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Welding Technology
Mississippi Curriculum Framework

Program CIP: 48.0508 – Welding Technology / Welder

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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

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ADOPTION OF NATIONAL CERTIFICATION STANDARDS

The **National Center for Construction Education and Research (NCCER)** is a not-for-profit 501(c)(3) education foundation created in 1996. It was developed with the support of more than 125 construction CEOs and various association and academic leaders who united to revolutionize training for the construction industry. Sharing the common goal of developing a safe and productive workforce, these companies created a standardized training and credentialing program for the industry. This progressive program has evolved into curricula for more than 70 craft areas and a complete series of more than 70 assessments offered in over 4,000 NCCER-accredited training and assessment locations across the United States.

NCCER develops standardized construction and maintenance curricula and assessments with portable credentials. These credentials are tracked through NCCER's National Registry which allows organizations and companies to track the qualifications of their craft professionals and/or check the qualifications of possible new hires. The National Registry also assists craft professionals by maintaining their records in a secure database.

NCCER's process of accreditation, instructor certification, standardized curriculum, national registry, assessment, and certification is a key component in the industry's workforce development efforts. NCCER also drives multiple initiatives to enhance career development and recruitment efforts for the industry. NCCER is headquartered in Alachua, Fl., and is affiliated with the University of Florida's M.E. Rinker, Sr. School of Building Construction.

As the accrediting body for the industry, NCCER establishes the benchmark for quality training and assessments. By partnering with industry and academia, NCCER has developed a system for program accreditation that is similar to those found in institutions of higher learning. This process fosters national unity among the construction industry while providing a defined career path with industry-recognized credentials.

NCCER's accreditation process assures that students and craft professionals receive quality training based on uniform standards and criteria. These standards are outlined in the NCCER Accreditation Guidelines and must be adhered to by all NCCER Accredited Training Sponsors and Accredited Assessment Centers.

For more information related to implementing NCCER at your local campus, please visit http://www.nccer.org/welding.

The **American Welding Society (AWS) Foundation** was established by the American Welding Society on September 13, 1989, to support programs that ensure the growth and development of the welding industry through strengthening research and educational opportunities in welding and related industries.

From giving children their first glimmer of excitement in learning about the natural sciences, to providing funding for welding engineering undergraduates and fellowships for welding research, the AWS Foundation supports the welding industry. Led by a volunteer Board of Trustees, the Foundation is organized as a not-for-profit 501(c)(3) charitable organization. Administration, including program development, fundraising, public relations, marketing and financial management, is provided by a small development staff of the American Welding Society. Its operations are conducted from the Society's offices in Miami, Florida.

As the accrediting body for the industry, AWS establishes the benchmark for quality training and assessments. By partnering with industry and academia AWS has developed a system for program accreditation that is similar to those found in institutions of higher learning. This process fosters national unity among the construction industry while providing a defined career path with industry-recognized credentials.

AWS's accreditation process assures that students and craft professionals receive quality training based on uniform standards and criteria. These standards are outlined in the AWS Accreditation Guidelines and must be adhered to by all AWS Accredited Training Sponsors and Accredited Assessment Centers.

The welding competencies required in this curriculum were developed to coincide with the

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Guide for the Training and Qualification of Welding Personnel:

- Entry-Level Welders (AWS EG2.0-95)
- Specification for Qualification & Certification for Entry-Level Welders (AWS QC 10-95)

Industry standards are based on the American Welding Society Standards EG2.0-95.

For more information related to implementing AWS at your local campus, please visit www.aws.org.

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INDUSTRY JOB PROJECTION DATA

Welders, cutters, solderers, and brazers occupations require an education level of a long term on the job training and moderate term on-the-job training. There is a 7.67% increase in occupational demand at the regional level and an 8.50% increase at the state level. Median annual income for plumbers, pipefitters, and steamfitters is $35,235.20 at the state and regional level. A summary of occupational data from the State Workforce Investment Board Data Center is displayed below:

Table 1: Education Level

Program Occupations	Education Level
Welders, Cutters, Solderers, and Brazers	Long-Term on-the-job training
Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	Moderate-Term on-the-job training

