OFFICE OF CHIEF ACADEMIC OFFICER
Summary of State Board of Education Agenda Items
Consent Agenda
December 17, 2020

OFFICE OF CAREER AND TECHNICAL EDUCATION

B. Approval to begin the Administrative Procedures Act process: To establish Mississippi Secondary Curriculum Framework for Advanced Manufacturing in Career and Technical Education

Executive Summary

The Advanced Manufacturing program provides a foundation of knowledge to prepare students for employment or continued education in several occupations related to the manufacturing industry. The curriculum framework for this program was developed in partnership with various industries across the state including Auto Parts Manufacturing Mississippi Inc., PACCAR, Ingalls Shipbuilding, and more.

When developing this curriculum, the authors recognized the importance of incorporating differentiated instruction and the needs of the 21st Century learners. Therefore, teaching strategies include a variety of hands-on, shop-based activities, soft skill development, and project-based learning. This curriculum is written for programs to foster and develop a partnership with local industry and tailor the content to fit the needs of that local industry, all while giving students a solid foundation in basic manufacturing skills.

All curricula frameworks are designed to provide local programs with an instructional foundation that can be used to develop localized instructional management plans and course syllabi. Additionally, the frameworks include the following elements for each secondary curriculum:

- Program
- Description
- Classification of Instructional Program (CIP) Code and CIP Name
- Course Outline and Codes
  - Curriculum
  - Student Competencies
  - Suggested Student Objectives

Recommendation: Approval

Back-up material attached

2021 Advanced Manufacturing

Program CIP: 15.0613 — Manufacturing Technology/Technician

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

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Dr. Carey M. Wright, state superintendent of education
Dr. Jason S. Dean, chair
Ms. Rosemary G. Aultman
Mr. Glen East
Dr. Karen J. Elam
Mr. Omar G. Jamil, student representative
Ms. Amy Zhang, student representative

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Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE advanced manufacturing curriculum is aligned to the following standards:

National Center for Construction Education and Research (NCCER) Core Standards
The NCCER Core standards covers the basic knowledge and skills necessary for students entering the construction and manufacturing field.
nccer.org/workforce-development-programs/disciplines/craft-details/core

International Society for Technology in Education Standards (ISTE)
Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE.
iste.org

College- and Career-Ready Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Ready Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st Century Learning
In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills. 21 *Framework Definitions* (2019).
battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510.

Executive Summary

Pathway Description
Advanced manufacturing is a pathway in the manufacturing career cluster. This program is designed for students who wish to pursue a career in the highly demanded automated and advanced manufacturing field. This course includes material on basic factory safety, hand tools, power tools, employability skills, welding, assembly, construction drawings, materials handling, circuits and electronics, robotics, and more.

College, Career, and Certifications
The automated and advanced manufacturing industry can be found throughout Mississippi, with numerous community colleges and universities having educational programs for it as well. Students who complete this pathway will be prepared for an entry-level position at many of the factories across the state or to pursue further education.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as a 10th grader. Exceptions to this are a district-level decision based on class size, enrollment numbers, and student maturity. A maximum of 25 students is recommended for classroom-based courses, while a maximum of 15 students is recommended for lab-based courses.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum/curriculumdownload.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ese/approved-course-for-the-secondary-schools.

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any of training sessions provided, please contact the RCU at 662.325.2510.

Course Outlines

Option 1— Four 1-Carnegie Unit Courses

This curriculum consists of four 1-credit courses, which should be completed in the following sequence:

1. **Basics of Advanced Manufacturing—Course Code: XXXXX**
2. **Fundamentals of Advanced Manufacturing—Course Code: XXXXX**
3. **Processes of Advanced Manufacturing—Course Code: XXXXX**
4. **Production in Advanced Manufacturing—Course Code: XXXXX**

Course Description: Basics of Advanced Manufacturing
This course identifies the basic skills and knowledge students need to master in order to move ahead in the advanced manufacturing field. Material covered in this course includes employability skills, safety, construction math and drawings, materials handling, tools, and more.

Course Description: Fundamentals of Advanced Manufacturing
This course emphasizes the fundamentals necessary for a career in the advanced manufacturing field. It includes an introduction to fabrication, welding, and assembly.

Course Description: Processes of Advanced Manufacturing
This course focuses on the various processes and mechanics within advanced manufacturing. Material covered in this course includes precision measurement, circuits, electronics, hydraulics, and pneumatics.

Course Description: Production in Advanced Manufacturing
This capstone course focuses on more advanced segments of advanced manufacturing, such as programmable logic controllers and robotics. Along with some employability skills, the students will spend a large amount of time with assembly simulation in real-world applications.

