CARCAM
Consortium for Alabama Regional Center for Automotive Manufacturing

CARCAM Curriculum Gap Analysis
Best Practices Guide

Supported in part by grant # DUE 1003203 from the National Science Foundation, Advanced Technology Education Program.

Curriculum Gap Analysis
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Curriculum Gap Analysis Instructions

Thank you for agreeing to assist CARCAM in performing a curriculum gap analysis. This ensures that the AUT program content meets current industry needs and standards. Information gathered in this process assists us with adopting curricula additions and further review of curriculum content. Please review and share your feedback on the attached questionnaire and accompanying Plan-of-Instruction (**POI**).

About the Plan-of-Instruction (POI)

The POI is a course control document, designed by the instructors, which contain the minimum competencies in each course. **Competencies** are broad skills that graduating students have developed to be successful in **ENTRY LEVEL** positions. The POI's designed enable instructors the liberty to use various techniques and equipment to deliver the concepts/principles reflected in the POI.

The POI contains the minimum competencies required for a particular course, allowing instructor flexibility to tailor their instruction and include topics that are germane to their local industry. The POIs are divided into modules of instruction that generally group around a particular topic. POIs will be different based on the course content with no minimum or maximum numbers of modules.

Each module contains a description and an outline of general topics covered in that module providing the reader a brief overview of what a specific module is about.

Each module is separated into Four Segments:

1) The first segment is the **Professional Competency**. Generally, one sentence that attempts to capture in a macro view what the student should know or be able to do when they complete this module. (There may be more than one Professional Competency in a module depending on the material.) The Professional Competency is not necessarily a measurable statement.
2) The second segment contains the **Performance Objectives.** These are broad, general statements capturing the essence of what the student needs to accomplish to satisfy the requirements of the course. The instructors will build their lab components and evaluation instruments from these statements.
3) The third segment is the **Learning Objectives**. These statements are the concepts students will need to understand to satisfy the cognitive tests, lab components, and performance objectives.
4) The last area is the **KSA**, which refers to the level of knowledge, skill, and ability the student will need to attain to be successful in the course. Please refer to Fig.1:

Reference Chart. The KSAs indicate the depth and scope of instruction provided and measurement required.

It is reasonable to expect that, if a student understands the Learning Objectives and is successful in completing the Performance Objectives then it is likely that he/she can execute on the Professional Competency level.

The instructions below apply to all review documents.

1) Please review the POIs attached and mark your responses on the questionnaire **by placing only one check per question** with additional comments as necessary, and return the entire document.
2) We welcome your comments and ask that you provide specific content recommendations for needed changes.

Thank you for your participation in this very important research.

Sincerely,

Beverly Hildebrand
CARCAM Center Director

Please provide your contact information for further curriculum discussion and development. The following information will be used to help us better understand your company and technician requirements. Combined anonymous results will be reviewed and reported to the National Science Foundation and used by CARCAM to update curriculum content.

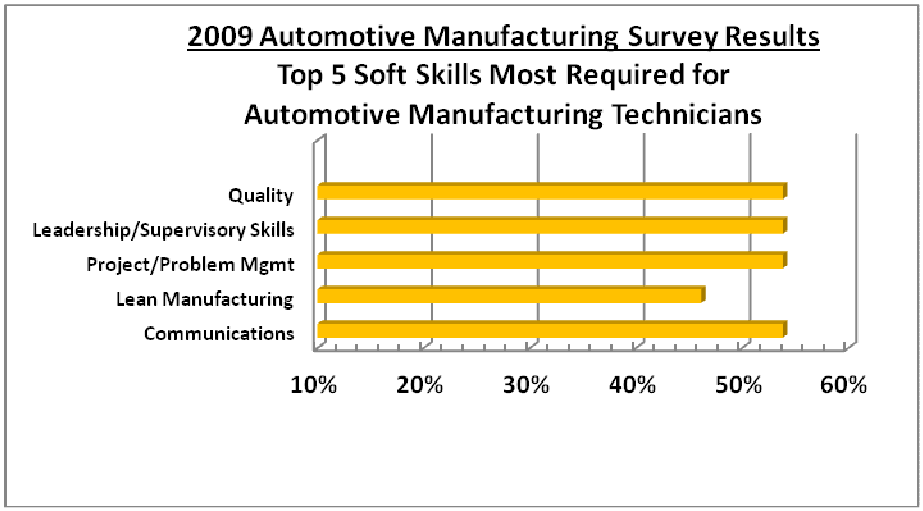
Date_____ Name and Contact Information_____
_____

Company
Name_____

Describe the major manufacturing processes used at your facility (for example: machining, welding, robotics, automation & controls, etc)

_____
_____
_____

2009 CARCAM Industry Needs Assessment Survey Results



Knowledge, Skills, and Abilities (KSA)