Table 2: Occupational Overview

	Region	State	United States
2010 Occupational Jobs	4,014	4,363	351,730
2020 Occupational Jobs	4,322	4,734	344,737
Total Change	308	371	-6993
Total % Change	7.67%	8.50%	-1.99%
2010 Median Hourly Earnings	$16.56	$17.28	$16.82
2010 Median Annual Earnings	$34,444.80	$35,942.40	$34,979.66
Annual Openings	30	37	-699

Table 3: Occupational Breakdown

Description	2010 Jobs	2020 Jobs	Annual Openings	2010 Hourly Earnings	2010 Annual Earnings 2,080 Work Hours
Welders, Cutters, Solderers, and Brazers	3,696	3,993	29	$18.00	$37,440.00
Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	318	329	1	$15.12	$31,449.60
TOTAL	4,014	4,322	30	$16.56	$34,444.80

Table 4: Occupational Change

Description	Regional Change	Regional % Change	State % Change	National % Change
Welders, Cutters, Solderers, and Brazers	297	8.04%	9.01%	-1.32%
Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	11	3.46%	2.62%	-7.54%

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ARTICULATION

Articulation credit from Secondary Career Pathway programs to Postsecondary Maritime Pipefitting is available. Secondary students who have completed the articulated the Secondary Career Pathway Courses listed below may be awarded articulated college credit according to Mississippi Community College Board (MCCB) guidelines (http://www.mccb.edu/pdfs/ct/StatewideArtManual201213.pdf).

Articulated Secondary Course	Articulated Postsecondary Course	Aligned Industry Certification
CIP 48.0508 Welding Technology	WLT 1173 Introduction to Welding and Safety	NCCER Core

TECHNICAL SKILLS ASSESSMENT

Colleges should report the following for students who complete the program with a career certificate, technical certificate, or an Associate of Applied Science Degrees for technical skills attainment:

NCCER Core Assessment ($45.00)
NCCER Welding Level 1 and 2 Credential ($50.00 - $100.00)

OR

NCCER NCCT Welding Level 1 ($45.00)

OR

AWS Sense Level 1 (program certification fee - $500 one-time fee; $15.00 student fee)

OR

MS-CPAS2

ONLINE AND BLENDED LEARNING OPPORTUNITIES

Course content includes lecture and laboratory semester credit hours. Faculty members are encouraged to present lecture related content to students in an online or blended learning environment. Training related to online and blended learning will be available to faculty members through the MS Community College Board.

INSTRUCTIONAL STRATEGIES

The NCCER and AWS standards were adopted and provide instructional strategies to faculty members implementing the curriculum.

ASSESSMENT STRATEGIES

The NCCER and AWS Standards were adopted and provide assessment strategies to faculty member implementing the curriculum. Additionally, performance tasks were included in course content when appropriate.

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CREDIT BY EXAMINATION

The following NCCER modules are aligned to courses listed below. Each module will serve as the state recommended exam to reward credit for prior learning experiences. Colleges have the local autonomy to create a college-level exam when awarding credit.

Course Number and Name	NCCER Credential and Module
WLT 1173 Introduction to Welding Safety	NCCER Core Curriculum Module 00101-09—Basic Safety Module 00102-09—Introduction to Construction Math Module 00103-09—Introduction to Hand Tools Module 00104-09—Introduction to Power Tools Module 00105-09—Introduction to Construction Drawing Module 00106-09—Basic Rigging Module 00107-09—Basic Communication Skills Module 00108-09—Basic Employability Skills Module 00109-09—Introduction to Materials Handling NCCER Welding Level 1 Module 29101-09—Welding Safety OR AWS Sense Level 1 Module 1: Occupational Orientation Module 2: Safety and Health of Welders