Basics of Advanced Manufacturing—Course Code: XXXXX

Unit	Unit Name	Hours
1	Orientation	3
2	Employability Skills	7.5
3	Fundamentals of Student Organizations	4.5
4	Communication Skills	7.5
5	Basic Safety	35
6	Introduction to Construction Math	15
7	Hand Tools	22.5
8	Power Tools	22.5
9	Construction Drawings	15
10	Materials Handling	7.5
11	Rigging and Signaling	7.5
Total		147.5

Fundamentals of Advanced Manufacturing—Course Code: XXXXX

Unit	Unit Title	Hours
12	Fabrication	40
13	Welding and Cutting	40
14	Basic Assembly	40
Total		120

Processes of Advanced Manufacturing—Course Code: XXXXX

Unit	Unit Title	Hours
15	Safety Review	20
16	Precision Measurement	15
17	Circuits and Electronics	60
18	Hydraulics and Pneumatics	15
Total		110

Production in Advanced Manufacturing —Course Code: XXXXX

Unit	Unit Title	Hours
19	Programmable Logic Controllers	15
20	Robotics and Automation	15
21	Advanced Assembly	65
22	Workforce Readiness	20
Total		115

Option 2—Two 2-Carnegie Unit Courses

This curriculum consists of two 2-credit courses, which should be completed in the following sequence:

1. **Advanced Manufacturing I—Course Code: XXXXXX**
2. **Advanced Manufacturing II—Course Code: XXXXXX**

Course Description: Advanced Manufacturing I
This course encompasses the basic skills and knowledge students need to master in order to move ahead in the advanced manufacturing field. Material covered in this course includes employability skills, safety, construction math and drawings, materials handling, tools, and more. This course also emphasizes the fundamentals necessary for a career in the advanced manufacturing field, including an introduction to fabrication, welding, and assembly.

Course Description: Advanced Manufacturing II
This course focuses on the various processes and mechanics within advanced manufacturing. Material covered in this course includes precision measurement, circuits, electronics, hydraulics, and pneumatics. This course also covers more advanced segments of advanced manufacturing, such as programmable logic controllers and robotics. Along with some employability skills, the students will finish the course with a large amount of time spent doing assembly simulation in real-world applications.

Advanced Manufacturing I—Course Code: XXXXXX

Unit	Unit Title	Hours
1	Orientation	3
2	Employability Skills	7.5
3	Fundamentals of Student Organizations	4.5
4	Communication Skills	7.5
5	Basic Safety	35
6	Introduction to Construction Math	15
7	Hand Tools	22.5
8	Power Tools	22.5
9	Construction Drawings	15
10	Materials Handling	7.5
11	Rigging and Signaling	7.5
12	Fabrication	40
13	Welding and Cutting	40
14	Basic Assembly	40
Total		267.5

Advanced Manufacturing II—Course Code: XXXXXX

Unit	Unit Title	Hours
15	Safety Review	20
16	Precision Measurement	15
17	Circuits and Electronics	60
18	Hydraulics and Pneumatics	15
19	Programmable Logic Controllers	15
20	Robotics and Automation	15
21	Advanced Assembly	65
22	Workforce Readiness	20
Total		225

Career Pathway Outlook

Overview
Advanced manufacturing uses innovative technology and processes to make products that are high tech, improved, and less expensive. Additionally, the efficiency of advanced manufacturing processes improves competitiveness in the manufacturing sector. Unlike traditional manufacturing, which uses dedicated production lines with little flexibility, advanced manufacturing uses more versatile production methods that depend on information, automation, computation, software, sensing, and networking. Careers in advanced manufacturing require workers with a willingness to learn and apply new knowledge and skills and have the capability to quickly adapt to using new or changing technologies.

Needs of the Future Workforce
In Mississippi, most employment in advanced manufacturing is projected to grow faster than average for all occupations. The need to keep increasingly sophisticated machinery functioning and efficient will continue to create a demand for these workers. Data for this synopsis were compiled from employment projections prepared by the U.S. Census Bureau, the U.S. Bureau of Labor Statistics (2020), and the Mississippi Department of Employment Security (2020).

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2016	Projected Jobs, 2026	Change (Number)	Change (Percent)	Average Hourly Earnings, 2020
Computer Numerically Controlled Tool Operators	430	470	40	9.3	$16.55
Computer Hardware Engineer	240	260	20	8.3	$42.23
Machinist	3,490	3,800	310	8.9	$20.46
Mechanical Engineer	1,160	1,280	120	10.3	$39.03
Electrical and Electronics Engineering Technicians	1,440	1,510	70	4.9	$32.75
Electronic Engineers	580	640	60	10.3	$43.12
Computer Numerically Controlled Tool Programmers	80	90	10	12.5	$22.40
Welders, Cutters, Solderers, and Brazers	5,490	6,050	560	10.2	$21.10

Source: Mississippi Department of Employment Security; mdes.ms.gov (2020).

Perkins V Requirements and Academic Infusion
The advanced manufacturing curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in advanced manufacturing. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for careers in advanced manufacturing. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, the curriculum focuses on ongoing and meaningful professional development for teachers, as well as relationships with industry.

Transition to Postsecondary Education
The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies

Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The advanced manufacturing educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction

Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunity to succeed.

CTE Student Organizations

Teachers should investigate opportunities to sponsor a student organization. There are several here in Mississippi that will foster the types of learning expected from the advanced manufacturing curriculum. SkillsUSA and the Technology Student Association (TSA) are examples of student organizations with many outlets for manufacturing. Student organizations provide participants and members with growth opportunities and competitive events. They also open the doors to the world of manufacturing careers and scholarship opportunities.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the advanced manufacturing curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The advanced manufacturing curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the advanced manufacturing curriculum that will allow and encourage collaboration with professionals currently in the manufacturing field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the advanced manufacturing classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and manufacturing professionals. Thus, supervised collaboration and immersion into the manufacturing around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

Association for Career and Technical Education
acteonline.org

SkillsUSA
skillsusa.org

Technology Student Association (TSA)
tsaweb.org

Using This Document

Suggested Time on Task
This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80% of the time in the course. The remaining percentage of class time will include instruction in non-tested material, review for end-of-course testing, and special projects.