Knowledge, Skills, and Abilities		
Indicator	**Student/worker Possesses**	**Description**
1	Limited Knowledge and Proficiency	Identifies **basic facts and terms** about the subject or competency. Performs **simple tasks** associated with the competency. Needs to be told or shown how to do most tasks. **Requires close supervision.**
2	Moderate Knowledge and Proficiency	Identifies relationship of basic facts and states general principles and **can determine step-by-step procedures** for doing the competency. **Performs most parts of the competency**. Needs help only on hardest parts. Requires **limited supervision.**
3	Advanced Knowledge and Proficiency	**Analyzes facts and principles and draws conclusions** about the subject to include **why and when the competency must be done** and why each step is needed. Can **predict outcomes.** Performs all parts of the competency. Needs only a spot check of completed work. Requires **little or no direct supervision**.
4	Superior Knowledge and Proficiency	Can **evaluate conditions** and make appropriate decisions as related to **resolving problems**. Performs competency quickly and accurately with **no direct supervision** and able to **instruct and supervise** others.

Figure 1: Reference Chart

AUT 224, ELM 202
Digital Circuits
Sample Survey Instrument combined with POI

Effective Date: 2010 **Version Number: 2009-1**

COURSE DESCRIPTION:
This course covers digital logic and digital networks. Topics include introductory concepts, number systems, codes, logic gates, Boolean algebra, combinational logic, flip-flop and related devices, arithmetic operations and arithmetic networks. Upon completion of this course, a student will be able to add, subtract, and multiply with digital electronic components.

CREDIT HOURS

Theory Hours	2 hours
Lab Hours	1 hour
Total Hours	3 hours

NOTE: Theory credit hours are a 1:1 contact to credit ratio. Colleges may schedule lab hours as 3:1 and/or 2:1 contact to credit ratio. Clinical hours are 3:1 contact to credit ratio. (Ref Board Policy 705.01)

Date_____ Name & Contact information _____
Company
Name_____

Please indicate whether this course applies to your particular industry: Yes___ No____
If NO, please move on to the next course to be reviewed.

Course Evaluated: **AUT 224 Digital Circuits** Based on your company's standards, please place a check in the appropriate box for each question. **Provide your comments below for any rating of *(1) CHANGES NEEDED.***	Changes Needed	Adequate	Aligns Well
	1	**2**	3
How well do the listed industry competencies reflect expectations of **entry- level** employees associated with your company?	1	2	3
Comments:			
How well does the material in each module reflect your company's standards in scope and quantity?	1	2	3
Comments:			
How well do the performance objectives and their KSA level reflect your company's standards? (Please see KSA chart)	1	2	3
Comments:			
How well do the learning objectives and their KSA level reflect your company's standards? (Please see KSA chart)	1	2	3
Comments:			
Given the entire content of this course how frequently is this information used? (1) Annually, (2) Monthly , (3) Daily/Weekly	1	2	3
Comments:			
How frequently should this course be evaluated by industry? (1) Annually, (2) Every 3 years , (3) Every 5 years	1	2	3
Are there competencies listed that are **not required** of individuals in your company? Use column 1 for Yes and column 3 for No.	1		3
If you answered yes (1), please list what should be removed.			
Are there competencies **not listed** that you expect in an individual at the entry-level position in your company? Use column 1 for Yes and 3 for No.	1		3
If you answered yes (1), please list what is missing.			

STUDENT LEARNING OUTCOMES

MODULE A – SAFETY		
MODULE DESCRIPTION – The purpose of this module is to teach the student the safety considerations associated with digital electronics. Topics include precautions to be taken with electrical equipment and digital equipment.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
A1.0 Explain safety considerations associated with digital electronics.	A1.1 This competency is measured throughout the course.	2
LEARNING OBJECTIVES		**KSA**
A1.1.1 Explain the safety precautions associated with an electrical environment.		2
A1.1.2 Explain safety associated with digital equipment and components.		2
MODULE A OUTLINE: • Precautions with electrical equipment • Precautions with digital equipment		
Comments:		

MODULE B – NUMBER SYSTEMS AND CODES		
MODULE DESCRIPTION – The purpose of this module is to teach the student how various numbering systems affect real life applications. Topics include digital concepts, digital logic, number systems, and conversions.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
B1.0 Comprehend how various numbering systems affect real life applications.	B1.1 Manipulate DIP switches to perform counting capabilities and take measurements to insure proper voltage readings using meters and LEDs.	2
LEARNING OBJECTIVES		**KSA**
B1.1.1 Explain the digital concept and its application.		1
B1.1.2 Describe the Elements of Digital Logic.		1
B1.1.3 Identify the number system and codes applied in digital electronics.		2
B1.1.4 Explain the number system and codes applied in digital electronics.		2
B1.1.5 Explain the decimal number system.		2

B1.1.6 Describe the binary number system.	2
B1.1.7 Describe how to convert decimal to binary and binary to decimal.	2
B1.1.8 Explain the hexadecimal number system.	2
B1.1.9 Convert binary to hexadecimal and hexadecimal to binary.	2
B1.1.10 Explain the octal number system.	2
B1.1.11 Convert binary to octal and octal to binary.	2
B1.1.12 Explain the binary coded decimal number system and its use.	2
B1.1.13 Convert decimal numbers to binary coded decimal.	2
B1.1.14 Explain the gray code number system and its use.	2
B1.1.15 Explain ASCII and EBCDIC alphanumeric codes.	2