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WLT 1115 Shielded Metal Arc Welding I	NCCER Welding Level 1 Module 29105-09—Base Metal Preparation Module 29107-09—SMAW-Equipment and Setup Module 29108-09—Shielded Metal Arc Welding-Electrodes Module 29109-09—SMAW-Beads and Fillet Welds Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 4: Shielded Metal Arc Welding (SMAW) Module 9: Welding Inspection And Testing Key Indicators
WLT 1225 Shielded Metal Arc Welding II	NCCER Welding Level 1 Module 29110-09—Joint Fit-Up and Alignment Module 29111-09—SMAW- Groove Welds with Backing Module 29112-09—Open V-Groove Welds Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 4: Shielded Metal Arc Welding (SMAW) *(Continued from WLT 1115)* MODULE 9: WELDING INSPECTION AND TESTING KEY INDICATORS
WLT 1314 Cutting Processes	NCCER Welding Level 1 Module 29102-09—Oxyfuel Cutting Module 29103-09—Plasma Arc Cutting Module 29104-09—Air Carbon Arc Cutting and Gouging Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 8: Thermal Cutting Processes Module 9: Welding Inspection and Testing Key Indicators
WLT 1124 Gas Metal Arc Welding (GMAW)	NCCER Welding Level 2 *(Only GMAW components)* Module 29205-09—GMAW and FCAW: Equipment and Filler Metals Module 29206-09—GMAW and FCAW: Plate NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 5: Gas Metal Arc Welding (GMAW-S, GMAW Spray Transfer) Module 9: Welding Inspection And Testing Key Indicators
WLT 1143 Flux Cored Arc Welding (FCAW)	NCCER Welding Level 2 Module 29205-09—GMAW and FCAW: Equipment and Filler Metals Module 29206-09—GMAW and FCAW: Plate NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 6: Flux Cored Arc Welding (FCAW-G/GM, FCAW-S) Module 9: Welding Inspection And Testing Key Indicators

WLT 1135 Gas Tungsten Arc Welding (GTAW)	NCCER Welding Level 2 Module 29207-09—GTAW: Equipment and Filler Metals Module 29208-09—GTAW: Plate NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 7: Gas Tungsten Arc Welding (GTAW) Module 9: Welding Inspection and Testing Key Indicators
WLT 1232 Blueprint Reading, Welding Symbols, and Metallurgy	NCCER Welding Level 2 Module 29201-09—Welding Symbols Module 29202-09—Reading Welding Detail Drawings Module 29203-09—Physical Characteristics and Mechanical Properties of Metal Module 29204-09—Pre-heating and Post-Heating of Metals NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 3: Drawing and Welding Symbol Interpretation Module 9: Welding Inspection and Testing Key Indicators

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PROGRAM DESCRIPTION

The Welding and Cutting Technology program prepares students for entry level employment in the field of welding and cutting. The curriculum includes Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), Plasma Arc Cutting (PAC), Carbon Arc Cutting, Oxyfuel Cutting, and Gas Tungsten Arc Welding (GTAW). Electives are available in advanced levels of welding and cutting.

The welding competencies required in this curriculum were developed to coincide with the Guide for the Training and Qualification of Welding Personnel: Entry-Level Welders (AWS EG2.0-95) and Specification for Qualification and Certification for Entry-Level Welders (AWS QC 10-95).

One major goal of this program is to prepare graduates to complete NCCER Core Curriculum, NCCER Level 1 and 2, or AWS Sense Level 1.

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SUGGESTED COURSE SEQUENCE

Work Ready Credential

			SCH Breakdown			Clock Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Clock Hours	Lecture	Lab	Certification Name
WLT 1173	Introduction to Welding and Safety	3	2	2	60	30	30	NCCER Core
WLT 1313	Cutting Processes	3	1	4	75	30	45	
	Approved Technical Electives	9						
	TOTAL	**15**						

Career Certificate Required Courses

			SCH Breakdown			Clock Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Clock Hours	Lecture	Lab	Certification Name
WLT 1173	Introduction to Welding and Safety	3	2	2	60	30	30	NCCER Core
WLT 1115	Shield Metal Arc Welding I	5	1	8	135	15	120	
WLT 1225	Shield Metal Arc Welding II	5	1	8	135	15	120	
WLT 1313	Cutting Processes	3	1	4	75	15	60	NCCER Level 1
WLT 1124	Gas Metal Arc Welding	4	1	6	105	15	90	
WLT 1135	Gas Tungsten Arc Welding	5	1	8	135	15	120	
WLT 1143	Flux Cored Arc Welding	3	1	4	75	15	60	
WLT 1232	Blueprint Reading, Welding and Metallurgy	2	1	2	45	15	30	NCCER Level 2
	TOTAL	**30**	**7**	**40**	**705**	**105**	**600**	

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Technical Certificate Required Courses

			SCH Breakdown			Clock Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Clock Hours	Lecture	Lab	Certification Name
WLT 1155	Pipe Welding	5	1	8	135	15	120	
WLT 1252	Advanced Pipe Welding	2	1	2	45	15	30	
	Approved Technical Elective	8			0	0	0	
	TOTAL	**15**			**180**	**30**	**150**	