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at rcu.msstate.edu/curriculum/curriculumdownload.aspx. All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future, if they are not already. To be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Many of the units include an enrichment section at the end. If the advanced manufacturing program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the advanced manufacturing program is using a national certification or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested. It is the responsibility of the teacher to ensure all competencies for the selected assessment are covered throughout the year.

Unit 1: Orientation

Competencies and Suggested Objectives
1. Describe local program and center expectations, policies, and procedures. DOK 1 a. Describe local program and career center policies and procedures, including dress code, attendance, academic requirements, discipline, shop/lab rules and regulations, and transportation regulations. b. Give a brief overview of the course, explaining to students what advanced manufacturing is, why it is important, and how it will be delivered. c. Compare and contrast local program and school policies to the expectations of employers. d. Preview course objectives, program policy, and industry standards.
2. Research and discuss work-based learning (WBL) opportunities related to the program area. DOK 1 a. Define WBL. b. Explore the opportunities available in advanced manufacturing, including WBL, job shadowing, apprenticeship programs, on-the-job training, etc.

Unit 2: Employability Skills

Competencies and Suggested Objectives
1. Describe employment opportunities in the manufacturing industry. DOK 1 a. Describe employment opportunities, including potential earnings, employee benefits, job availability, working conditions, educational requirements, required technology skills, and continuing education/training. b. Discuss the guidelines for developing a proper résumé. c. Demonstrate completing job applications.
2. Examine the Mississippi Department of Employment Security (MDES) website and its applications relating to employment opportunities. DOK 1 a. Perform various searches through the MDES website, such as: • Number of jobs available for a specific area of expertise • Hourly wage • Percentage of jobs in the county • Percentage of jobs in the state
3. Demonstrate appropriate interviewing skills. DOK 1 a. Identify interviewing skills such as speaking, dress, professionalism, and punctuality. b. Simulate a job interview.
4. Describe basic employee responsibilities and appropriate work ethics. DOK 1 a. Compare and contrast employment responsibilities and expectations to local school and program policies and expectations. b. Define effective relationship skills and identify workplace issues, including, but not limited to, sexual harassment, stress, and substance abuse.

Unit 3: Fundamentals of Student Organizations

Competencies and Suggested Objectives
1. Discuss the history, mission, and purpose of career and technical student organizations (CTSO). DOK 1 a. Trace the history of the program area's student organizations – SkillsUSA and the Technology Student Association (TSA). b. Identify the mission, purpose, and/or goals of the program area's student organizations.
2. Explore the advantages of membership in student organizations. DOK 1 a. Discuss the membership process for the program area's student organizations. b. Explain the activities related to the local chapter and the state and national organizations.
3. Discuss the organization's brand resources. DOK 1 a. Identify the motto, creed, and/or pledge and discuss their meanings. b. Recognize related brand resources, such as: • Emblem • Colors • Official attire • Logos • Graphic standards
4. Describe the importance of effective communication skills. DOK 1 a. Demonstrate verbal and nonverbal communication skills. b. Apply appropriate speaking and listening skills to class- and work-related situations.
5. Apply leadership skills and 21st century skills to class- and work-related situations. DOK 2 a. Define leadership. b. Discuss the attributes of a leader. c. Identify the roles a leader can assume.
6. Utilize team-building skills in class- and work-related situations. DOK 2 a. Define team-building. b. Discuss the attributes of a team. c. Identify the roles included in a team.
7. Discuss the various competitions offered through the program area's CTSOs. DOK 1 a. Describe each of the competitions and the skills needed to accomplish the tasks. b. Perform the tasks needed to complete an assigned requirement for a competition.

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 4: Communication Skills

Competencies and Suggested Objectives
1. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations. DOK 2 a. Follow basic written and verbal instructions. b. Effectively communicate in on-the-job situations using verbal, written, or electronic communication.
2. Discuss the importance of good listening skills in on-the-job situations. DOK 2 a. Apply the tips for developing good listening skills.

