Instrumentation and Controls Technology With Systems Based Electronics Mississippi Curriculum Framework

Instrumentation Technology/Technician - CIP 15.0404

2018

Published by:
Mississippi Community College Board
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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.

For information, please contact curriculum@mccb.edu

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ADOPTION OF NATIONAL CERTIFICATION STANDARDS

At the time of publication, no national standards were identified for alignment with this curriculum framework. The Office of Curriculum, Instruction, and Assessment will continue to work with college faculty and the industry advisory committee to identify potential national standards and/or national certifications appropriate for this program of study.

INDUSTRY JOB PROJECTION DATA

The Systems Based Electronics 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 0.00% increase in occupational demand at the regional level and 0.00% increase at the state level. Median annual income for this occupation is $54,664.71 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
Precision Instrument and Equipment Repairers, ALL OTHER	Moderator51-Term On the Job Training

Table 2: Occupational Overview

	Region	State	United States
2014 Occupational Jobs	51	51	24448
2024 Occupational Jobs	51	51	24449
Total Change	0	0	1
Total % Change	0.00%	0.00%	0.00%
2014 Median Hourly Earnings	$26.44	$26.28	$25.28
2024 Median Annual Earnings	$54,984.80	$54,664.71	$52,582.40
Annual Openings	0	0	0

Table 3: Occupational Breakdown

Description	2010 Jobs	2020 Jobs	Annual Openings	2010 Hourly Earnings	2010 Annual Earnings 2,080 Work Hours
Electro-Mechanical Technicians	26	26	0	$27.82	$57,865.60
Precision Instrument and Equipment Repairers, ALL OTHER	25	25	0	$25.05	$52,104.00
TOTAL	51	51	0	$26.44	$54,984.80

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Electro-Mechanical Technicians	0	0.00%	0.00%	-0.01%
Precision Instrument and Equipment Repairers, ALL OTHER	0	0.00%	0.00%	0.02%

Articulation

There is no secondary Instrumentation and Controls Technology to articulate to this program.

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	
15.0404	Instrumentation Technology/Technician	
Level	**Standard Assessment**	**Alternate Assessment**
Career	MS-CPAS-3 Postsecondary	
Level	**Standard Assessment**	**Alternate Assessment**
Technical/AAS	MS-CPAS-3 Postsecondary	

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 fall of 2017, the Office of Curriculum and Instruction (OCI) met with the different industry members who made up the advisory committees for the Instrumentation and Controls Technology with Systems Based Electronics 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 a positive attitude, being at work every day and on time, and having reading and writing skills. Occupation-specific skills stated include being able to troubleshoot, be able to interpret a technical manual, and be able to locate information.

A curriculum writing meeting was convened in November 2017 and attended by faculty, administrators, and industry members. During the writing meeting, the curriculum was aligned to the 30/45/60 model allowing for a stackable credentials model whereby students can earn a career certificate, technical certificate, and an Associate of Applied Science degree in Instrumentation and Controls Technology with Systems Based Electronics.

REVISION HISTORY:

2018 Mississippi Community College Board

PROGRAM DESCRIPTION

The Instrumentation and Controls Technology provides the instruction necessary for students to gain the knowledge, skills, and abilities to monitor instrumentation and controls for a variety of processes that include but are not limited to energy or power generation and petroleum refining. The program of study consists of a fifteen hour core of systems-based electronics and thirty hours of targeted instruction designed to provide specialized skills in Instrumentation and Controls Technology. Students completing the 60-hour program of study may earn an Associate of Applied Science degree in Instrumentation and Controls Technology.