General Education Core Courses

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement1 describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

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

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Technical Electives

			SCH Breakdown				Clock Hour Breakdown			Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Clinical/ Internship	Total Clock Hours	Lecture	Lab	Clinical/ Internship	Certification Name
WLT 1162	Gas Metal Arc Aluminum Welding	2	1	2		45	15	30		
WLT 1921	Supervised Work Experience in Welding and Cutting Tech	1			3	45			45	
WLT 1922	Supervised Work Experience in Welding and Cutting Tech	2			6	90			90	
WLT 1923	Supervised Work Experience in Welding and Cutting Tech	3			9	135			135	
WLT 1924	Supervised Work Experience in Welding and Cutting Tech	4			12	180			180	
WLT 1925	Supervised Work Experience in Welding and Cutting Tech	5			15	225			225	
WLT 1926	Supervised Work Experience in Welding and Cutting Tech	6			18	270			270	
WLT 2812	Welding Metallurgy	2	2	0		30	30			
WLT 2913	Welding Code	3	3			45	45			
DDT 1114	Fundamentals of Drafting	4	2	4		90	30	60		
PPV 1426	Basic Fabrication of Pipefitting	6	2	8		150	30	120		
PPV 1823	Steel Ship Building and Marine Construction	3	2	2		60	30	30		
WLT 2514	Fundamentals of Robotic Welding	4	2	4		90	30	60		
WLT 2524	Advanced Robotic Welding	4	2	4		90	30	60		
WLT 1911	Special Problem in Welding and Cutting Technology	1			3	45			45	
WLT 1912	Special Problem in Welding and Cutting Technology	2			6	90			90	
WLT 1913	Special Problem in Welding and Cutting Technology	3			9	135			135	
WLT 1914	Special Problem in Welding and Cutting Technology	4			12	180			180	

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WLT 1915	Special Problem in Welding and Cutting Technology	5			15	225			225	
WLT 1916	Special Problem in Welding and Cutting Technology	6			18	270			270	
WLB 19(1-3)	Work Based Learning									
IMM 1935	Manufacturing Skills Basic	5	2	6		120	30	90		
WLT 1931	Welding Seminar I	1		2		30		30		
WLT 1941	Welding Seminar II	1		2		30		30		
	Other Instructor Approved Elective(s)									

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CAREER CERTIFICATE REQUIRED COURSES

Course Number and Name: **WLT 1173** **Introduction to Welding and Safety**

Classification: Career Certificate Core Requirement

Description: This course is designed to give student an introduction to the welding profession and experience in safety procedures related to welding.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	2	2	60

National Assessment: NCCER Core Curriculum, selected modules from NCCER Level 1 *or* AWS Modules 1 & 2

Prerequisite: None

Student Learning Outcomes:

NCCER Core

Module 00101-09--Basic Safety

1. Explain the idea of a safety culture and its importance in the construction crafts.
2. Identify causes of accidents and the impact of accident costs.
3. Explain the role of OSHA in job-site safety.
4. Explain OSHA's General Duty Clause and 1926 CFR Subpart C.
5. Recognize hazard recognition and risk assessment techniques.
6. Explain fall protection, ladder, stair, and scaffold procedures and requirements.
7. Identify struck-by hazards and demonstrate safe working procedures and requirements.
8. Identify caught-in-between hazards and demonstrate safe working procedures and requirements.
9. Define safe work procedures to use around electrical hazards.
10. Demonstrate the use and care of appropriate personal protective equipment (PPE).
11. Explain the importance of hazard communications (HazCom) and material safety data sheets (MSDSs).
12. Identify other construction hazards on your job site, including hazardous material exposures, environmental elements, welding and cutting hazards, confined spaces, and fires.

Module 00102-09--Introduction to Construction Math

1. Add, subtract, multiply, and divide whole numbers, with and without a calculator.
2. Use a standard ruler, a metric ruler, and a measuring tape to measure.
3. Add, subtract, multiply, and divide fractions.
4. Add, subtract, multiply, and divide decimals, with and without a calculator.
5. Convert decimals to percentages and percentages to decimals.
6. Convert fractions to decimals and decimals to fractions.
7. Explain what the metric system is and how it is important in the construction trade.
8. Recognize and use metric units of length, weight, volume, and temperature.
9. Recognize some of the basic shapes used in the construction industry and apply basic geometry to measure them.