Unit 5: Basic Safety

Competencies and Suggested Objectives
1. Describe, define, and illustrate general safety rules for working in a shop/lab and how they relate to the manufacturing industry. DOK 2 a. Describe how to avoid on-site accidents. b. Explain the relationship between housekeeping and safety. c. Explain the importance of following all safety rules and company safety policies according to OSHA standards. d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses. e. Explain the need for evacuation policies and the importance of following them. f. Explain causes of accidents and the impact of accident costs. g. Compare and contrast shop/lab safety rules to industry safety rules.
2. Identify and apply safety practices around welding operations. DOK 1 a. Use proper safety practices when welding or working around welding operations. b. Use proper safety practices when welding in or near trenches and excavations. c. Explain the term "proximity work."
3. Discuss and display appropriate safety precautions to take around common jobsite hazards. DOK 1 a. Explain the safety requirements for working in confined areas. b. Explain the different barriers and barricades and how they are used.
4. Demonstrate the appropriate use and care of personal protective equipment (PPE). DOK 1 a. Identify commonly used PPE items. b. Demonstrate proper use of PPE. c. Demonstrate appropriate care for PPE.
5. Explain fall protection and ladder, stair, and scaffold procedures and requirements. DOK 1 a. Explain the use of proper fall protection. b. Inspect and safely work with various ladders, stairs, and scaffolds.
6. Explain the safety data sheet (SDS). DOK 1 a. Explain the function of the SDS. b. Interpret the requirements of the SDS. c. Discuss hazardous material exposures.
7. Discuss and display appropriate safety procedures related to fires. DOK 1 a. Explain the process by which fires start. b. Explain fire prevention of various flammable liquids. c. Explain the classes of fire and the types of extinguishers. d. Illustrate the proper steps to follow when using a fire extinguisher. e. Demonstrate the proper techniques for putting out a fire.
8. Explain safety in and around electrical situations. DOK 1 a. Explain the injuries that can result when electrical contact occurs. b. Explain safety around electrical hazards. c. Explain the actions to take when an electrical shock occurs.
Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Unit 6: Introduction to Construction Math

Competencies and Suggested Objectives
1. Apply the four basic math skills using whole numbers, fractions, decimals, and percentages, both with and without a calculator. DOK 2 a. Define basic geometric shapes used in the construction industry. b. Add, subtract, multiply, and divide whole numbers, decimals, and fractions with and without a calculator. c. Convert whole numbers to fractions and convert fractions to whole numbers. d. Convert decimals to percentages and convert percentages to decimals. e. Convert fractions to decimals. f. Convert fractions to percentages. g. Demonstrate reading a standard and metric ruler and tape measure. h. Recognize and use metric units of length, weight, volume, and temperature.

Unit 7: Hand Tools

Competencies and Suggested Objectives
1. Demonstrate the use and maintenance of hand tools. DOK 2 a. Identify, visually inspect, and discuss the safe use of common hand tools. b. Discuss safety rules. c. Select and demonstrate the use of hand tools. d. Explain the procedures for maintenance.

Unit 8: Power Tools

Competencies and Suggested Objectives
1. Demonstrate the use and maintenance of power tools. DOK 2 a. Identify, visually inspect, and discuss the safe use of common power tools. b. Discuss safety rules. c. Select and demonstrate the use of power tools. d. Explain the procedures for maintenance.

Unit 9: Construction Drawings

Competencies and Suggested Objectives
1. Read, analyze, and interpret basic components of a drawing. DOK 3 a. Recognize and identify terms, components, and symbols commonly used on drawings. b. Relate information on construction drawings to actual locations on the drawings. c. Recognize different types of drawings. d. Interpret and use drawing dimensions.

Unit 10: Materials Handling

Competencies and Suggested Objectives
1. Safely handle and store materials. DOK 1 a. Define a load. b. Establish a pre-task plan prior to moving a load. c. Demonstrate proper materials-handling techniques. d. Choose the appropriate materials-handling equipment for a task. e. Recognize hazards and follow safety procedures required for materials handling. f. Identify and demonstrate commonly used knots.

Unit 11: Rigging and Signaling

Competencies and Suggested Objectives
1. Identify and explain safe rigging practices, load distribution, hand signals, and rigging equipment. DOK2 a. Identify, describe the uses of, inspect, and maintain common rigging hardware and equipment, including: • Jacks • Block and tackles • Chain hoists • Come-alongs b. Tie knots used in rigging. c. Identify basic rigging and crane safety procedures and use the correct hand signals to guide a crane operator.

Unit 12: Fabrication

Competencies and Suggested Objectives
1. Demonstrate proper safety procedures used in fabrication and fabrication tools. DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day, including: • PPE • Tool use • Materials handling a. Demonstrate proper tool use and storage each class period. b. Demonstrate proper ergonomics and materials handling each class period. c. Demonstrate knowledge of chemical and electrical hazards and use the proper, safety procedures for each.
2. Demonstrate various shop math skills and the proper use of measurement tools in a fabrication scenario or project. DOK2 a. Demonstrate proper use of the following semi-precision measurement tools during fabrication: • Tape measure • Ruler or scale b. Demonstrate the following functional shop math skills during fabrication: • Addition • Subtraction • Multiplication • Division • Working with decimals c. Demonstrate proper use of the following precision measurement tools during fabrication: • Calipers • Micrometers
3. Analyze and use print plans to perform fabrication skills. DOK2 a. Analyze different print plans and compare various elements of a standard title block. b. Analyze different print plans and compare and justify various scales used. c. Analyze different print plans and compare and justify the use of various view types, including top, left, right, and orthographic. d. Analyze different print plans, compare line types (from the Association of Mechanical Engineers' Alphabet of Lines) used, and report on the following most common uses: • Construction • Visible/object • Hidden

- Center
- Dimension
- Extension
- Phantom
- Long break
- Cutting plane
- Section
- Chain

e. Analyze different print plans, develop a chart of the different types of labels seen, and compare with those of other classmates.

