a. Describe the different types of tooling required for CNC mills, CNC lathes, and CNC machine centers
    b. Select tooling required for a specific job on a CNC mill, CNC machine centers, and CNC lathe
    c. Write and manually input program data
    d. Execute programs for CNC mill, CNC lathe, and CNC machine center according to project specifications

Course Number and Name: **MMT 2364 Industry 4.0 with Data Acquisition**

Description: This is a course to introduce and explain Industry 4.0 with data acquisition.

Hour Breakdown:

Semester Hours	Lecture	Lab	Contact Hours
4	2	4	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Discuss, define and explain the following[NC3 (1 Industry 4.0)]
   a. What is Industry 4.0
   b. How has these changes impacted industry, current and future employees, and other members of the manufacturing value chain.
   c. Give examples of the benefits and value of industry 4.0
   d. What is the 'interconnected world'
   e. Define important terms, theories, and ideas behind industry 4.0
   f. What is MES and related functionality.
   g. Explain the importance of data security [NC3 (2 Industry 4.0)]

2. Show the ability to complete the following
   a. Configuration of MES [NC3 (2 Industry 4.0)]
   b. Incorporate HMI applications to a production system [NC3 (2 Industry 4.0)]
   c. Utilize web services/ email push delivery [NC3 (2 Industry 4.0)]
   d. Configure VLANs to isolate data on an industrial Ethernet network
   e. Set firewall rules to isolate data on an industrial Ethernet network

3. Explain data communication components used in automation systems
   a. Identify characteristics and use of various EIA or IEEE standard data communication interfaces
   b. Describe standard serial communications used in computers
   c. Describe Parallel communication interfaces
   d. Explain Ethernet
   e. Explain Controlnet
   f. Explain CAN based networks
   g. Explain point-to-point wireless network

4. Use data communication software PLC and a computer to connect a network
   a. Configure a computer for serial or parallel communications
   b. Perform data transfer between computers
   c. Use communication test equipment to troubleshoot communications links

5. Use computers and / or controllers for data acquisition
   a. Interface seniors with computer or controller data acquisition using Ethernet
   b. Configure software and computer for data acquisition from a PLC

National Coalition of Certification Centers

NC3 (1 Industry 4.0)
NC3 (2 Industry 4.0)

Course Number and Name: **SBE 1113 Electronic Fundamentals I**

Description: Principles and theories associated with DC circuits. This course includes the study of electrical circuits, laws and formulae, and the use of test equipment to analyze DC circuits.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate and Practice General Safety Procedures
    a. Apply relevant and appropriate safety techniques.
    b. Demonstrate an understanding of and comply with relevant OSHA safety standards
2. Demonstrate knowledge of Electronic Circuits and Symbols
    a. Write numbers in scientific and engineering notation.
    b.Perform mathematical manipulations with numbers expressed in engineering notation.
    c. Differentiate between DC circuit schematic symbols
3. Demonstrate an understanding of voltage, current, resistance, and power and how they relate.
    a. Explain the physical properties of voltage, current, and resistance.
    b. State three equations used to express Ohm's law.
    c. Analyze circuit parameters using Ohm's law.
    d. State three forms of power equations.
4. Analyze Series, Parallel& Series-Parallel Resistive Networks
    a. Identify parallel and series circuits.
    b. Compute total resistance of parallel and series circuits.
    c.Using Ohm's law, compute the current in paralle and series circuits.
    d.Explain why current is the same at all points in a series circuit.
    e. Expalin why voltage is the same in all branches of a parallel circuit.
    f.State and apply Kirchhoff's voltage law in analysis of series circuits.
    g.Explain why a series circuit is known as a voltage divider.
    h.Using Ohm's law, compute the voltage drops in a series circuit.
5. Demonstrate attitude and behavior required for safe & environmentally sound work habits

Course Number and Name: **SBE 1213 Digital Electronics**

Description: Introduction to Number systems, logic circuits, Counters, Registers, Memory devices, Combinational and Sequential Logic circuits, Boolean algebra as used in industry for Control Systems.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Convert between Binary, Octal, Hex & Dec Values
2. Classify logic gates, and explain their functions
3. Develop Truth Tablesfor Logic Gates and Boolean Expressions
4. Design and sketch Schematic diagramsfor Logic Gates and Logic Flow Diagrams
5. Describe Logic structures and timing for use in PLC, DCS and other Control Systems
6. Demonstrate attitude and behavior required for safe & environmentally sound work habits