MODULE B OUTLINE:

- Digital concepts
- Digital Logic
- Number systems
  - Decimal
  - Binary
  - Hexadecimal
  - Octal
  - Gray code
  - ASCII & EBCDIC
- Conversions

Comments:

MODULE C – LOGIC GATES		
MODULE DESCRIPTION – The purpose of this module is to teach the students how logic circuits work and how they are simplified through the use of digital components. Topics include common logic gates, and symbols.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
C1.0 Comprehend how logic circuits work and how they are simplified through the use of digital components.	C1.1 Construct various logic circuits using specified parts and perform the appropriate validation for each logic circuit.	2
LEARNING OBJECTIVES		**KSA**
C1.1.1 Explain logical operation and application of logic gates.		2
C1.1.2 Explain the operation of logic gates; inverters, AND, OR, NAND, NOR,		2

XOR, and XNOR.	
C1.1.3 Recognize standard and alternate logic gate symbols.	2
C1.1.4 Construct correct truth tables for all logic gates.	2
C1.1.5 Construct truth tables for gates with more than two inputs.	2

MODULE C OUTLINE:

- Logic gates
  - Inverters
  - AND
  - OR
  - NAND
  - NOR
  - XOR
  - XNOR
- Symbols
- Truth tables
- Multiple inputs

Comments:

MODULE D – BOOLEAN ALGEBRA		
MODULE DESCRIPTION – The purpose of this module is to teach the student how Boolean algebra is used to simplify and save money. Topics include Boolean algebra laws, rules, and conversion.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
D1.0 Comprehend how Boolean algebra is used to simplify and save money.	D1.1 This competency is measured cognitively.	1
LEARNING OBJECTIVES		**KSA**
D1.1.1 Apply the basic laws and rules of Boolean algebra to logic circuits.		1
D1.1.2 Convert between number systems used in digital electronics.		1

MODULE D OUTLINE:

- Boolean algebra
  - Laws
  - Rules
  - Conversion

Comments:

MODULE E – FLIP-FLOPS		
MODULE DESCRIPTION – The purpose of this module is to teach the student how Flip-Flops are used as storage devices and latch circuits. Topics include Flip-Flops purpose, latches, switch buffering, contact bounce, storage registers, and JK Flip-Flops.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
E1.0 Comprehend how Flip-Flops are used as storage devices and latch circuits.	E1.1 Construct a flip-flop circuit and test for proper operation.	2
LEARNING OBJECTIVES		**KSA**
E1.1.1 Define Flip-Flops.		2
E1.1.2 Explain the purpose of Flip-Flops.		2
E1.1.3 Explain the latches on a Flip-Flop by using truth tables.		2
E1.1.4 Explain switch buffering and contact bounce.		2
E1.1.5 Describe storage registers and how they are used.		2
E1.1.6 Explain how JK Flip-Flops are used as storage elements.		2

MODULE E OUTLINE:
• Flip-Flops
  o Purpose
  o Latches
  o Switch buffering
  o Contact bounce
  o Storage registers
  o JK Flip-Flops		

Comments:		

MODULE F – SEQUENTIAL LOGIC CIRCUITS
MODULE DESCRIPTION – The purpose of this module is to teach the student the functions of sequential logic circuits. Topics include counters, shift registers, and clocks.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
F1.0 Comprehend the functions of sequential logic circuits.	F1.1 Apply sequential logic functions related to counters, shift registers, and clock circuits.	2

LEARNING OBJECTIVES	KSA
F1.1.1 Define counters.	2
F1.1.2 Explain the function of counters.	2
F1.1.3 Explain the code used by counters.	2
F1.1.4 Describe asynchronous counters.	2
F1.1.5 Identify the function and movement of a shift register.	2
F1.1.6 Explain the serial to parallel conversions of a shift register.	2
F1.1.7 Describe the basic types of MOS shift registers.	2
F1.1.8 Define the function of a clock oscillator circuit.	2

MODULE F OUTLINE:

- Counters
- Shift Registers
- Clocks

Comments:

The following module is optional provided time is available.

MODULE G – COMBINATIONAL LOGIC

MODULE DESCRIPTION – The purpose of this module is to teach the student how combinational logic circuits function in a digital logic environment. Topics include Encoders, Multiplexers, Demulitplexers, exclusive ORs and ROM.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
G1.0 Comprehend how combinational logic circuits function in a digital logic environment.	G1.1 Construct a combinational logic circuit and test for proper operation.	2

LEARNING OBJECTIVES	KSA
G1.1.1 Explain the functions of Decoders and Encoders.	2
G1.1.2 Differentiate between Decoders and Encoders.	2

G1.1.3 Explain BCD to 7-segment display Decoder.	2
G1.1.4 Explain the operations of Multiplexers and Demultiplexers.	2
G1.1.5 Differentiate between Multiplexers and Demultiplexers.	2
G1.1.6 Identify the symbol and truth tables of exclusive OR logic circuits.	2
G1.1.7 Explain how ROM operations work with memory circuits.	2
G1.1.8 Explain how to convert analog signals to digital and digital signals to analog.	2

MODULE G OUTLINE:

- Decoders
- Encoders
- Mulitplexers
- Demulitiplexers
- Exclusive ORs
- ROM
- Conversions

Comments:

Curriculum Gap Analysis Management Plan

The goal is to perform one survey per semester (survey generally consists of three to six courses as appropriate).