Module 00103-09--Introduction to Hand Tools

1. Recognize and identify some of the basic hand tools and their proper uses in the construction trade.
2. Visually inspect hand tools to determine if they are safe to use.
3. Safely use hand tools.

Module 00104-09--Introduction to Power Tools

1. Identify power tools commonly used in the construction trades.
2. Use power tools safely.
3. Explain how to maintain power tools properly.

Module 00105-09--Introduction to Construction Drawings

1. Recognize and identify basic construction drawing terms, components, and symbols.
2. Relate information on construction drawings to actual locations on the print.
3. Recognize different classifications of construction drawings.
4. Interpret and use drawing dimensions.

Module 00106-09--Basic Rigging

1. Identify and describe the use of slings and common rigging hardware.
2. Describe basic inspection techniques and rejection criteria used for slings and hardware.
3. Describe basic hitch configurations and their proper connections.
4. Describe basic load-handling safety practices.
5. Demonstrate proper use of American National Standards Institute (ANSI) hand signals.

Module 00107-09--Basic Communication Skills

1. Interpret information and instructions presented in both verbal and written form.
2. Communicate effectively in on-the-job situations using verbal and written skills.
3. Communicate effectively on the job using electronic communication devices.

Module 00108-09--Basic Employability Skills

1. Explain your role as an employee in the construction industry.
2. Demonstrate critical thinking skills and the ability to solve problems using those skills.
3. Demonstrate knowledge of computer systems and explain common uses for computers in the construction industry.
4. Define effective relationship skills.
5. Recognize workplace issues such as sexual harassment, stress, and substance abuse.

Module 00109-09--Introduction to Materials Handling

1. Define a load.
2. Establish a pre-task plan prior to moving a load.
3. Use proper materials-handling techniques.
4. Choose appropriate materials-handling equipment for the task.
5. Recognize hazards and follow safety procedures required for materials handling.

NCCER Welding Level 1

Module 29101-09-Welding Safety

1. Identify some common hazards in welding.
2. Explain and identify proper personal protection used in welding.
3. Describe how to avoid welding fumes.
4. Explain some of the causes of accidents.
5. Identify and explain uses for material safety data sheets.
6. Explain safety techniques for storing and handling cylinders.
7. Explain how to avoid electric shock when welding.
8. Describe proper material handling methods.

OR

AWS Sense Welding Level 1

Module 1: Occupational Orientation

1. Prepares time or job cards, reports or records.
2. Performs housekeeping duties.
3. Follows verbal instructions and complete work assignments.
4. Follows written instructions to complete work assignments.

Module 2: Safety and Health of Welders

1. Demonstrates proper use and inspection of personal protection equipment (PPE).
2. Demonstrates proper safe operation practices in work areas.
3. Demonstrates proper use and inspection of ventilation equipment.
4. Demonstrates proper HotZone operation.
5. Demonstrate proper work actions for working in confined spaces.
6. Demonstrate proper use of precautionary labeling and MSDS information.
7. Demonstrate proper inspection and operation of equipment use for each welding and thermal cutting process. (Tills are best done as part of the process module/unit for each of the required welding and thermal cutting processes.)

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Course Number and Name: **WLT 1115 Shielded Metal Arc Welding I**

Classification: Career Certificate Core Requirement

Description: This course is designed to teach students introductory welding techniques using the SMAW process.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
5	1	8	135

National Assessment: Selected Modules of NCCER Welding Level 1 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 1

Module 29105-09—Base Metal Preparation

1. Clean base metal for welding or cutting.
2. Identify and explain joint design.
3. Explain joint design considerations.
4. Mechanically bevel the edge of a mild steel plate.
5. Thermally bevel the end of a mild steel plate.
6. Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.

Module 29107-09—SMAW-Equipment and Setup

1. Identify and explain shielded metal arc welding (SMAW) safety.
2. Explain welding electrical current.
3. Identify welding power supplies and their characteristics.
4. Explain how to set up welding power supplies.
5. Set up a machine for welding.
6. Identify tools used for weld cleaning.

Module 29108-09—Shielded Metal Arc Welding-Electrodes

1. Identify factors that affect electrode selection.
2. Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
3. Identify different types of filler metals.
4. Explain the storage and control of filler metals.
5. Explain filler metal traceability requirements and how to use applicable code requirements.
6. Identify and select the proper electrode for an identified welding task.