Career Certificate Required Courses (Systems Based Instrumentation Controls Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
SBE 1113	Electronic Fundamentals I	3	2	2				
SBE 1123	Electronic Fundamentals II	3	2	2				
SBE 1213	Digital Electronics	3	2	2				
SBE 1223	Test and Measurement Fundamentals	3	2	2				
SBE 2353	Solid State Motor Control	3	1	4				
SBE 2363	Programmable Logic Controllers	3	1	4				
PPT 1513	Safety, Health and Environment	3	3	0				
IET 1133	Industrial Press, Level, Temp and Flow	3	2	2				
IET 1313	Industrial Control I	3	2	2				
IET 2113	Final Control Devices	3	2	2				
	TOTAL	**30**	**19**	**22**				

Technical Certificate Required Courses (Systems Based Instrumentation Controls Technology)

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
IET 2413	Industrial Controls II	3	2	2				
IET 2423	Industrial Electronic Communications & Security	3	2	2				
IET 2433	Installation Practices	3	1	4				
IET2453	Troubleshooting and Calibration Principles	3	2	2				
IET 2513	Instrumentation Capstone	3	1	4				
	TOTAL	**15**	**8**	**14**				

General Education Core Courses – Systems Based Electronics

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 (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement1 describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The 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	3	0				
	Social/Behavioral Sciences	3	3	0				
	Math/Science	3	3	0				
	Academic electives	6						
	TOTAL	**15**						

1 Southern Association of Colleges and Schools Commission on Colleges. (2012). *The principles of accreditation: Foundations for quality enhancement.* Retrieved from http://www.sacscoc.org/pdf/2012PrinciplesOfAcreditation.pdf

SYSTEMS BASED ELECTRONICS COURSES

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 1123** **Electronic Fundamentals II**

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

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate knowledge of Capacitance in DC and Transient Circuits
2. Explain and analyze Sine Wave
3. Explain and analyze Transformer voltage, Current, Impedance Transformation, and Applications
4. Explain and analyze AC Reactive Circuits for Volt Drops, Branch Currents and Power Dissipation
5. Demonstrate a knowledge of Semiconductor Diode Theory
6. Analyze a Diode Circuit
7. Analyze a BJT circuit configured for switching
8. Explain the operation of a BJT amplifier
9. 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 Tables for Logic Gates and Boolean Expressions
4. Design and sketch Schematic diagrams for 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 1113 Industrial Press, Level, Temp and Flow**

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. Calculate and convert press, level, temp, and flow measurement.
2. Describe the necessity for measurement in industry
3. Demonstrate troubleshoot temperature and flow sensing devices.
4. Demonstrate troubleshoot press and level sensing devices.
5. Perform measurements of pressure, temperature, level and flow.
6. Identify instrument air systems.
7. Demonstrate attitude and behavior required for safe & environmentally sound work habits.

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 2413** **Industrial Controls II**

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: **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 2423** **Industrial Electronic Communication & Security**

Description: Introduction course to recognize and understand the common threats faced today for information security in industry. Students will understand the principles and practice of computer system, DCS and physical security of industrial infrastructure to include wireless communication of instruments used in instrumentation and control.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Interpret general security concepts.
    a. Discuss and explain the access control models (mandatory, discretionary, and role-based).
    b. Explain authentication methods and technologies
    d. Differentiate various types of cyber-attacks and identify appropriate strategies for defense.
    e. Discuss malicious code and appropriate strategies to reduce risk to systems.
2. Recognize the importance of operational and organizational security.
    a. Analyze the significance of physical security to information security.
    b. Discuss the security implications of disaster recovery and business continuity.
    c. Discuss the proper implementation and use of policies and procedures.
    d. Explain the concepts of privilege management.
    e. Discuss the security relevance of the education and training of end users, executives, and human resources.
    g. Recognize various social engineering techniques and effective security strategies to deter successful social engineering attacks.
3. Describe the elements of communication security.
    a. Explain the administration and vulnerabilities of current remote access technologies.
    b. Discuss current e-mail security technologies and vulnerabilities.
    c. Explain the administration of Internet security concepts, including Web content, wireless technologies, instant messaging, and vulnerabilities.
    e. Discuss the administration of file transfer protocols and concepts.
4. Describe the elements of infrastructure security.
    a. Discuss the security concerns of network devices.
    b. Explain the security concerns of various types of digital communication media.
    c. Discuss current security topologies.
    d. Differentiate types of intrusion detection systems.
    e. Discuss the concepts of security baselines and operating system and network hardening.
5. Summarize cryptography standards.
    a. Explain hashing, symmetric, and asymmetric cryptographic algorithms.
    b. Differentiate the various cryptographic standards and protocols.
    c. Describe the concepts of public key infrastructure.
    d. Discuss and explain the concepts of key management and certificate lifecycles.
6. Recognize domestic and international law regarding security.
    a. Identify restrictions on import and export of encryption technologies.
    b. Discuss domestic and international law on apprehension and prosecution of cyber criminals.
    c. Explain the concept of digital rights management