Course Number and Name: **SBE 1223 Test and Measurement Fundamentals**

Description: Principles and theories associated with utilizing Test Equipment to measure DC/AC circuit parameters and electronic components. This course includes the study of electrical circuits, laws and formulae, and the use of test equipment to analyze DC/AC circuits.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Explain DMM Operation
2. Explain Oscilloscope Operation
3. Perform DC Circuit Measurements with a bench VOM, handheld DMM and an Oscilloscope
4. Perform AC Circuit Measurements with a bench VOM, handheld DMM and an Oscilloscope
5. Perform DC/AC Current Measurements with a bench VOM and a handheld DMM
6. Perform Resistance Measurements with a bench VOM and a handheld DMM
7. Explain Sinewave Characteristics and perform Sinewave measurements—Peak, Peak-Peak, RMS, Average, Frequency & Phase Angle
8. Demonstrate Electrostatic Sensitive Device (ESD) protection
9. Demonstrate attitude and behavior required for safe & environmentally sound work habits

Course Number and Name: **SBE 2353 Solid State Motor Control**

Description: Principles and operation of solid state motor control as well as the design, installation, and maintenance of different solid state devices for motor control.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Apply general safety principles and safety requirements for working on and around electrical motors
2. Demonstrate theory of operation of field devices used in control circuits.
3. Demonstrate knowledge of basic digital logic principles as used in motor controllers.
4. Demonstrate theory of operation of control transformers and voltage distribution.
5. Demonstrate theory of operation of various relay types in control circuits.
6. Demonstrate theory of operation of variable frequency drives.
7. Connect and Operate AC and DC variable speed drives.
8. Troubleshoot basic motor control circuits.
9. Demonstrate theory of operation and ability to wire 3 phase AC induction motors.
10. Demonstrate attitude and behavior required for safe & environmentally sound work habits.

Course Number and Name: **SBE 2363** **Programmable Logic Controllers**

Description: Principles and operation of Programmable Logic Controllers (PLCs) in modern industrial settings as well as the operating principles of PLCs and practice in the programming, installation, and maintenance of PLCs.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate ladder logic programming
2. Demonstrate operation of field devices that are used in Control Circuits
3. Understand theory of operation of field devices.
4. Demonstrate knowledge of basic digital logic principles
5. Troubleshoot PLC Control Circuits
6. Demonstrate theory of operation and ability to wire 3 phase AC induction motors
7. Demonstrate attitude and behavior required for safe & environmentally sound work habits.
8. Connect and Operate Programmable Logic Controller.

Course Number and Name: **IET 1313 Industrial Controls I**

Description: A review of measurement theory and includes the principles of operation, connection, maintenance, testing, calibration, troubleshooting and repairing/replacing of pneumatic and electronic analog process controllers, signal transmitters, recorders, alarms and associated test equipment along with annunciator/shutdown systems and introduce the concepts of proportional, integral, and derivative control modes, loop tuning, and documentation.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate/ Troubleshoot Press, Level, Temp and flow process
2. Calibrate manually I/P, Press XMTR, D/P XMTR (Level and flow)
3. Demonstrate and Calibrate a wet and dry leg level
4. Review temperature sensor device operations and troubleshooting.
5. Identify process sensors, XMTRs and equipment using various instrument drawings.
6. Demonstrate knowledge in use of instrument drawings and specification sheets.
7. Troubleshoot DC loop circuits**.**
8. Demonstrate attitude and behavior required for safe & environmentally sound work habits

Course Number and Name: **IET 2113** **Final Control Devices**

Description: A study of the various designs of Final Control Devices, including principles of operation, sizing, selection, servicing pneumatic and electric actuators, positioners, solenoid operated valves, self-contained regulators, louvers, dampers, metering pumps and required documentation. Introduces concepts of variable speed drives and frequency speed circuitry for various motor operated final control devices.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate the operation of a final control valve.
2. Describe the principles of variable speed and frequency drives.
3. Perform the maintenance of stroking and travel of the valve (Stem)
4. Demonstrate/ Troubleshoot a process loop with a final control device.
5. Demonstrate attitude and behavior required for safe & environmentally sound work habits.

Course Number and Name: **IET 2433** **Installation Practices**

Description: A course focusing on the principals and techniques for interconnection of instruments and equipment in industry.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate cabinet wiring
2. Demonstrate proper wire routing
3. Demonstrate proper wire terminations
4. Troubleshoot cable/ termination problems
5. Develop “As Built” P&ID Drawings
6. Demonstrate attitude and behavior required for safe & environmentally sound work habits

Course Number and Name: **IET 2453** **Troubleshooting and Calibration Principles**

Description: A course focusing on the principals and techniques for troubleshooting and calibration of various instruments used in process controls.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate and calibrate troubleshooting of DC instrument circuits
2. Demonstrate and calibrate troubleshooting of Instrument Current Loops
3. Demonstrate and calibrate troubleshooting of Digital Communication
4. Troubleshoot Faulted 24 VDC Power Supply Circuit
5. Demonstrate attitude and behavior required for safe & environmentally sound work habits

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
31. HART Communicator/Calibrator
32. Human machine interface
33. Industrial networking equipment

