2024 Metal Fabrication

Program CIP: 48.0511 Metal Fabricator

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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. Ray Morgigno, interim state superintendent of education, executive secretary
Mr. Glen V. East, chair
Mr. Matt Miller, vice chair
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Mr. Bill Jacobs
Mr. Mike Pruitt
Mrs. Mary Werner
Dr. Wendi Barrett
Mr. Charlie Frugé, student representative
Ms. Kate Riddle, 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 Metal Fabrication technology is aligned to the following standards:

National Center for Construction Education and Research (NCCER) Learning Series Welding Standards
The NCCER developed and published a set of industry standards that are taught nationwide by contractors, associations, construction/manufacturing users, and secondary and postsecondary schools called the NCCER learning series. When developing this set of standards, the NCCER assembled a team of subject matter experts who represented manufacturing companies and schools across the nation. Each committee met several times and combined experts' knowledge and experience to finalize the set of national industry standards.

As a part of the accreditation process, all Mississippi manufacturing instructors must complete the Instructor Certification Training Program successfully. This program ensures that instructors possess a deep knowledge of the content of the standards.

National Institute for Metalworking Skills (NIMS) Standards
Districts will be required to complete a self-evaluation of all programs and host a site visit from industry to ensure proper lab, safety, and instructional procedures are in place. The NIMS is a nationally recognized nonprofit organization that was established in 1995 to help develop industry standards to maintain the United States' global competitiveness. The NIMS sets industry standards and certifies individuals who meet the quality requirements contained in the industry standards. The NIMS also accredits training programs and facilities that meet its quality requirements. The NIMS organization and standards are accredited by the American National Standards Institute (ANSI) in the metalworking field.

The NIMS metalworking standards reflect expertise in areas such as stamping, press brake, roll forming, machining, tool-and-die making, mold making, screw machining, and machine maintenance and repair. All NIMS standards are industry-written, industry-validated, and subjected to periodic reviews under the procedures accredited and audited by the ANSI.

International Society for Technology in Education Standards (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 required by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS)

to provide a consistent, clear understanding of what students are expected to learn 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, 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 or helpdesk@rcu.msstate.edu.

Executive Summary

Pathway Description
The Metal Fabrication pathway is designed as a secondary program for preparation to enter the field of metalworking. The metal fabrication program includes an introduction to the basic machining and metalworking processes and the basic welding profession. The course aims to prepare students to continue studying in a postsecondary metals program (welding or machine tool operation) or to begin entry-level work in a metal fabrication occupation. The machining units in this curriculum are written to the NIMS credentialing standards, and the welding units are written to the NCCER certification standards.

College, Career, and Certifications
NIMS—Level I
NCCER Learning Series—Welding Standards Level 1

Grade Level and Class Size Recommendations
It is recommended that students enter this program as sophomores. Exceptions to this are a district-level decision based on class size, enrollment numbers, student maturity, and CTE delivery method. This is a hands-on, lab- or shop-based course. Therefore, a maximum of 15 students is recommended per class, with only one class with the teacher at a time.

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.

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 or helpdesk@rcu.msstate.edu.

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. **Fundamentals of Metal Fabrication—Course Code: 993208**
2. **Application of Metal Fabrication—Course Code: 993209**
3. **Theory of Metal Fabrication—Course Code: 993210**
4. **Advanced Skills of Metal Fabrication—Course Code: 993211**

Course Description: Fundamentals of Metal Fabrication
Fundamentals of Metal Fabrication includes an introduction to the field and the fundamentals of safety, tools, math, blueprint reading, and milling machinery.

Course Description: Application of Metal Fabrication
Application of Metal Fabrication emphasizes an overview of safety and leadership, lathe theory, and grinding operations. This course gives students real-world, hands-on practice in these areas. This course should only be taken after students successfully pass the Fundamentals of Metal Fabrication.

Course Description: Theory of Metal Fabrication
Theory of Metal Fabrication includes a study of precision machining techniques and reinforces safety related to the manufacturing industry. This course should only be taken after students successfully pass Application of Metal Fabrication.

Course Description: Advanced Skills of Metal Fabrication
Advanced Skills of Metal Fabrication include a study of basic oxyfuel cutting, plasma arc cutting, gas metal arc, and flux core arc. It also serves as an introduction to gas tungsten arc and shielded metal arc welding. This course also reinforces safety related to the manufacturing industry and should only be taken after students successfully pass the Theory of Metal Fabrication.