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

Course Number and Name: **IET 2513 Capstone Class**

Description: A course designed to give a review of principals of operation, connection, testing, troubleshooting of control elements, to include a demonstration of knowledge, skills, and abilities obtained.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate knowledge of open and close loop process
2. Demonstrate troubleshooting techniques
3. Design, construct, document, and demonstrate a process with loop control
4. Prepare a professional resume'
5. Participate in a job interview
6. Demonstrate attitude and behavior required for safe & environmentally sound work habits

Appendix A: RECOMMENDED TOOLS AND EQUIPMENT

CAPITALIZED ITEMS (inventory items)

1. Complete CAI/breadboard Training Station (1 per 2 students)
2. Cable tester (1 per station)
3. Laptop with PLC and Motor Control Software (1 per Station)
4. Computer with monitor and software (1 per station w/network connection)
5. Conveyor system trainer (1 per station)
6. DC trainer CAI/breadboard (1 per 2 students)
7. Digital trainer CAI/breadboard (1 per 2 students)
8. Electronic trainer (base station) (1 per 2 students)
9. Electronics communication CAI/breadboard (1 per station)
10. Function generator (1 per station)
11. Hydraulic trainer (1 per station)
12. In-circuit component tester (1 per station)
13. Industrial motor control trainer (1 per station)
14. Interfacing trainer (1 per station)
15. Laser (under 1 watt power) (1 per station)
16. Laser power meter (1 per station)
17. Linear integrated Circuits CAI/Breadboard (1 per station)
18. Logic analyzer (1 per station)
19. Microprocessor CAI/breadboard (1 per station)
20. Microprocessor interfacing CAI/breadboard (1 per station)
21. Motor control troubleshooter (1 per station)
22. Bench Multimeter digital (1 per station)
23. Oscilloscope digital storage (1 per station)
24. Pedestal drill press (1)
25. PLC (1 per station)
26. PLD programmer (1 per station)
27. Pneumatic trainer (1 per station)
28. Printer for computer (1 per 4 stations)
29. RF signal generator (1 per station)
30. Semiconductor tester (1 per station)
31. Sensor and transducer trainer (1 per station)
32. Soldering/de-soldering station (through hole and SMD) (1 per station)
33. Soldering station (through hole and SMD) (1 per station)
34. Solid-state devices CAI/breadboard (1 per 2 students)
35. Spectrum analyzer (1 per station)
36. Adjustable isolation transformer (1 per station)
37. Air compressor (1 per station)
38. Work Station/bench (1 per station)

NON-CAPITALIZED ITEMS (consumables) less than 1,000

1. Antenna trainer (1)
2. Audio amplifier and speakers (1 per station)
3. Student tool kit (1per student)
4. Hand held Digital Multimeter (1 per student)
5. Breakout/Electrical Junction box (1 per station)
6. Safety Equipment (1 set per student)

RECOMMENDED INSTRUCTIONAL AIDS

1. Adjustable isolation transformer (1 per station)
2. Air compressor (1 per station)
3. Antenna trainer (1)
4. Audio amplifier and speakers (1 per station)
5. Breakout/Electrical Junction box (1 per station)

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)