1.0 Choose courses to survey

1.1 Evaluate number of courses taught by school and as a total across Consortium for Alabama Regional Center for Automotive Manufacturing (CARCAM) colleges.

1.2 Provide this information to CARCAM faculty and staff for review.

1.3 Open discussion to choose courses by consensus, grouping like courses when possible.

2.0 Survey and analysis instruments

2.1 Develop survey instrument for each course to be surveyed using existing Plans of Instruction (POIs). Ensure all POIs are updated to most current format.

2.2 Develop analysis spreadsheets to input data upon receipt.

3.0 Forward survey instruments to CARCAM Co-Principle Investigators (CoPIs) and Senior Team Members (STMs), CARCAM's Industry Advisory Committee (IAC), Alabama Automotive Manufacturing Association (AAMA) participants, and associated faculty.

3.1 CoPIs present survey to their program's Industry Advisory Committees, former students working in industry, and faculty member's familiar with courses.

3.1 CARCAM Center in conjunction with Department of Postsecondary Education (DPE)/Curriculum & Instruction Unit (CIU) administers surveys to CARCAM Industry Advisory Committee and AAMA participants.

4.0 Completed surveys

4.1 Collect Surveys via email, fax or US mail.

4.2 Evaluate surveys for completeness.

4.3 Input data into analysis spreadsheet.

4.4 Recheck entries against original survey for accuracy.

4.5 Compile all survey data into final report document for analysis.

4.6 Send document to CARCAM Staff and faculty for analysis and feedback.

5.0 Joint meetings for feedback review and response

5.1 Schedule meeting/s for feedback discussion

5.2 With each piece of feedback for each course surveyed, pose the following questions:

5.2.1 Is this feedback asking for a change in this course?
5.2.2 What needs to be changed?
5.2.3 If something is missing, is it taught in another course?
5.2.4 Is the suggested change appropriate for the students taking this course or should it be implemented elsewhere?
5.2.5 Will this change require other changes to be made to this course or other courses?

5.3 After discussion, decide by consensus whether a change is warranted. If so move on to step 6.0. If no change is to be made go to 5.4

5.4 If no change is to be made, discuss appropriate response to the feedback with rationale and fill in Action Taken block on summary report.

6.0 Make changes to courses as warranted.

6.1 Update POIs with new or updated information according to feedback and discussion of faculty members.

6.2 Once completed send POI to faculty for final review.

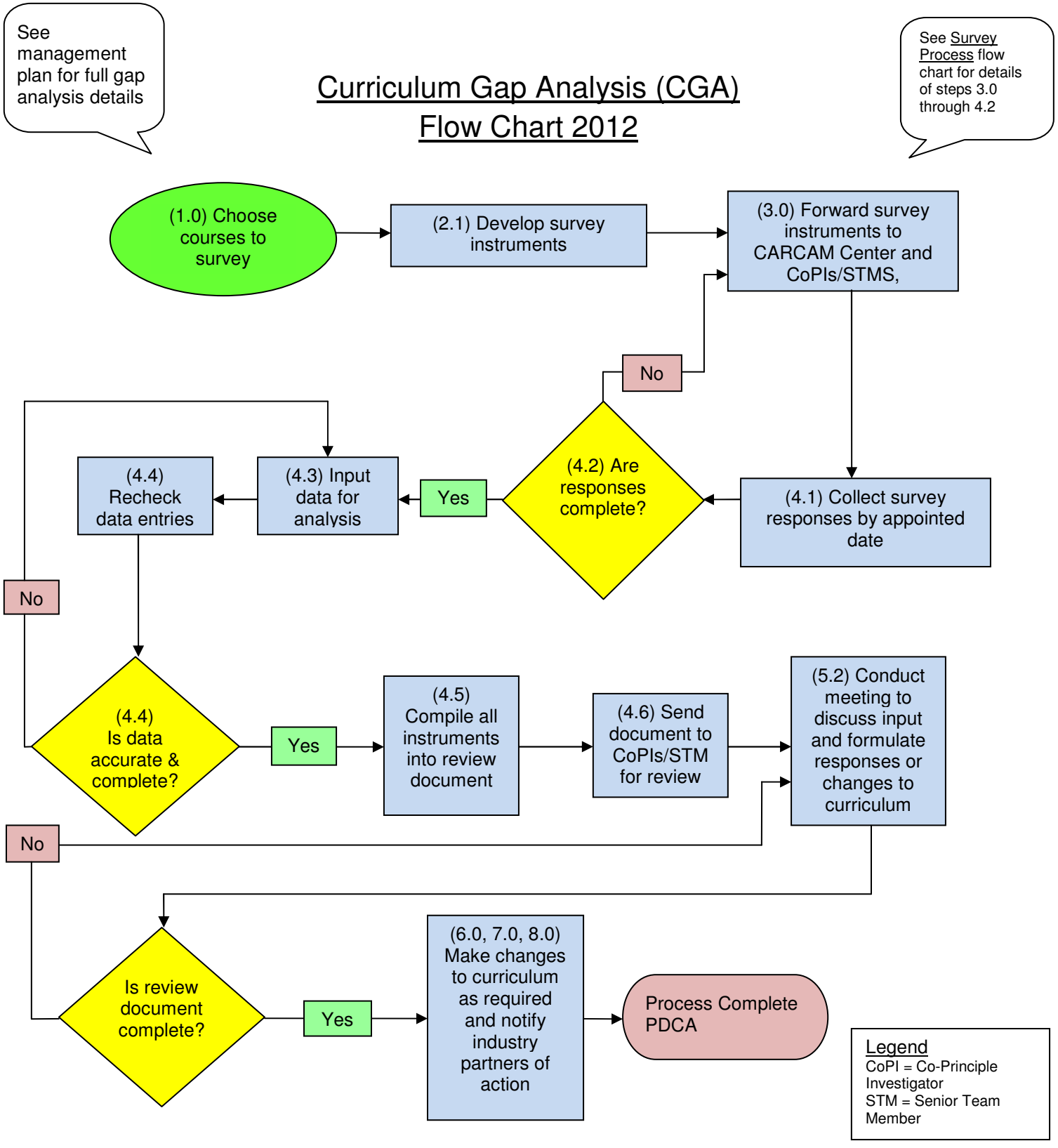
6.3 Post the completed POI on the Alabama Community College System web site in the AUT POI section.