Fundamentals of Metal Fabrication—Course Code: 993208

Unit	Unit Name	Hours
1	Orientation	3
2	Fundamentals of Student Organizations	4
3	Employability Skills	7
4	Communication Skills	7
5	Basic Safety	20
6	Introduction to Construction Math	20
7	Hand Tools	12
8	Power Tools	12
9	Introduction to Construction Drawing	15
10	Introduction to Materials Handling	7
11	Introduction to Welding	33
Total		**140**

Application of Metal Fabrication—Course Code: 993209

Unit	Unit Name	Hours
12	Lathe Theory and Operation	60
13	Milling Machine Theory and Operation	30
14	Drill Press and Band Saw Theory and Operation	20
15	Introduction to Measurement, Materials, and Safety	30
Total		**140**

Theory of Metal Fabrication—Course Code: 993210

Unit	Unit Name	Hours
16	Orientation, Advanced Leadership, and Employability Skills	7
17	Basic Safety (Review and Reinforcement)	7
18	Advanced Lathe Operation	60
19	Advanced Milling Operation	40
20	Introduction to Shielded Metal Arc Welding (SMAW)	26
Total		**140**

Advanced Skills of Metal Fabrication—Course Code: 993211

Unit	Unit Name	Hours
21	Advanced Measurement, Materials, and Safety	30
22	Shielded Metal Arc Welding (SMAW)	20
23	Gas Metal Arc Welding (GMAW) and Flux Core Arc Welding (FCAW)	30
24	Introduction to Gas Tungsten Arc Welding (GTAW)	20
25	Basic Oxy-Fuel Cutting and Plasma Arc Cutting (PAC)	20
26	Grinding Theory and Operation	10
27	Computerized Numerical Control	10
Total		**140**

Option 2—Two 2-Carnegie Unit Courses

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

1. **Metal Fabrication I—Course Code: 993206**
2. **Metal Fabrication II—Course Code: 993207**

Course Description: Metal Fabrication I
Metal Fabrication I content includes orientation and leadership, basic safety, math, measuring tools and instruments, blueprints, hand and power tools, lathe theory and operation, milling machine theory and operation, drill press and band saw, and introduction to welding. Safety is emphasized in each unit and every activity.

Course Description: Metal Fabrication II
Metal Fabrication II includes grinding theory and operations, advanced precision machining techniques, and an emphasis on welding processes. Welding topics include employability skills, safety, basic oxy-fuel cutting, PAC, GMAW, FCAW, GTAW, and SMAW. The course should be taken after the student has successfully passed Fabrication I.

Metal Fabrication I—Course Code: 993206

Unit	Unit Name	Hours
1	Orientation	3
2	Fundamentals of Student Organizations	4
3	Employability Skills	7
4	Communication Skills	7
5	Basic Safety	20
6	Introduction to Construction Math	20
7	Hand Tools	12
8	Power Tools	12
9	Introduction to Construction Drawing	15
10	Introduction to Materials Handling	7
11	Introduction to Welding	33
12	Lathe Theory and Operation	60
13	Milling Machine Theory and Operation	30
14	Drill Press and Band Saw Theory and Operation	20
15	Introduction to Measurement, Materials, and Safety	30
Total		**280**

Metal Fabrication II—Course Code: 993207

Unit	Unit Name	Hours
16	Orientation, Advanced Leadership, and Employability Skills	7
17	Basic Safety (Review and Reinforcement)	7
18	Advanced Lathe Operation	60
19	Advanced Milling Operation	40
20	Introduction to Shielded Metal Arc Welding (SMAW)	26
21	Advanced Measurement, Materials, and Safety	30
22	Shielded Metal Arc Welding (SMAW)	20
23	Gas Metal Arc Welding (GMAW) and Flux Core Arc Welding (FCAW)	30
24	Introduction to Gas Tungsten Arc Welding (GTAW)	20
25	Basic Oxy-Fuel Cutting and Plasma Arc Cutting (PAC)	20
26	Grinding Theory and Operation	10
27	Computerized Numerical Control	10
Total		**280**

Career Pathway Outlook

Overview

The Metal Fabrication curriculum is designed to prepare students for entry-level employment. Students enrolled in this course will complete a study of basic safety, student organizations, communication, and employability skills. This pathway covers the broad field of occupations related to setting up and operating fabricating machines to cut, bend, and straighten sheet metal. There is also a focus on shaping metal over anvils, blocks, or forms using hammers and operating soldering and welding equipment to join sheet metal parts. Additionally, inspecting, assembling, and smoothing seams and joints of burred surfaces are explored in this pathway. Students will design shop drawings with high accuracy within each measurement. Fabrication and installation of final assemblies are completed with the utmost care while following safety procedures. Various raw metal materials are utilized, including plate metals, expanded metals, welding wires, and rods, and even cast metals. Employment in this career path is spread across a variety of categories: specialty trade contractors (59%), manufacturing (23%), government-related (6%), and building construction (3%), to name a few. A shortlist of careers that this pathway contains positions like cutting, punching, and press machine setters and operators; first-line supervisors; machinists; team assemblers; welders, cutters, solderers, and brazers; mechanical fitters, sheet metal mechanics; metalworking specialists; welders; shipwrights; and mold technicians. Fabricators work in either machine shops or designated metal fabrication shops.

Most careers related to this pathway require at least a high school diploma or equivalent, although careers with the highest earning potential—plating and laser engineers and postsecondary teaching positions, for example—usually require advanced degrees. According to the U. S. Bureau of Labor Statistics, two out of three of those who work in the metalworking machinery manufacturing job sector have a high school diploma or GED equivalent. More than one out of every six individuals has received a bachelor's degree. One out of 10 has received a postsecondary nondegree award.