Unit 13: Welding and Cutting

Competencies and Suggested Objectives
2. Identify basic welding concepts and demonstrate safety procedures and proper welding technique. DOK2 a. Identify the different types of welding and cutting and create a chart of uses according to industry applications. b. Identify the different types (i.e., approaches/techniques) of welds and cuts and create a chart of uses according to industry applications. c. Participate in an instructor-led review of welding procedures and safety. d. Demonstrate emergency procedures under simulated conditions. e. Demonstrate repeated safe and proper welding technique under the supervision of the instructor.
3. Demonstrate safe and proper procedures when welding and cutting. DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day, including: • PPE • Tool use • Materials handling b. Demonstrate proper tool/equipment use and storage each class period. c. Demonstrate proper ergonomics and materials handling each class period. d. Demonstrate knowledge of chemical and electrical hazards and use proper, safe procedures for each.
4. Demonstrate functional shop math in a welding and cutting project or scenario. DOK2 a. Use and solve problems in real-world applications involving fractions, angles, squareness, and/or parallelism.
5. Use and read print specifications to demonstrate various welding and cutting skills in a project or scenario. DOK2 a. Demonstrate the following welding and cutting skills: • Part fit • Measurements • Material selection and handling • Proper welding techniques
6. Demonstrate proper logistics procedures in a welding and cutting project or scenario. DOK2 a. Demonstrate how to obtain materials, equipment, and hot work permits and define a workspace.
7. Demonstrate budget planning and accounting in a welding and cutting project scenario, ensuring the consideration and application of component and labor costs. DOK2

8. Explore various careers in welding and cutting. DOK1 a. Research various welding careers among two different industries or companies, making sure to include information on certifications and salaries.
9. Demonstrate appropriate habits of work in a welding and cutting project or scenario. DOK2 a. Demonstrate the following habits of work in this project and throughout the class: • On-time project completion • Attendance • Punctuality • Cooperation • Initiative

Unit 14: Basic Assembly

Competencies and Suggested Objectives
1. Identify safety concerns associated with assembly and demonstrate proper procedures to ensure safety during assembly. DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day, including: • PPE • Tool use • Materials handling b. Demonstrate proper tool use and storage each class period. c. Demonstrate proper ergonomics and materials handling each class period. d. Demonstrate knowledge of chemical and electrical hazards and use proper, safe procedures for each. e. Review safety concerns associated with assembly in advanced manufacturing (i.e., the fatal four: caught in between, falls, electrocution, struck by an object).
2. Identify, describe, and practice standardized work in advanced manufacturing. DOK2 a. Examine standardized work in advanced manufacturing. b. Identify the purpose of standardized work in advanced manufacturing. c. Perform a standardized work activity to create a product.
3. Demonstrate various shop math skills and the proper use of measurement tools in an assembly scenario or project. DOK2 a. Demonstrate proper use of the following semi-precision measurement tools: • Tape measure • Ruler or scale b. Demonstrate the following functional shop math skills during assembly: • Addition • Subtraction • Multiplication • Division • Working with decimals c. Demonstrate proper use of the following precision measurement tools during assembly: • Calipers • Micrometers

4. Identify and describe basic elements of print plans for assembly. DOK1
    a. Identify the following basic elements and technical specifications in print or digital form:
        - Title block
        - Scale
        - Line type and weight
        - Keys/legends and labels
        - Measurements
        - Information relevant for an assembly project

5. Demonstrate appropriate, efficient teamwork and team problem-solving skills during the assembly project scenario according the associated rubric. DOK3
    a. In student groups, develop an organizational or task chart connecting to the assembly project rubric, detailing team member accountability.
    b. Research proven models to develop a conflict resolution plan for each team and use as needed during the assembly project.
    c. Identify and explain appropriate workflow and production rates for the assembly project.

6. Explore various careers in assembly. DOK1
    a. Compare and contrast assembly careers among two different industries or companies.
    b. Examine career trends in assembly.

Unit 15: Safety Review and Orientation

Competencies and Suggested Objectives
1. Describe local program and center policies and procedures. DOK2 a. Describe local program and career center policies and procedures.
2. Explore leadership skills and personal development opportunities provided for students by student organizations. DOK2 a. Demonstrate effective team-building and leadership skills. b. Demonstrate, through practice, appropriate work ethics.
3. Participate in an advanced manufacturing orientation. DOK2 a. Describe the types of work performed by advanced manufacturing craftworkers. b. Identify career opportunities available to advanced manufacturing craftworkers. c. Explain the purpose and objectives of an apprentice training program. d. Explain the responsibilities and characteristics of a good advanced manufacturing craftworker. e. Explain the importance of safety in relation to advanced manufacturing craftworkers.
4. Describe general safety rules for working in a shop/lab and industry. DOK2 a. Discuss safety issues and prevention associated with the advanced manufacturing shop area. b. Explain fire safety and prevention in the workplace.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.

Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 16: Precision Measurement

Competencies and Suggested Objectives
1. Demonstrate proper procedures to ensure safety during precision measurement. DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day, including: • PPE • Tool use • Materials handling b. Hold an instructor- or student-led safety equipment review focusing on PPE. c. Demonstrate proper tool/equipment use and storage each class period. d. Demonstrate proper ergonomics and materials handling each class period.
2. Demonstrate functional shop math skills in a precision measurement scenario. DOK2 a. Add, subtract, multiply, and divide for imperial, metric, and international system (SI) units, making sure to include fractions and decimals.
3. Demonstrate proper use of various precision measurement tools in a project or industry simulation scenario. DOK2 a. Measure samples according to needed precision level. • Semi-precision—scales, rulers, tape measures • Precision—calipers, micrometers b. Convert measured samples from SI to imperial.
4. Demonstrate appropriate, efficient teamwork and team problem-solving skills during the precision measurement project scenario. DOK3 a. In student groups, develop an organizational or task chart connecting to the assembly project rubric, detailing team member accountability. b. Develop a system that accounts for quality using a two-person (e.g., one checks, one verifies) approach. c. Research proven models to develop a conflict resolution plan for each team and use as needed during the precision measurement project.
5. Read, interpret, and create print plans to assemble and communicate information about a specific part. DOK3 a. Read prints in order to verify measurements of various parts. b. Develop basic print elements after performing precision measurements. c. Assemble a designated part, selecting components according to print documents. d. Use specific, written terminology to describe the component above, making sure to include precision measurements, conversions, and the procedure used to assemble it.

6. Explore various careers that utilize precision measurement. DOK1 a. Examine careers in quality control (e.g., technicians, engineers, etc.).
7. Demonstrate appropriate habits of work throughout precision measurement projects or scenarios. DOK2 a. Practice key qualities for precision measurement (e.g., detail oriented, dependable, etc.). b. Discuss the "snowball" effect on cost at different stages of mistakes (e.g., A mistake in CAD could cost pennies, which means the prototype would have a mistake that costs cents, then the line could have a mistake that costs many dollars, resulting in a final product for the end user with a mistake that could be very expensive).

Unit 17: Circuits and Electronics

Competencies and Suggested Objectives
1. Demonstrate proper procedures to ensure safety when working with circuits and electronics. DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day, including: a. Arc flash b. Don't touch wires c. Lockout/tagout b. Hold an instructor- or student-led electrical safety and equipment review focusing on PPE. c. Demonstrate proper tool/equipment use and storage each class period. d. Demonstrate proper ergonomics and materials handling each class period. e. Demonstrate knowledge of electrical hazards and use proper, safe procedures for each.
2. Demonstrate functional shop math skills in a project/scenario(s) involving circuits and/or electronics. DOK2 a. Solve problems using current/voltage calculations and give precise answers using decimals.
3. Read, interpret, and use print plans in a project or scenario to demonstrate print reading skills with circuits and electronics, including component identification, placement, and current paths. DOK3
4. Demonstrate knowledge and skills associated with circuit, electronic, and basic electrical theory and applications. DOK2 a. Identify, describe, and use series, parallel, and combination circuits. b. Distinguish between direct and alternating voltage and use each in various scenarios. c. Describe the difference between single-phase and three-phase circuits in industrial settings. d. Explore and practice the techniques for electrical fabrication such as wire stripping and assembly of circuits, switches/input devices, and loads/output devices.
5. Explore Ohm's law in a project or scenario, specifically investigating power, voltage, current, resistance, and Kirchhoff's law of current flow. DOK2
6. Explore magnetic relays and logic. DOK1 a. Explain what relays are and what they are used for. b. Examine relay logic use and define characteristics, including AND, OR, NOT, NOR, NAND, and memory.

7. Discuss basic aspects of motor controls. DOK1 a. Explain how electric motors operate. b. Explain how push-buttons are used in automated equipment. c. Examine and explain circuits using a start push button, stop push button, and magnetic relay (hands-on, simulated, or online examples can be utilized).
8. Explore various careers that utilize electronic systems as part of their day-to-day operations (e.g. maintenance, design, hazards, etc.). DOK1
10. Demonstrate professional habits of work, including proper attendance, punctuality, conformance to rules, and teamwork. DOK2

Unit 18: Hydraulics and Pneumatics

Competencies and Suggested Objectives
1. Demonstrate proper procedures to ensure safety when working with hydraulics and pneumatics. DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day, including: • Embolism • High pressure • Pinch points • Compressed gases • Flying debris b. Hold an instructor- or student-led safety equipment review focusing on PPE. c. Demonstrate proper tool/equipment use and storage each class period. d. Demonstrate proper ergonomics and materials handling each class period. e. Demonstrate knowledge of hazards and use proper, safe procedures where applicable.
2. Research and discuss basic aspects of hydraulics and pneumatics in advanced manufacturing. DOK1 a. Identify common measurements associated with hydraulics and pneumatics. b. Investigate how hydraulics are used in advanced manufacturing. c. Investigate how pneumatics are used in advanced manufacturing. d. Examine a hydraulic/pneumatic circuit that will extend a cylinder using a valve.