6.4 Update Action Taken block on summary report.

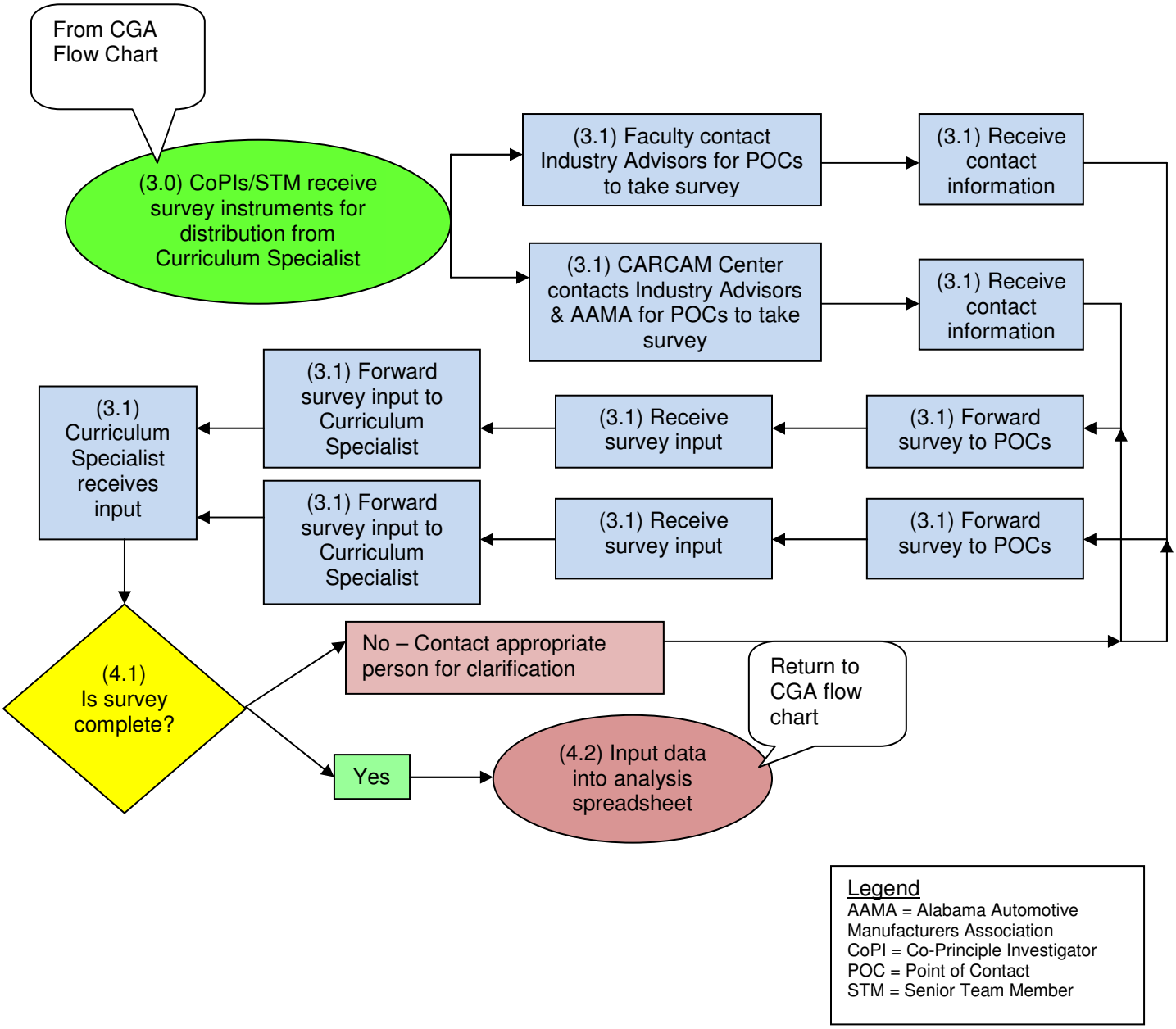
7.0 Notify all affected colleges of curriculum changes.