Needs of the Future Workforce

According to the U. S. Bureau of Labor Statistics, over 1.4 million workers employed in metal fabrication and related fields, such as welders, cutters, solderers, and brazers, are projected to grow 2 percent from 2021 to 2031. The metal fabrication global market is expected to reach over 29 billion dollars by 2029, registering a growth rate of 4.7% over this decade. Also, over the course of this decade, the average employment growth total is projected to increase by 9.5% for all general occupations in Mississippi combined. The data in Table 1.1 below, including the average hourly earnings, was compiled from the Mississippi Department of Employment Security in 2022.

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2020	Projected Jobs, 2030	Change (Number)	Change (Percent)	Average Hourly Earnings, Year
Structural Iron and Steel Workers	640	650	10	1.6%	$20.41, 2022
Rolling Machine Setters, Operators, and Tenders—Metal and Plastic	430	430	0	0.0%	$14.97, 2022
Machinists	2,880	3,040	160	5.6%	$19.88, 2022
Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders	40	50	10	25.0%	$12.56, 2022
Sheet Metal Workers	1,510	1,570	60	4.0%	$21.86, 2022
Metal-Refining Furnace Operators and Tenders	180	190	10	5.6%	$17.20, 2022
Pourers and Casters, Metal	50	50	0	0.0%	$16.65, 2022
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	520	530	10	1.9	$16.42, 2022
Tool Grinders, Filers, and Sharpeners	50	50	0	0.0%	$16.99, 2022
Welders, Cutters, Solderers, and Brazers	6,370	6,830	460	7.2%	$22.43, 2022

Source: Mississippi Department of Employment Security; mdes.ms.gov (2022).

Perkins V Requirements and Academic Infusion

The Metal Fabrication curriculum meets Perkins V's requirements of introducing students to and preparing them for high-skill, high-wage occupations in metal fabrication fields. It also offers students a program of study, including secondary and postsecondary education, and institutions of higher learning courses that will further prepare them for metal fabrication careers. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers and 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 metal fabrication educator's goal should include teaching strategies incorporating 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 opportunities 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 metal fabrication curriculum. SkillsUSA is an example of a student organization with many outlets for construction. 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 metal fabrication curriculum for group work. Students need to be able to work collaboratively with others and solve problems without excessive conflict to function in today's workforce. The metal fabrication curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the metal fabrication curriculum that will allow and encourage collaboration with professionals currently in the metal fabrication field.

Work-Based Learning

Work-based learning is an extension of understanding competencies taught in the metal fabrication 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 electrical professionals. Thus, supervised collaboration and immersion into the manufacturing industry around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

Association for Career and Technical Education (ACTE)
acteonline.org

National Center for Construction Education and Research (NCCER)
nccer.org/

The National Institute for Metalworking Skills (NIMS)
nims-skills.org/contact-us

Skills USA – Mississippi
mdek12.org/CTE/SO/SkillsUSA

SkillsUSA – National
skillsusa.org/

Using This Document

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
All teachers should request to be added to the Canvas Resource Guide for their course. For questions or to 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
Some of the units may include an enrichment section at the end. This material will greatly enhance the learning experiences for students. If the Metal Fabrication program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be assessed on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Orientation

Competencies and Suggested Objectives
1. Describe local program and center expectations, policies, and procedures. DOK1 a. Describe local program and career center policies and procedures, including dress code, attendance, academic requirements, discipline, shop or lab rules and regulations, and transportation regulations. b. Give a brief overview of the course. Explain to students what metal fabrication 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. Relate work-based learning opportunities to program areas. DOK1 a. Define work-based learning. b. Explore the opportunities available through the program areas: • Work-based learning • Job shadowing • Apprenticeship programs • On-the-job training • Etc.

Unit 2: Fundamentals of Student Organizations

Competencies and Suggested Objectives
1. Discuss the history, mission, and purpose of student organizations, including SkillsUSA. DOK1 a. Trace the history of the program area's student organization. b. Identify the mission, purpose, and/or goals of the program area's student organization.
2. Explore the advantages of membership in a student organization. DOK1 a. Discuss the membership process for the program area's student organization. b. Explain the activities related to the local chapter and the state and national organizations.
3. Discuss the organizations' brand resources. DOK1 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. DOK1 a. Demonstrate verbal and nonverbal communication skills. b. Apply appropriate speaking and listening skills to class- and work-related situations.
5. Apply leadership skills to class- and work-related situations and 21st Century Skills. DOK2 a. Define leadership. b. Discuss the attributes of a leader. c. Identify the roles a leader can assume.
6. Utilize teambuilding skills in class- and work-related situations. DOK2 a. Define teambuilding. 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 student organization. DOK1 a. Describe each competition 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 3: Employability Skills

Competencies and Suggested Objectives
1. Describe employment opportunities in the construction industry. DOK1 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 website and its applications relating to employment opportunities. DOK1 a. Perform various searches through the MDES website, such as: • Number of jobs available for a specific area of expertise • Hourly wage • Percent of jobs in the county • Percent of jobs in the state
3. Demonstrate appropriate interview skills. DOK1 a. Identify interview skills, such as speaking, dress, professionalism, and punctuality. b. Simulate a job interview.
4. Describe basic employee responsibilities and appropriate work ethics. DOK1 a. Compare and contrast employment responsibilities and expectations to local school and program policies and expectations. b. Define effective relationship skills and workplace issues, including but not limited to sexual harassment, stress, and substance abuse.