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 (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. Precision measuring equipment
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. 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 Systems Based Automation Control CIP: 15.0406		
SBA 1113 (or SBE 2353)	Solid State Motor Controls Systems	3
SBA 1123	Fluid Power	3
SBA 1133	Power Distribution	3
SBA 1144 or IMM 1934	Manufacturing Skills Basic	4
SBA 1163	Motor Controls Systems	3
SBA 1173 (or SBE 2363)	Programmable Logic Controllers	3
SBA 1213	Capstone for Systems Based Automation	3
SBA 1223	Robotics & Automation	3
SBA 1283 (or IET 1114)	Industrial Instrumentation	3
SBA 1313 (or SBE 1113 & 1123)	AC/DC Circuits	3
SBA 1413	System Based Digital and Solid State Devices	3
SBA 1513	Wiring for System Based Automation	3
SBA 2113	Advanced Programmable Logic Controllers/ Data Acquisition	3
SBA 2123 (or IET 1314)	Advanced Instrumentation and Process Controls	3
SBA 2131-4	Special Project in System Based Automation	1-4
PPT 1513	Safety Health & Environment	3
MMT 2133	Mechatronics Troubleshooting and Repair	3
MMT 2344	CNC/Computer Assisted Manufacturing	4
MMT 2364	Industry 4.0 with Data Acquisition	4
IET 2113	Final Control Devices	3
IET 2453	Troubleshooting and Calibrations	3

APPENDIX D: RECOMMENDED TEXTBOOKS

Systems Based Automation and Control Textbook List CIP 15.0406		
Book Title	**Author (s)**	**ISBN**
Systems Level Technician	Wiesenfeld, J. Baldwin, R. Walker, J. Thompson, A. Wiesenfeld, K. Eilers	
Cabling: The Complete Guide to Copper and Fiber-Optic Networking, 5E	Andrew Oliviero, Bill Woodward	978-1-118-80732-3
National Electrical Code, 2017	National Fire Protection Assn.	
EM Study Guide Series	Karl Eilers	
The Associate CET Study Guide, 6E		1-891749-07-2
Electronic Communications: A System Approach, 1E	J.S. Beasley, J.D. Hymer, G.M. Miller	978-0132988636
Modern Electronic Communications, 9E	J.S. Beasley, G.M. Miller	978-0132988636
Technicians Guide to Fiber Optics, 4E	Donald J. Sterling	1-4018-1270-8
Understanding Fiber Optics, 5E	Jeff Hecht	978-0131174290
Wiring for Wireless Sites	Ira Wiesenfeld, P.E., CETsr	978-1-40181037-5
ARRL Handbook, 2017 edition	American Radio Relay League	978- 1-62595-063-5
Modern Industrial Electronics,5E	Maloney	978-0130487414
Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, 3E	Kissell	978-0130602411
Solid State Devices and Systems,4E	Rockis	978-0826916372
Industrial Control Electronics,3E	Bartelt	978-1401862923
Electrical Systems for Facilities Maintenance Personnel	Mazur	978- 0826915948
Troubleshooting Electric Motors,4E	Mazur, Proctor	978-0826917898
Electrical Principles and Practices,3E	Mazur, Zurlis	978-0826918031
Industrial Motor Control,6E	Herman	978-1435442399
Printreading for Installing and Troubleshooting Electrical Systems	Mazur, Weindorf	978-0826920508
Programmable Logic Controllers,4E	Petruzella	978- 0073510880
Microprocessor and Microcontroller Fundamentals: The 8085 and 8051 Hardware and Software	Kleitz	978-0132628259
Industrial Electrical Troubleshooting	Lundquist	978-0766806030
DC/AC Fundamentals: a systems approach	Thomas L. Floyd, David M. Buchla	0-13-293393-4/2013
McGraw Hill-High Performance Manufacturing	MSSC	0-07-861487-2/2006
Transformer: Principles and Applications	American Technical Publishers, Inc.	978-0-8269-1604-4/2006
Fluid Power with Applications	Anthony Esposito-7th ed.	978-0-13-513690-3/2009

VALIDATION

Electric Motors and Control Systems	Frank D. Petruzella-2nd ed.	978-0-07-337381-2/ 2016
Programmable Logic Controllers	Frank Petruzella-5th ed.	978-0-07-337384-3/ 2017
Lessons in industrial Instrumentation 1/3	Tony R. Kuphaldt	978-9888407088/ 2017
www.Radio-Electronics.com	Ian Poole	
www.Electronicdesign.com	Lou Frenzel	
www.tpub.com/neets/index.htm		
www.rockwellautomation.com/resources/		
www.plc.us		
http://www.automationfederation.org/		
http://www.redlion.net/resources		
www.open-electronics.org		
http://www.bb-elec.com/Learning-Center.aspx		
www.automationworld.com		
www.belden.com		
Wikipedia		
http://www.eta-i.org/industry_links_and_resources.html		