8.0 Notify industry partners of response to their feedback.

Curriculum Gap Analysis (CGA) Flow Chart 2012



Curriculum Gap Analysis
Survey Process 2012 - Flow Chart



Sample Final Report

AUT 224 Digital Circuits

Curriculum Gap Analysis

Industry Evaluated Fall 2011

Evaluation Overview

Questions	Changes Needed	%	Adequate	%	Aligns Well	%	Total	%
1	0	0%	5	38%	8	62%	13	100%
2	0	0%	6	46%	7	54%	13	100%
3	0	0%	5	38%	8	62%	13	100%
4	0	0%	4	31%	9	69%	13	100%
Total	0		20		32		52	
Percent	0%		38%		62%		100%	% Acceptable
	Annually		Monthly		Daily/Weekly		Total	
5	0	0%	4	31%	9	69%	13	100%
	Annually		3 Years		5 Years			
6	2	15%	8	62%	3	23%	13	100%
	Yes	%			No	%	Total	%
7	2	15%			11	85%	13	100%
8	0	0%			13	100%	13	100%
Total	2				24		26	
Percent	8%				92%		100%	

AUT 224 Compiled Evaluations & Feedback Based on your company's standards, please place a check in the appropriate box for each question. **Provide your comments below for any rating of *(1) CHANGES NEEDED.***	Changes Needed	Adequate	Aligns Well
	1	**2**	3
1. How well do the listed industry competencies reflect expectations of **entry- level** employees associated with your company?	0	3	6
Comments: This module is particularly important because of uncertainties when it comes to programming changes or digital changes. Knowing and understanding the safety components and practices directly affects the outcome of any program or equipment changes. Because these type changes are integrated within a device or program, there has to be strong knowledge in this module.			
Action Taken: No action required at this time.			
2. How well does the material in each module reflect your company's standards in scope and quantity?	0	4	5
Comments:			
Action Taken:			
3. How well do the performance objectives and their KSA level reflect your company's standards? (Please see KSA chart)	0	3	6
Comments:			
Action Taken:			
4. How well do the learning objectives and their KSA level reflect your company's standards? (Please see KSA chart)	0	4	5
Comments:			
Action Taken:			
5. Given the entire content of this course how frequently is this information used? Annually, Monthly , Daily/Weekly	0	4	5
Comments: The specific details not very often, but the fundamental concepts apply widely in the electronics/programming areas.			

Action Taken: No action required.			
6. How frequently should this course be evaluated by industry? (1) Annually, (2) Every 3 years , (3) Every 5 years	0	6	1
Comments:			
Action Taken:			
7. Are there competencies listed that are **not required** of individuals in your company? Use 1 for Yes and 3 for No.	0	X	9
Comments: **1) Boolean Algebra** **2) Octal System**			
Action Taken: (1) Boolean is frequently used in PLC programming **(2) Octal will be taught as informational only**			
8. Are there competencies **not listed** that you expect in an individual at the entry-level position in your company? Use 1 for Yes and 3 for No.	0	X	9
Comments:			
Action Taken:			

STUDENT LEARNING OUTCOMES

MODULE A – SAFETY		
MODULE DESCRIPTION – The purpose of this module is to teach the student the safety considerations associated with digital electronics. Topics include precautions to be taken with electrical equipment and digital equipment.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
A1.0 Explain safety considerations associated with digital electronics.	A1.1 This competency is measured throughout the course.	2
LEARNING OBJECTIVES		**KSA**
A1.1.1 Explain the safety precautions associated with an electrical environment.		2
A1.1.2 Explain safety associated with digital equipment and components.		2
MODULE A OUTLINE: • Precautions with electrical equipment		

- Precautions with digital equipment

Comments: **Everything here looks good. Would not make any changes.**

Action Taken:

MODULE B – NUMBER SYSTEMS AND CODES

MODULE DESCRIPTION – The purpose of this module is to teach the student how various numbering systems affect real life applications. Topics include digital concepts, digital logic, number systems, and conversions.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
B1.0 Comprehend how various numbering systems affect real life applications.	B1.1 Manipulate DIP switches to perform counting capabilities and take measurements to insure proper voltage readings using meters and LEDs.	2