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. DOK2 a. Follow basic written and verbal instructions. b. Effectively communicate in on-the-job situations using verbal, written, or electronic communication. c. Demonstrate reading and writing requirements in on-the-job situations.
2. Discuss the importance of good listening skills in on-the-job situations. DOK2 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 construction industry. DOK2 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 the causes of accidents and the impact of accident costs. g. Compare and contrast shop and lab safety rules to industry safety rules.
2. Identify and practice safety around welding operations. DOK1 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. Display appropriate safety precautions to take around common job site hazards. DOK1 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). DOK1 a. Identify commonly used PPE items. b. Understand the proper use of PPE. c. Demonstrate appropriate care for PPE.
5. Explain fall protection, ladder, stair, and scaffold procedures and requirements. DOK1 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). DOK1 a. Explain the function of the SDS. b. Interpret the requirements of the SDS. c. Discuss hazardous material exposures.
7. Display appropriate safety procedures related to fires. DOK1 a. Explain the process by which fires start. b. Explain fire prevention for 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. DOK1 a. Explain injuries that can result when electrical contact occurs. b. Explain safety around electrical hazards. c. Explain action 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.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

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. DOK2 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.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 7: Hand Tools

Competencies and Suggested Objectives

1. Demonstrate the use and maintenance of hand tools. DOK2
   a. Identify, visually inspect, and discuss the safe use of common hand tools including:
      - Hammers
      - Demolition tools
      - Chisels and punches
      - Screwdrivers
      - Adjustable wrenches
      - Non-adjustable wrenches
      - Sockets
      - Pliers
      - Tape measures
      - Levels
      - Squares
      - Handsaws
      - Clamps
      - Files
      - Utility knives
      - Shovels
   b. Discuss safety rules.
   c. Select and demonstrate the use of hand tools.
   d. Explain the procedures for maintenance.

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

Unit 8: Power Tools

Competencies and Suggested Objectives
1. Demonstrate the use and maintenance of power tools. DOK2 a. Identify, visually inspect, and discuss the safe use of common power tools including: • Electric drill (corded or cordless) • Hammer drill • Impact driver • Circular saw • Jigsaw • Reciprocating saw • Portable band saw • Miter or cutoff saw • Table saw • Portable or bench grinder • Oscillating multi-tool • Power nailer b. Discuss safety rules. c. Select and demonstrate the use of power tools. d. Explain the procedures for maintenance.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 9: Introduction to Construction Drawings

Competencies and Suggested Objectives
1. Read, analyze, and understand basic components of a blueprint. DOK3 a. Recognize and identify terms, components, and symbols commonly used on blueprints. b. Relate information on construction drawings to actual locations on the print. c. Demonstrate the use of an engineer's and architect's scales. d. Recognize different types of drawings. e. Interpret and use drawing dimensions.

Unit 10: Introduction to Materials Handling

Competencies and Suggested Objectives
1. Safely handle and store materials. DOK1 a. Define a load. b. Establish a pre-task plan prior to moving a load. c. Demonstrate proper materials-handling techniques. d. Choose appropriate materials-handling equipment for the task. e. Recognize hazards and follow safety procedures required for materials handling. f. Identify and demonstrate commonly used knots.

Unit 11: Introduction to Welding

Competencies and Suggested Objectives
1. Identify and describe the basic equipment, setup, and safety rules for the proper use of equipment, and prepare the base metal for oxy-fuel cutting, SMAW, FCAW, and GMAW. DOK2 a. Identify and explain the use of equipment. b. Demonstrate how to properly use equipment. c. Perform setup and operation for each welding and cutting process.

Unit 12: Lathe Theory and Operation

Competencies and Suggested Objectives
1. Identify the parts, rules, and care of the metal lathe. DOK1 a. Identify the four major parts of the lathe. b. Set up a lathe and determine the rpm and feed rate according to the manufacturer's specifications for basic lathe operations. c. Explain the advantages and disadvantages of carbide-tip cutting tools and demonstrate how to freehand grind a high-speed steel (HSS) turning tool. d. Explain the turning of a piece of stock. e. Describe how to chuck a piece of stock. f. Describe facing, center drilling, filing, tapping, and cutoff.
2. Perform procedures for a machining operation. DOK2 a. Identify the terms and procedures for lathe operations. b. Discuss the rules of safety. c. Demonstrate centering a work piece in a four-jaw chuck on the lathe. d. Face a part to length. e. Perform a straight-turning operation. f. Perform a chamfer operation. g. Perform a center-drilling operation. h. Perform a knurling operation. i. Perform a cutoff operation. j. Tap a blind hole. k. Cut external and internal threads on the lathe. l. Complete a NIMS turning-chucking Level I project. m. Complete a NIMS turning between centers Level I project. n. Install a chuck on a lathe. o. Mount and align a part in a four-jaw chuck on a lathe to instructor's specifications. p. Turn a taper with a compound rest and a taper attachment. q. Perform a boring operation. r. Perform wet and dry cuts.