Module 29109-09—SMAW-Beads and Fillet Welds

1. Set up shielded metal arc welding (SMAW) equipment.
2. Describe methods of striking an arc.
3. Properly strike and extinguish an arc.
4. Describe causes of arc blow and wander.
5. Make stringer, weave, and overlapping beads.
6. Make fillet welds in the following positions: Horizontal (2F), Vertical (3F), Overhead (4F)

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NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 4: Shielded Metal Arc Welding (SMAW)

1. Performs safety inspections of SMAW equipment and accessories.
2. Makes minor external repairs to SMAW equipment and accessories.
3. Sets up for SMAW operations on carbon steel.
4. Operates SMAW equipment on carbon steel.
5. Makes fillet weld in all positions on carbon steel.
6. Makes groove welds, n all positions, on carbon steel.
7. Passes SMAW welder performance qualifications test (2G and 3G, uphill, limited thickness test plates) on carbon steel.

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1225 Shielded Metal Arc Welding II**

Classification: Career Certificate Core Requirement

Description: This course is designed to teach students advanced welding techniques using the SMAW process.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
5	1	8	135

National Assessment: Selected Modules of NCCER Welding Level 1 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 1

Module 29110-09—Joint Fit-Up and Alignment

1. Identify and explain job code specifications.
2. Use fit-up gauges and measuring devices to check joint fit-up.
3. Identify and explain distortion and how it is controlled.
4. Fit up joints using plate and pipe fit-up tools.
5. Check for joint misalignment and poor fit-up before and after welding.

Module 29111-09—SMAW- Groove Welds with Backing

1. Identify and explain groove welds.
2. Identify and explain groove welds with backing.
3. Set up shielded metal arc welding (SMAW) equipment for making V-groove welds.
4. Perform SMAW for V-groove welds with backing in the following: Flat (1G), Horizontal (2G), Vertical (3G), Overhead (4G)

Module 29112-09—Open V-Groove Welds

1. Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.
2. Perform open-root V-groove welds in the following positions: Flat (1G), Horizontal (2G), Vertical (3G), Overhead (4G)

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 4: Shielded Metal Arc Welding (SMAW) *(Continued from WLT 1115)*

1. Performs safety inspections of SMAW equipment and accessories.
2. Makes minor external repairs to SMAW equipment and accessories.
3. Sets up for SMAW operations on carbon steel.
4. Operates SMAW equipment on carbon steel.

5. Makes fillet weld in all positions on carbon steel.
6. Makes groove welds, n all positions, on carbon steel.
7. Passes SMAW welder performance qualifications test (2G and 3G, uphill, limited thickness test plates) on carbon steel.

MODULE 9: WELDING INSPECTION AND TESTING KEY INDICATORS

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1313 Cutting Processes**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student experience in oxyfuel cutting principles and practices, air carbon cutting and gouging, and plasma arc cutting.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	1	4	75

National Assessment: Selected Modules of NCCER Welding Level 1 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 1

Module 29102-09—Oxyfuel Cutting

1. Identify and explain the use of oxyfuel cutting equipment.
2. Set up oxyfuel equipment.
3. Light and adjust an oxyfuel torch.
4. Shut down oxyfuel cutting equipment.
5. Disassemble oxyfuel equipment.
6. Change cylinders.
7. Perform oxyfuel cutting (straight line and square shapes, piercing and slot cutting, bevels, washing, gouging)
8. Operate a motorized, portable oxyfuel gas cutting machine.

Module 29103-09—Plasma Arc Cutting

1. Explain the plasma arc cutting processes.
2. Identify plasma arc cutting equipment.
3. Prepare and set up plasma arc cutting equipment.
4. Use plasma arc cutting equipment to make various types of cuts.
5. Properly store equipment and clean the work area after use.

Module 29104-09—Air Carbon Arc Cutting and Gouging

1. Identify and explain the air carbon arc cutting (CAC-A) process and equipment.
2. Select and install CAC-A electrodes.
3. Prepare the work area and CAC-A equipment for safe operation.
4. Use CAC-A equipment for washing and gouging activities.
5. Perform storage and housekeeping activities for CAC-A equipment.
6. Make minor repairs to CAC-A equipment.