LEARNING OBJECTIVES	KSA
B1.1.1 Explain the digital concept and its application.	1
B1.1.2 Describe the Elements of Digital Logic.	1
B1.1.3 Identify the number system and codes applied in digital electronics.	2
B1.1.4 Explain the number system and codes applied in digital electronics.	2
B1.1.5 Explain the decimal number system.	2
B1.1.6 Describe the binary number system.	2
B1.1.7 Describe how to convert decimal to binary and binary to decimal.	2
B1.1.8 Explain the hexadecimal number system.	2
B1.1.9 Convert binary to hexadecimal and hexadecimal to binary.	2
B1.1.10 Explain the octal number system.	1
B1.1.11 Convert binary to octal and octal to binary.	1
B1.1.12 Explain the binary coded decimal number system and its use.	2
B1.1.13 Convert decimal numbers to binary coded decimal.	2
B1.1.14 Explain the gray code number system and its use.	2
B1.1.15 Explain ASCII and EBCDIC alphanumeric codes.	2

MODULE B OUTLINE:

- Digital concepts
- Digital Logic
- Number systems
  - Decimal
  - Binary
  - Hexadecimal

- Octal
- Gray code
- ASCII & EBCDIC

- Conversions

Comments: 1) **Everything here looks good. Would not make any changes.**
2) Used very often Robotics & PLCs
3) Never used the Octal numbering system in the work environment.

Action Taken: **(3) Instructors recognize that hexadecimal numbering is used more frequently than Octal. We have reduced the KSA to knowledge level information for the Octal.**

MODULE C – LOGIC GATES

MODULE DESCRIPTION – The purpose of this module is to teach the students how logic circuits work and how they are simplified through the use of digital components. Topics include common logic gates, and symbols.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
C1.0 Comprehend how logic circuits work and how they are simplified through the use of digital components.	Construct various logic circuits using specified parts and perform the appropriate validation for each logic circuit.	2

LEARNING OBJECTIVES	KSA
C1.1.1 Explain logical operation and application of logic gates.	2
C1.1.2 Explain the operation of logic gates; inverters, AND, OR, NAND, NOR, XOR, and XNOR.	2
C1.1.3 Recognize standard and alternate logic gate symbols.	2
C1.1.4 Construct correct truth tables for all logic gates.	2
C1.1.5 Construct truth tables for gates with more than two inputs.	2

MODULE C OUTLINE:

- Logic gates
  - Inverters
  - AND
  - OR
  - NAND
  - NOR
  - XOR
  - XNOR
- Symbols
- Truth tables
- Multiple inputs

Comments:
1) Everything here looks good. Would not make any changes.
2) Good for logical understanding
3) The specifics of the symbols and such are only used occasionally. However, the basic understanding of the logic function is used on a regular basis.

Action Taken: **No action required**

MODULE D – BOOLEAN ALGEBRA		
MODULE DESCRIPTION – The purpose of this module is to teach the student how Boolean algebra is used to simplify and save money. Topics include Boolean algebra laws, rules, and conversion.		
PROFESSIONAL COMPETENCIES	**PERFORMANCE OBJECTIVES**	**KSA**
D1.0 Comprehend how Boolean algebra is used to simplify and save money.	D1.1 This competency is measured cognitively.	1
LEARNING OBJECTIVES		**KSA**
D1.1.1 Apply the basic laws and rules of Boolean algebra to logic circuits.		1
D1.1.2 Convert between number systems used in digital electronics.		1

MODULE D OUTLINE:

- Boolean algebra
  - Laws
  - Rules
  - Conversion

Comments:
1) Everything here looks good. Would not make any changes.
2) Not used, more for engineering in my opinion

Action Taken: **(2) Boolean Algebra is used to explain the logic function of gates and to program PLCs. It is important to keep this in the curriculum.**

MODULE E – FLIP-FLOPS
MODULE DESCRIPTION – The purpose of this module is to teach the student how Flip-Flops are used as storage devices and latch circuits. Topics include Flip-Flops purpose, latches, switch buffering, contact bounce, storage registers, and JK Flip-Flops.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
E1.0 Comprehend how Flip-Flops are used as storage devices and latch circuits.	E1.1 Construct a flip-flop circuit and test for proper operation.	2

LEARNING OBJECTIVES	KSA
E1.1.1 Define Flip-Flops.	2
E1.1.2 Explain the purpose of Flip-Flops.	2
E1.1.3 Explain the latches on a Flip-Flop by using truth tables.	2
E1.1.4 Explain switch buffering and contact bounce.	2
E1.1.5 Describe storage registers and how they are used.	2
E1.1.6 Explain how JK Flip-Flops are used as storage elements.	2

MODULE E OUTLINE:

- Flip-Flops
  - Purpose
  - Latches
  - Switch buffering
  - Contact bounce
  - Storage registers
  - JK Flip-Flops

Comments:

1) No comments at this time.

2) Not used in my job, but a basic understanding would be good.

3) For the most part in the work environment, all of these functions are performed internally by PLCs.