Unit 13: Milling Machine Theory and Operation

Competencies and Suggested Objectives
1. Differentiate between the types of milling machines. DOK1 a. Identify the different types of milling machines. b. Explain the use and safety of each type of milling machine.
2. Identify the parts, cutting tools, and basic maintenance of a vertical milling machine. DOK1 a. Identify the major parts of a horizontal and vertical mill. b. Identify the cutting tools used on a horizontal and vertical mill. c. Clean and lubricate a vertical mill following the manufacturer's specifications. d. Determine the rpm and feed rate.
3. Perform operations on a milling machine. DOK2 a. Perform operations on a vertical milling machine. b. Perform the end milling, side milling, slotting, drilling, reaming, boring, and fly cutting operations. c. Mount cutters and cutter holders. d. Mount and align a swivel vise. e. Mill a key seat, a given angle, and a straight boring operation.

Unit 14: Drill Press and Band Saw Theory and Operation

Competencies and Suggested Objectives
1. Identify and describe the safe operation of the types of power saws. DOK1 a. Identify and describe rules for the safe use of power saws. b. Describe the factors that determine saw blade selection. c. Describe the factors to consider in the care and cleaning of power saws. d. Lay out and cut stock with a band saw according to specifications.
2. Identify and describe the types of drilling machines, including hand powered and drill press, and the rules for safe operation of each. DOK2 a. Describe the safety rules for the safe use of a hand power drill and drill press. b. Identify work-holding and setup devices in drill press operations. c. Lay out holes and drill, ream, countersink, and counter bore according to project specifications.

Unit 15:Introduction to Measurement, Materials, and Safety

Competencies and Suggested Objectives
1. Demonstrate machining safety related to the National Institute for Metalworking Skills (NIMS). DOK2
2. Apply measurement systems and machining math related to NIMS. DOK3
3. Demonstrate the use of semi-precision measuring tools related to NIMS such as: DOK2 • Rules • Calipers • Angular measurement • Fixed gages
4. Demonstrate the use of precision measuring tools related to NIMS. DOK3 a. Discuss the care of precision measuring tools used in machining environment. b. Discuss the application of precision measuring tools.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 16: Orientation, Advanced Leadership, and Employability Skills

Competencies and Suggested Objectives
1. Describe local program and career and technical center policies and procedures. DOK1 a. Describe policies and procedures, including dress code, attendance, academic requirements, discipline, and transportation regulations.
2. Describe employment opportunities and responsibilities. DOK1 a. Describe employment opportunities, including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities. c. Design a résumé and complete a job application.
3. Research, design, and conduct a project that will apply the knowledge and skills learned in the manufacturing pathway course in a real-world, unpredictable environment. DOK3 a. Demonstrate effective team building and leadership skills. b. Explore leadership skills and personal development opportunities provided to students through student organizations such as SkillsUSA. c. Work as a team to design a community service project for which the knowledge and skills learned in the course can be used to improve the lives of others.
4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations. DOK2 a. Perform welding projects through written instruction. b. Perform welding projects through oral instruction.
Note: This unit is designed to provide review and reinforcement of content taught in year one of the program.

Unit 17: Basic Safety

Competencies and Suggested Objectives
1. Describe, define, and illustrate the general safety rules for working in a shop or lab and how they relate to the manufacturing industry. DOK2 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 the causes of accidents and the impact of accident costs. g. Compare and contrast shop and lab safety rules to industry safety rules.
2. Identify and practice safety around welding operations. DOK1 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. Display the appropriate safety precautions to take around common jobsite hazards. DOK1 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). DOK1 a. Identify commonly used PPE. b. Understand the proper use of PPE. c. Demonstrate the appropriate care for PPE.
5. Explain fall protection, ladder, stair, and scaffold procedures and requirements. DOK1 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). DOK1 a. Explain the function of the SDS. b. Interpret the requirements of the SDS. c. Discuss hazardous materials exposure.
7. Display the appropriate safety procedures related to fires. DOK1 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. DOK1 a. Explain 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 18: Advanced Lathe Operation

Competencies and Suggested Objectives
1. Describe the safety precautions, the methods for measuring thread pitch diameters, and the calculation of dimensions using taper formulas. DOK2 a. Describe safety precautions. b. Describe the methods for measuring thread pitch diameters. c. Calculate dimensions using taper formulas.
2. Perform various operations according to specifications. DOK2 a. Perform chamfer, recessing, and knurling; drill and recess a hole; align and start a tap using a lathe center; and practice cutoff. b. Perform turning a taper with a taper attachment, turning a taper with a compound, boring, cutting external threads to relief, picking up threads, and cutting internal threads.

Unit 19: Advanced Milling Operation

Competencies and Suggested Objectives
1. Explore vertical milling operations. DOK2 a. Describe and apply safety rules. b. Identify the types of milling machines and describe their major components. c. Identify work-holding devices, cutting tools, tool holders, and other attachments. d. Describe the different types of horizontal milling operations.
2. Mount and remove cutters and cutter holders, align a vise using a dial indicator, and perform selected vertical milling and boring operations. DOK2 a. Mount and remove cutters and cutter holders; mount and align a vise. b. Adjust speed and feed rates. c. Perform selected milling and boring operations according to specifications; align the head square to the table, perform a mill operation with head tilted to 45°, and complete dividing head operations. d. Clean and lubricate to the manufacturer's specifications.