Unit 19: Programmable Logic Controllers

Competencies and Suggested Objectives
1. Demonstrate proper procedures to ensure safety when working with programmable logic controllers (PLCs). DOK2 a. Hold an instructor- or student-led team safety meeting to review expectations and develop a strategy for the day. b. Hold an instructor- or student-led safety equipment review focusing on PPE. c. Demonstrate proper tool/equipment use and storage each class period. d. Demonstrate proper ergonomics and materials handling each class period. e. Demonstrate knowledge of hazards and use proper, safe procedures where applicable.
2. Research and discuss basic concepts of PLCs, including terminology, uses in advanced manufacturing, and careers that utilize PLCs. DOK1 a. Explore PLCs and common terminology associated with PLCs. b. Identify and investigate how PLCs are utilized in advanced manufacturing. c. Examine careers using PLCs.

Unit 20: Robotics and Automation

Competencies and Suggested Objectives
1. Research and discuss the use of robotics in advanced manufacturing. DOK1 a. Identify reasons for the use of robotics in advanced manufacturing. b. Explain how geometric measurement is used by the robot to calculate geometric position in a three-dimensional space. c. Explain how user-frames and tool-frames are used by the robot to perform tool handling programming. d. Identify the layout of the robot cell layout. e. Identify safety and danger zones around the robot using a robot cell layout.
2. Demonstrate functional shop math skills in a project/scenario(s) involving robotics and automation. DOK2 a. Measure linear distance using millimeters. b. Convert millimeters to inches and inches to millimeters.
3. Examine robotic tool handling/motion control. DOK2 a. Identity the parts of the robot arm and controller. b. Explore the process for programming robots for manufacturing.

Unit 21: Advanced Assembly

Competencies and Suggested Objectives
1. Investigate alternative manufacturing processes such as additive manufacturing (e.g., 3D printing), extrusions, injection molding, and CNC manufacturing. DOK3 a. Create a 3D model or print to utilize in the assembly of parts. b. Produce assembly parts utilizing 3D printing, injection molding, extrusions, or CNC manufacturing.
2. Complete an assembly project with various elements of advanced manufacturing utilized throughout the entire course. DOK3 a. Include at least the following skills in the project: • Hand and power tools • Precision measurement • Fabrication • Assembly • Communication skills and teamwork • Flexibility • Materials handling

Unit 22: Workforce Readiness

Competencies and Suggested Objectives
1. Research and demonstrate workforce readiness for advanced manufacturing jobs. DOK2 a. Create a résumé in accordance with manufacturing industry standards. b. Demonstrate adequate interview skills in a real or simulated interview (virtual and/or face-to-face). c. Research employer expectations of multiple companies and see how they align to other manufacturing industries. d. Demonstrate adequate money management and personal finance skills. e. Gather industry professional references and record interactions. f. Explain workplace flexibility from both the employer and employee point of view. g. Demonstrate excellent communication skills (i.e., verbal, written, and digital). h. Exhibit high-quality habits of work (i.e., professionalism), including integrity, work ethic, and dependability.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Orientation		
	1.	Describe local program and center expectations, policies, and procedures.
	2.	Research and discuss work-based learning (WBL) opportunities related to the program area.
Unit 2: Employability Skills		
	1.	Describe employment opportunities in the manufacturing industry.
	2.	Examine the Mississippi Department of Employment Security (MDES) website and its applications relating to employment opportunities.
	3.	Demonstrate appropriate interviewing skills.
	4.	Describe basic employee responsibilities and appropriate work ethics.
Unit 3: Fundamentals of Student Organizations		
	1.	Discuss the history, mission, and purpose of career and technical student organizations (CTSO) – SkillsUSA and the Technology Student Association (TSA).
	2.	Explore the advantages of membership in a student organization.
	3.	Discuss the organization's brand resources.
	4.	Describe the importance of effective communication skills.
	5.	Apply leadership skills and 21st century skills to class- and work-related situations.
	6.	Utilize team-building skills in class- and work-related situations.
	7.	Discuss the various competitions offered through the program area's CTSOs.
Unit 4: Communication Skills		
	1.	Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
	2.	Discuss the importance of good listening skills in on-the-job situations.

Unit 5: Basic Safety		
	1.	Describe, define, and illustrate general safety rules for working in a shop/lab and how they relate to the manufacturing industry.
	2.	Identify and apply safety practices around welding operations.
	3.	Discuss and display appropriate safety precautions to take around common jobsite hazards.
	4.	Demonstrate the appropriate use and care of personal protective equipment (PPE).
	5.	Explain fall protection and ladder, stair, and scaffold procedures and requirements.
	6.	Explain the safety data sheet (SDS).
	7.	Discuss and display appropriate safety procedures related to fires.
	8.	Explain safety in and around electrical situations.
Unit 6: Introduction to Construction Math		
	1.	Apply the four basic math skills using whole numbers, fractions, decimals, and percentages, both with and without a calculator.
Unit 7: Hand Tools		
	1.	Demonstrate the use and maintenance of hand tools.
Unit 8: Power Tools		
	1.	Demonstrate the use and maintenance of power tools.
Unit 9: Construction Drawings		
	1.	Read, analyze, and interpret basic components of a drawing.
Unit 10: Materials Handling		
	1.	Safely handle and store materials.
Unit 11: Rigging and Signaling		
	1.	Identify and explain safe rigging practices, load distribution, hand signals, and rigging equipment.
Unit 12: Fabrication		
	1.	Demonstrate proper safety procedures used in fabrication and fabrication tools.
	2.	Demonstrate various shop math skills and the proper use of measurement tools in a fabrication scenario or project.
	3.	Analyze and use print plans to perform fabrication skills.
Unit 13: Welding and Cutting		
	1.	Identify basic welding concepts and demonstrate safety procedures and proper welding technique.
	2.	Demonstrate safe and proper procedures when welding and cutting.
	3.	Demonstrate functional shop math in a welding and cutting project or scenario.
	4.	Use and read print specifications to demonstrate various welding and cutting skills in a project or scenario.