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 8: Thermal Cutting Processes

Manual Oxyfuel Gas Cutting (OFC)

1. Performs safety inspections of manual OFC equipment and accessories.
2. Makes minor external repairs to manual OFC equipment and accessories.
3. Sets up for manual OFC operations on carbon steel.
4. Operates manual OFC equipment on carbon steel.
5. Performs straight, square edge cutting operations, in the flat position, on carbon steel.
6. Performs shape, square edge cutting operations, in the flat position, on carbon steel.
7. Performs straight, bevel edge cutting operations, in the flat position, on carbon steel.
8. Performs scarfing and gouging operations to remove base and weld metal, in the flat and horizontal positions, on carbon steel.

Mechanized Oxyfuel Gas Cutting (OFC) [E.G., Track Burner]

1. Performs safety inspections of mechanized OFC equipment and accessories.
2. Makes minor external repairs to mechanized OFC equipment and accessories.
3. Sets up for mechanized OFC operations on carbon steel.
4. Operates mechanized OFC equipment on carbon steel.
5. Performs straight, square edge cutting operations in the flat position, on carbon steel.
6. Performs straight, bevel edge cutting operations in the flat position, on carbon steel.

Manual Plasma Arc Cutting (PAC)

1. Performs safety inspections of manual PAC equipment and accessories.
2. Makes minor external repairs to manual PAC equipment and accessories.
3. Sets up for manual PAC operations on carbon steel, austenitic stainless steel, and aluminum.
4. Operates manual PAC equipment on carbon steel, austenitic stainless steel, and aluminum.
5. Performs straight, square edge cutting operations, in the flat position, on carbon steel, austenitic stainless steel, and aluminum.
6. Performs shape, square edge cutting operations, in the flat position, on carbon steel, austenitic stainless steel and aluminum.

Manual Air Carbon Arc Cutting (CAC-A) Key Indicators

1. Performs safety inspections of manual CAC-A equipment and accessories.
2. Makes minor external repairs to manual CAC-A equipment and accessories.
3. Sets up for manual CAC-A scarfing and gouging operations on carbon steel.
4. Operates manual CAC-A equipment on carbon steel.
5. Performs scarfing and gouging operations to remove base and weld metal, in the flat and horizontal positions, on carbon steel.

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1124 Gas Metal Arc Welding (GMAW)**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student experience in various welding applications with the GMAW process using various modes of transfer.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
4	1	6	105

National Assessment: Selected Modules of NCCER Welding Level 1 and 2 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 2 **(***Students will only focus on GMAW process of the following NCCER Standards.)*

Module 29205-09—GMAW and FCAW: Equipment and Filler Metals

1. Explain gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) safety.
2. Explain the characteristics of welding current and power sources.
3. Identify and explain the use of GMAW and FCAW equipment: Spray transfer, Globular, Short circuiting, Pulse.
4. Identify and explain the use of GMAW and FCAW shielding gases and filler metals.
5. Set up GMAW and FCAW equipment and identify tools for weld cleaning.

Module 29206-09—GMAW and FCAW: Plate

1. Perform GMAW-S (short-circuit) multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using solid or composite wire and shielding gas.
2. Perform GMAW-S (short-circuit) multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
3. Perform GMAW spray fillet and V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
4. Perform FCAW multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using flux-cored wire and, if required, shielding gas.
5. Perform FCAW multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using flux-cored wire and, if required, shielding gas.

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 5: Gas Metal Arc Welding (GMAW-S, GMAW Spray Transfer)

1. Performs safety inspections of GMAW equipment and accessories.
2. Makes minor external repairs to GMAW equipment and accessories.
3. Short Circuiting Transfer
4. Sets up for GMAW-S operations on carbon steel.
5. Operates GMAW-S equipment on carbon steel.
6. Makes fillet welds in all positions on carbon steel.
7. Makes groove welds in all positions on carbon steel.
8. Passes GMAW-S welder performance qualification test on carbon steel.
9. Spray Transfer
10. Sets up for GMAW (spray) operations on carbon steel.
11. Operates GMAW (spray) equipment on carbon steel.
12. Makes fillet welds in the1F and 2F positions on carbon steel.
13. Makes groove welds in the1G position on carbon steel.
14. Passes GMAW (spray) welder performance qualification test on carbon steel.