Unit 20: Introduction to Shielded Metal Arc Welding (SMAW)

Competencies and Suggested Objectives
1. Identify and explain the safety, setup, weld cleanup, and maintenance of arc welding equipment. DOK2
2. Identify and use the procedures for joint fit-up and alignment. DOK1 a. Identify and explain job code specifications. b. Use fit-up gauges and measuring devices to check joint fit-up. c. Use plate fit-up tools to fit up joints. d. Identify and explain distortion and how it is controlled. e. Check for joint misalignment and poor fit-up.
3. Identify and explain filler metal and the selection of electrodes. DOK1 a. Identify and explain the AWS/ASME filler metal classification system. b. Explain the storage and control of filler metals. c. Identify the factors that affect electrode selection.

Unit 21: Advanced Measurement, Materials, and Safety

Competencies and Suggested Objectives
1. Identify, define, and discuss the following: DOK2 a. Quality assurance b. Process planning c. Quality control
2. Compare the composition and classification of ferrous and nonferrous metals. DOK2
3. Examine the equipment and processes used in the heat treatment of metals. DOK1
4. Demonstrate proper maintenance and use of lubrication and cutting fluids in the machining process. DOK2
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 22: Shielded Metal Arc Welding (SMAW)

Competencies and Suggested Objectives
1. Construct various welds using different positions and electrodes. DOK2 a. Weld pads in the flat, horizontal, vertical, and overhead positions. b. Make fillet welds in the flat position using E6010 and E7018 electrodes. c. Make fillet welds in the horizontal position using E6010 and E7018 electrodes. d. Make fillet welds in the vertical position using E6010 and E7018 electrodes. e. Make fillet welds in the overhead position using E6010 and E7018 electrodes.
2. Construct various advanced welds using different positions. DOK2 a. Weld plate, V-butt with backing, using E7018 electrodes in the flat position. b. Weld beads on a plate using E7018 electrodes in the horizontal position. c. Weld plate, V-butt with backing, using E7018 electrodes in the horizontal position. d. Weld beads on a plate using E7018 electrodes in the vertical position. e. Weld plate, V-butt with backing, using E7018 electrodes in the vertical position. f. Weld beads on a plate using E7018 electrodes in the overhead position. g. Weld plate, V-butt with backing, using E7018 electrodes in the overhead position.
3. Weld various plates using E6010/E6011 and E7018 electrodes in different positions. DOK2 a. Weld plate, open V-butt joint, using E6010/E6011 and E7018 electrodes in the flat position. b. Weld beads on a plate using E6010/E6011 and E7018 electrodes in the horizontal position. c. Weld plate, open V-butt joint, using E6010/E6011 and E7018 electrodes in the horizontal position. d. Weld beads on a plate using E6010/E6011 and E7018 electrodes in the vertical position. e. Weld plate, open V-butt-joint, using E6010/E6011 and E7018 electrodes in the vertical position. f. Weld beads on a plate using E6010/E6011 and E7018 electrodes in the overhead position. g. Weld plate, open V-butt-joint, using E6010/E6011 and E7018 electrodes in the overhead position.
4. Identify quality welds. DOK1 a. Identify and explain weld imperfections and their causes. b. Identify and explain destructive and non-destructive examination practices. c. Identify and explain welder qualification tests. d. Explain the importance of quality workmanship.

Unit 23: Gas Metal Arc Welding (GMAW) and Flux Core Arc Welding (FCAW)

Competencies and Suggested Objectives
1. Demonstrate and discuss safety procedures, applications and their advantages and limitations, and identify the machine controls for GMAW and FCAW. DOK2
2. Perform various welds according to specifications. DOK2 a. Perform GMAW welds (in the flat position). • Fabricate a butt-joint weld. • Fabricate a lap-joint fillet weld. • Fabricate a T-joint fillet weld to include a multi-pass fillet weld. • Fabricate a V-groove butt-joint weld in the flat and horizontal positions (vertical and overhead optional) according to specifications. b. Perform FCAW welds. • Fabricate a multi-pass fillet weld (vertical and overhead optional) according to specifications. • Fabricate a V-grooved butt-joint weld in the flat and horizontal positions (vertical and overhead optional) according to specifications.

Unit 24: Introduction to Gas Tungsten Arc Welding (GTAW)

Competencies and Suggested Objectives
1. Identify the proper safety procedures, principles, and parts; and perform a setup. DOK2 a. Describe the different types of tungsten electrodes. b. Identify the major controls on a machine. c. Identify the parts of a torch and the functions of each. d. Identify the different types of cups and the application of each.
2. Perform various welds on plate steel. DOK2 a. Run stringer beads in the flat and horizontal positions. b. Fabricate a square-groove butt weld in the flat and horizontal positions. c. Fabricate a T-joint fillet weld in the flat and horizontal positions.