	5.	Demonstrate proper logistics procedures in a welding and cutting project or scenario.
	6.	Demonstrate budget planning and accounting in a welding and cutting project scenario, ensuring the consideration and application of component and labor costs.
	7.	Explore various careers in welding and cutting.
	8.	Demonstrate appropriate habits of work in a welding and cutting project or scenario.
Unit 14: Basic Assembly		
	1.	Identify safety concerns associated with assembly and demonstrate proper procedures to ensure safety during assembly.
	2.	Identify, describe, and practice standardized work in advanced manufacturing.
	3.	Demonstrate various shop math skills and the proper use of measurement tools in an assembly scenario or project.
	4.	Identify and describe basic elements of print plans for assembly.
	5.	Demonstrate appropriate, efficient teamwork and team problem-solving skills during the assembly project scenario according the associated rubric.
	6.	Explore various careers in assembly.
Unit 15: Safety Review and Orientation		
	1.	Describe local program and center policies and procedures.
	2.	Explore leadership skills and personal development opportunities provided for students by student organizations.
	3.	Participate in an advanced manufacturing orientation.
	4.	Describe general safety rules for working in a shop/lab and industry.
Unit 16: Precision Measurement		
	1.	Demonstrate proper procedures to ensure safety during precision measurement.
	2.	Demonstrate functional shop math skills in a precision measurement scenario.
	3.	Demonstrate proper use of various precision measurement tools in a project or industry simulation scenario.
	4.	Demonstrate appropriate, efficient teamwork and team problem-solving skills during the precision measurement project scenario.
	5.	Read, interpret, and create print plans to assemble and communicate information about a specific part.
	6.	Explore various careers that utilize precision measurement.
	7.	Demonstrate appropriate habits of work throughout precision measurement projects or scenarios.

Unit 17: Circuits and Electronics		
	1.	Demonstrate proper procedures to ensure safety when working with circuits and electronics.
	2.	Demonstrate functional shop math skills in a project/scenario(s) involving circuits and/or electronics.
	3.	Read, interpret, and use print plans in a project or scenario to demonstrate print reading skills with circuits and electronics, including component identification, placement, and current paths.
	4.	Demonstrate knowledge and skills associated with circuit, electronic, and basic electrical theory and applications.
	5.	Explore Ohm's law in a project or scenario, specifically investigating power, voltage, current, resistance, and Kirchhoff's law of current flow.
	6.	Explore magnetic relays and logic.
	7.	Discuss basic aspects of motor controls.
	8.	Explore various careers that utilize electronic systems as part of their day-to-day operations (e.g. maintenance, design, hazards, etc.).
	9.	Demonstrate professional habits of work, including proper attendance, punctuality, conformance to rules, and teamwork.
Unit 18: Hydraulics and Pneumatics		
	1.	Demonstrate proper procedures to ensure safety when working with hydraulics and pneumatics.
	2.	Research and discuss basic aspects of hydraulics and pneumatics in advanced manufacturing.
Unit 19: Programmable Logic Controllers		
	1.	Demonstrate proper procedures to ensure safety when working with programmable logic controllers (PLCs).
	2.	Research and discuss basic concepts of PLCs, including terminology, uses in advanced manufacturing, and careers that utilize PLCs.
Unit 20: Robotics and Automation		
	1.	Research and discuss the use of robotics in advanced manufacturing.
	2.	Demonstrate functional shop math skills in a project/scenario(s) involving robotics and automation.
	3.	Examine robotic tool handling/motion control.
Unit 21: Advanced Assembly		
	1.	Investigate alternative manufacturing processes such as additive manufacturing (e.g., 3D printing), extrusions, injection molding, and CNC manufacturing.
	2.	Complete an assembly project with various elements of advanced manufacturing utilized throughout the entire course.
Unit 22: Workforce Readiness		
	1.	Research and demonstrate workforce readiness for advanced manufacturing jobs.

Appendix A: Industry Standards

National Center for Construction Education and Research (NCCER) Core Standards

	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Standard																							
Core-BS						X																	
Core-CM							X																
Core-HT								X															
Core-PT									X														
Core-CD										X													
Core-BR												X											
Core-CS					X																		
Core-ES			X																				
Core-MH											X												

NCCER Core

Core-BS: Module 00101-15 Basic Safety
Core-CM: Module 00102-15 Introduction to Construction Math
Core-HT: Module 00103-15 Introduction to Hand Tools
Core-PT: Module 00104-15 Introduction to Power Tools
Core-CD: Module 00105-15 Introduction to Construction Drawing
Core-BR: Module 00106-15 Introduction to Basic Rigging
Core-CS: Module 00107-15 Basic Communication Skills
Core-ES: Module 00108-15 Basic Employability Skills
Core-MH: Module 00109-15 Introduction to Materials Handling