Action Taken: **No action required**

MODULE F – SEQUENTIAL LOGIC CIRCUITS

MODULE DESCRIPTION – The purpose of this module is to teach the student the functions of sequential logic circuits. Topics include counters, shift registers, and clocks.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
F1.0 Comprehend the functions of sequential logic circuits.	F1.1 Apply sequential logic functions related to counters, shift registers, and clock circuits.	2

LEARNING OBJECTIVES	KSA
F1.1.1 Define counters.	2

F1.1.2 Explain the function of counters.	2
F1.1.3 Explain the code used by counters.	2
F1.1.4 Describe asynchronous counters.	2
F1.1.5 Identify the function and movement of a shift register.	2
F1.1.6 Explain the serial to parallel conversions of a shift register.	2
F1.1.7 Describe the basic types of MOS shift registers.	2
F1.1.8 Define the function of a clock oscillator circuit.	2

MODULE F OUTLINE:

- Counters
- Shift Registers
- Clocks

Comments:

1) None at this time.

2) Good to know this stuff.

3) Most of these functions are performed

4) Most of these functions are performed internally by the PLC, and no knowledge of their construction is required for being effective in troubleshooting.

Action Taken: This is taught as foundational information to be applied in future, complex systems.

The following module is optional provided time is available.

MODULE G – COMBINATIONAL LOGIC

MODULE DESCRIPTION – The purpose of this module is to teach the student how combinational logic circuits function in a digital logic environment. Topics include Encoders, Multiplexers, Demulitplexers, exclusive ORs and ROM.

PROFESSIONAL COMPETENCIES	PERFORMANCE OBJECTIVES	KSA
G1.0 Comprehend how combinational logic circuits function in a digital logic environment.	Construct a combinational logic circuit and test for proper operation.	2

LEARNING OBJECTIVES	KSA
G1.1.1 Explain the functions of Decoders and Encoders.	2
G1.1.2 Differentiate between Decoders and Encoders.	2
G1.1.3 Explain BCD to 7-segment display Decoder.	2
G1.1.4 Explain the operations of Multiplexers and Demultiplexers.	2
G1.1.5 Differentiate between Multiplexers and Demultiplexers.	2

G1.1.6 Identify the symbol and truth tables of exclusive OR logic circuits. G1.1.7 Explain how ROM operations work with memory circuits. G1.1.8 Explain how to convert analog signals to digital and digital signals to analog.	2 2 2
MODULE G OUTLINE: • Decoders • Encoders • Mulitplexers • Demulitiplexers • Exclusive ORs • ROM • Conversions	
Comments: **Everything here looks good. Would not make any changes.**	
Action Taken:	

Sample Analysis Spreadsheet

Ratings

Questions	Changes Needed	%	Adequate	%	Aligns Well	%	Total	%
1	0	0%	5	38%	8	62%	13	100%
2	0	0%	6	46%	7	54%	13	100%
3	0	0%	5	38%	8	62%	13	100%
4	0	0%	4	31%	9	69%	13	100%
Total	0		20		32		52	
Percent	0%		38%		62%		100%	% Acceptable
	Annually		Monthly		Daily/Weekly		Total	
5	0	0%	4	31%	9	69%	13	100%
	Annually		3 Years		5 Years			
6	2	15%	8	62%	3	23%	13	100%
	Yes	%			No	%	Total	%
7	2	15%			11	85%	13	100%
8	0	0%			13	100%	13	100%
Total	2				24		26	
Percent	8%				92%		100%	

Comments from Survey Instruments

Comments Item 1	This module is particularly important because of uncertainties when it comes to programming changes or digital changes. Knowing and understanding the safety components and practices directly affects the outcome of any program or equipment changes. Because these type changes are integrated within a device or program, there has to be strong knowledge in this module.
Comments Item 2	
Comments Item 3	
Comments Item 4	
Comments Item 5	The specific details not very often, but the fundamental concepts apply widely in the electronics/programming areas.
Comments Item 6	

Comments Item 7	1) Boolean Algebra 2) Octal System
Comments Item 8	
Comments Module A Safety	Everything here looks good. Would not make any changes.
Comments Module B Numbering Systems and Codes	1) Everything here looks good. Would not make any changes. 2) Used very often Robotics & PLCs 3) Never used the Octal numbering system in the work environment.
Comments Module C Logic Gates	1) Everything here looks good. Would not make any changes. 2) Good for logical understanding 3) The specifics of the symbols and such are only used occasionally. However, the basic understanding of the logic function is used on a regular basis.
Comments Module D Boolean Algebra	1) Everything here looks good. Would not make any changes. 2) Not used, more for engineering in my opinion
Comments Module E Flip-Flops	1) No comments at this time. 2) Not used in my job, but a basic understanding would be good. 3) For the most part in the work environment, all of these functions are performed internally by PLCs.
Comments Module F Sequential Logic Circuits	1) None at this time. 2) Good to know this stuff. 3) Most of these functions are performed 4) Most of these functions are performed internally by the PLC, and no knowledge of their construction is required for being effective in troubleshooting.
Comments Module G Combinational Logic	Everything here looks good. Would not make any changes.