Unit 25: Basic Oxy-Fuel and Plasma Arc Cutting (PAC)

Competencies and Suggested Objectives
1. Identify and describe the basic equipment, setup, and safety rules for the proper use of equipment, and prepare the base metal for oxy-fuel welding and brazing. DOK1 a. Identify and explain joint design and considerations. b. Prepare base metal joints for welding, oxy-fuel welding, and brazing. c. Properly secure portable gas cylinders and cutting equipment. d. Set up oxy-fuel equipment. e. Light and adjust the oxy-fuel cutting torch. f. Properly shut down oxy-fuel equipment. g. Perform the different types of cuts using an oxy-fuel torch. h. Change out empty cylinders.
2. Perform the various operations of welding, oxy-fuel welding, and brazing using the proper equipment. DOK1 a. Oxy-fuel weld in the flat position. b. Braze in the flat position.
3. Explain safety and identify the major components of plasma arc cutting. DOK1 a. Identify and understand plasma arc cutting processes. b. Identify plasma arc cutting equipment.
4. Set up and perform operations using the plasma arc cutting process. DOK2 a. Perform necessary setup. b. Cut mild steel.

Unit 26: Grinding Theory and Operation

Competencies and Suggested Objectives
1. Describe safety, magnetic chuck work, surface grinding operations, and reasons for truing and balancing a grinding wheel. DOK1 a. Describe grinding safety. b. Describe the safety rules that apply to magnetic chuck work. c. Identify surface grinding operations. d. Explain the reasons for truing and balancing grinding wheels.
2. Perform maintenance operations to the manufacturer's specifications and grinding operations to the teacher's specifications. DOK2 a. Remove and replace a grinding wheel. b. Dress a wheel flat. c. Grind a workpiece flat and parallel, and grind a workpiece square, to an angular surface and to dimension.

Unit 27: Computerized Numerical Control

Competencies and Suggested Objectives
1. Describe computerized numerical control (CNC), including the codes and the input of a pre-written program. DOK2 a. Describe the operations of CNC. b. Describe codes used in a CNC machine.

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.	Relate work-based learning opportunities to program areas.
Unit 2: Fundamentals of Student Organizations		
	1.	Discuss the history, mission, and purpose of student organizations, including SkillsUSA.
	2.	Explore the advantages of membership in a student organization.
	3.	Discuss the organizations' brand resources.
	4.	Describe the importance of effective communication skills.
	5.	Apply leadership skills to class- and work-related situations and 21st century skills.
	6.	Utilize teambuilding skills in class- and work-related situations.
	7.	Discuss the various competitions offered through the program area's student organization.
Unit 3: Employability Skills		
	1.	Describe employment opportunities in the construction industry.
	2.	Examine the Mississippi Department of Employment Security website and its applications relating to employment opportunities.
	3.	Demonstrate appropriate interview skills.
	4.	Describe basic employee responsibilities and appropriate work ethics.
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 the general safety rules for working in a shop/lab and how they relate to the construction industry.
	2.	Identify and practice safety around welding operations.
	3.	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, ladder, stair, and scaffold procedures and requirements.
	6.	Explain the safety data sheet (SDS).
	7.	Display the 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: Introduction to Construction Drawing		
	1.	Read, analyze, and understand the basic components of a blueprint.
Unit 10: Introduction to Materials Handling		
	1.	Safely handle and store materials.
Unit 11: Introduction to Welding		
	1.	Identify and describe the basic equipment, setup, and safety rules for the proper use of equipment, and prepare the base metal for oxy-fuel cutting, SMAW, FCAW, GMAW, and GTAW.
Unit 12: Lathe Theory and Operation		
	1.	Identify the parts, rules, and care of the metal lathe.
	2.	Perform procedures for a machining operation.
Unit 13: Milling Machine Theory and Operation		
	1.	Differentiate between the types of milling machines.
	2.	Identify the parts, cutting tools, and basic maintenance of a vertical milling machine.
	3.	Perform operations on a milling machine.
Unit 14: Drill Press and Band Saw Theory and Operation		
	1.	Identify and describe the safe operation of the types of power saws.
	2.	Identify and describe the types of drilling machines, including hand powered and drill press, and the rules for safe operation of each.
Unit 15: Introduction to Measurement, Materials, and Safety		
	1.	Demonstrate machining safety related to NIMS.
	2.	Apply measurement systems and machining math related to NIMS.

	3.	Demonstrate the use of semi-precision measuring tools related to NIMS.
Unit 16: Orientation, Advanced Leadership, and Employability Skills		
	1.	Describe local program and career and technical center policies and procedures.
	2.	Describe employment opportunities and responsibilities.
	3.	Research, design, and conduct a project that will apply the knowledge and skills learned in the manufacturing pathway course in a real-world, unpredictable environment.
	4.	Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
Unit 17: Basic Safety (Review and Reinforcement)		
	1.	Describe, define, and illustrate the general safety rules for working in a shop or lab and how they relate to the manufacturing industry.
	2.	Identify and practice safety around welding operations.
	3.	Display the 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, ladder, stair, and scaffold procedures and requirements.
	6.	Explain the safety data sheet (SDS).
	7.	Display the appropriate safety procedures related to fires.
	8.	Explain safety in and around electrical situations.
Unit 18: Advanced Lathe Operation		
	1.	Describe safety precautions, methods for measuring thread pitch diameters, and calculation of dimensions using taper formulas.
	2.	Perform various operations according to specifications.
Unit 19: Advanced Milling Operation		
	1.	Explore vertical milling operations.
	2.	Mount and remove cutters and cutter holders, align a vise using a dial indicator, and perform selected vertical milling and boring operations.
Unit 20: Introduction to Shielded Metal Arc Welding (SMAW)		
	1.	Identify and explain the safety, setup, weld cleanup, and maintenance of arc welding equipment.
	2.	Identify and use procedures for joint fit-up and alignment.
	3.	Identify and explain filler metal and the selection of electrodes.
Unit 21: Advanced Measurement, Materials, and Safety		
	1.	Identify, define, and discuss the following: a. Quality assurance b. Process planning c. Quality control

	2.	Compare the composition and classification of ferrous and nonferrous metals.
	3.	Examine the equipment and processes used in the heat treatment of metals.
	4.	Demonstrate proper maintenance and use of lubrication and cutting fluids in the machining process.
Unit 22: Shielded Metal Arc Welding (SMAW)		
	1.	Construct various welds using different positions and electrodes.
	2.	Construct various advanced welds using different positions.
	3.	Weld various plates using different positions and electrodes.
	4.	Identify quality welds.
Unit 23: Gas Metal Arc Welding (GMAW) and Flux Core Arc Welding (FCAW)		
	1.	Demonstrate and discuss the safety procedures, applications, and their advantages and limitations, and identify the machine controls for GMAW and FCAW.
	2.	Perform various welds according to specifications.
Unit 24: Introduction to Gas Tungsten Arc Welding (GTAW)		
	1.	Identify proper safety procedures, principles, and parts; and perform a setup.
	2.	Perform various welds on plate steel.
Unit 25: Basic Oxy-Fuel and Plasma Arc Cutting (PAC)		
	1.	Identify and describe the basic equipment, setup, and safety rules for the proper use of equipment, and prepare the base metal for oxy-fuel welding and brazing.
	2.	Perform various operations of welding, oxy-fuel welding, and brazing using the proper equipment.
	3.	Explain safety and identify the major components of plasma arc cutting.
	4.	Set up and perform operations using the plasma arc cutting process.
Unit 26: Grinding Theory and Operation		
	1.	Describe safety, magnetic chuck work, surface grinding operations, and the reasons for truing and balancing a grinding wheel.
	2.	Perform maintenance operations to the manufacturer's specifications and grinding operations to the teacher's specifications.
Unit 27: Computerized Numerical Control		
	1.	Describe computerized numerical control (CNC), including the codes and the input of a pre-written program.

Appendix A: Industry Standards

	Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Standards																												
BSM						X												X									
ICM							X																					
IHT								X																				
IPT									X																			
BLU										X																		
COM					X												X										
EMP				X													X										
IMH											X																	
WSS																X											
WOC																X									X		
PAC																										X		
BMP																X											
WQT																X											
SWS																X					X						
SES																X					X		X				
SBF																X					X		X				
JFA																					X		X				
GWB																					X		X				
VGW																							X				
WSY																											
RWD																											
GFM																								X			
GFP																								X			
TFM																									X		
TPW																									X		
L1B												X							X								
L1L												X							X								
1VM													X			X				X							
1DP																											
1SG														X													X	
1TB												X							X								
1TC												X							X								
1CM													X							X							X
1CT													X							X							X
MMS															X							X					

NCCER Core

BSM – BASIC SAFETY (00101-09)
ICM – INTRODUCTION TO CONSTRUCTION MATH (00102-09)
IHT – INTRODUCTION TO HAND TOOLS (00103-09)
IPT – INTRODUCTION TO POWER TOOLS (00104-09)
BLU – INTRODUCTION TO CONSTRUCTION DRAWINGS (00105-09)
COM – BASIC COMMUNICATION SKILLS (00107-09)
EMP – BASIC EMPLOYABILITY SKILLS (00108-09)
IMH – INTRODUCTION TO MATERIALS HANDLING (00109-09)

NCCER Welding

WSS – Welding Safety (29101-09)
WOC – Oxyfuel Cutting (29102-09)
PAC – Plasma Arc Cutting (29103-09)
BMP – Base Metal Preparation (29105-09)
WQT – Weld Quality (29106-09)
SWS –SMAW – Equipment and Setup (29107-09)
SES – Shielded Metal Arc Welding – Electrodes (29108-09)
SBF – SMAW – Beads and Fillet Welds (29109-09)
JFA – Joint Fit-up and Alignment (29110-09)
GWB – SMAW – Groove Welds with Backing (29111-09)
VGW – SMAW – Open V-Groove Welds (29112-09
WSY – Welding Symbols (39201-09)
RWD – Reading Welding Detail Drawings (29202-09)
PTM – Preheating and Postheating of Metals (29204-09)
GFM – GMAW and FCAW: Equipment and Filler Metals (29205-09)
GFP – GMAW and FCAW: Plate (29206-09)
TFM – GTAW: Equipment and Filler Metals (29207-09)
TPW – GTAW: Plate (29208-09)

NIMS Level 1

L1B – Benchwork
LIL – Layout
1VM – Vertical Milling
1DP – Drill Press
1SG – Surface Grinding
1TB – Turning – Between Centers
1TC – Turning – Chucking
1CM – CNC Milling
1CT – CNC Turning
MMS – Measurement, Materials, and Safety