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1143 Flux Cored Arc Welding (FCAW)**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student experience using FCAW process.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	1	4	75

National Assessment: Selected Modules of NCCER Welding Level 1 and 2 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 2 (*Students will only focus on FCAW process of the following NCCER Standards***.)**

Module 29205-09—GMAW and FCAW: Equipment and Filler Metals

1. Explain gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) safety.
2. Explain the characteristics of welding current and power sources.
3. Identify and explain the use of GMAW and FCAW equipment: Spray transfer, Globular, Short circuiting, Pulse
4. Identify and explain the use of GMAW and FCAW shielding gases and filler metals.
5. Set up GMAW and FCAW equipment and identify tools for weld cleaning.

Module 29206-09—GMAW and FCAW: Plate

1. Perform GMAW-S (short-circuit) multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using solid or composite wire and shielding gas.
2. Perform GMAW-S (short-circuit) multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
3. Perform GMAW spray fillet and V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
4. Perform FCAW multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using flux-cored wire and, if required, shielding gas.
5. Perform FCAW multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using flux-cored wire and, if required, shielding gas.

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 6: Flux Cored Arc Welding (FCAW-G/Gm, FCAW-S)

1. Performs safety inspections of FCAW equipment and accessories.
2. Makes minor external repairs to FCAW equipment and accessories.

Gas Shielded

3. Sets up for FCAW-G/GM operations on carbon steel.
4. Operates FCAW-G/GM equipment on carbon steel.
5. Makes fillet welds in all positions on carbon steel.
6. Makes groove welds in all positions on carbon steel.
7. Passes FCAW-G/GM welder performance qualification test on carbon steel

Self-Shielded

8. Sets up for FCAW-S operations on carbon steel.
9. Operates FCAW-S equipment on carbon steel.
10. Makes fillet welds in all positions on carbon steel.
11. Makes groove welds in all positions on carbon steel.
12. Passes FCAW-S welder performance qualification test on carbon steel.

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1135 Gas Tungsten Arc Welding (GTAW)**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student experience in various welding applications using the GTAW process.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
5	1	8	135

National Assessment: Selected Modules of NCCER Welding Level 1 and 2 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 2

Module 29207-09—GTAW: Equipment and Filler Metals

1. Explain gas tungsten arc welding (GTAW) safety.
2. Identify and explain the function of GTAW equipment.
3. Identify and explain the function of GTAW filler metals.
4. Identify and explain the function of GTAW shielding gases.
5. Set up GTAW equipment.

Module 29208-09—GTAW: Plate

1. Build a pad in the flat position with stringer beads using GTAW and carbon steel filler metal.
2. Perform multiple-pass GTAW fillet welds on carbon steel plate coupons in the following positions, using carbon steel filler metal: 1F, 2F, 3F, 4F
3. Perform multiple-pass GTAW V-groove welds on carbon steel plate coupons in the following positions, using carbon steel filler metal: 1G, 2G, 3G, 4G

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 7: Gas Tungsten Arc Welding (GTAW)

1. Performs safety inspections of GTAW equipment and accessories.
2. Makes minor external repairs to GTAW equipment and accessories.

Carbon Steel

3. Sets up for GTAW operations on carbon steel.
4. Operates GTAW equipment on carbon steel.
5. Makes fillet welds in all positions on carbon steel.
6. Makes groove welds in all positions on carbon steel.
7. Passes GTAW welder performance qualification test on carbon steel.

Austenitic Stainless Steel

8. Sets up for GTAW operations on austenitic stainless steel.
9. Operates GTAW equipment on austenitic stainless steel.
10. Makes fillet welds in the IF, 2F, and 3F positions, on austenitic stainless steel.
11. Makes groove welds in the1G and 2G positions, on austenitic stainless steel.
12. Passes GTAW welder performance qualification test on austenitic stainless steel.

Aluminum

13. Sets up for GTAW operations on aluminum.
14. Operates GTAW equipment on aluminum.
15. Makes fillet welds in the IF and 2F positions, on aluminum.
16. Makes groove welds in the lG position, on aluminum.
17. Passes GTAW welder performance qualification test on aluminum.

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1232 Blueprint Reading, Welding Symbols, and Metallurgy**

Classification: Career Certificate Core Requirement

Description: This course is designed to give the student experience in blueprint reading, welding symbols, and metallurgy.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
2	1	2	45

National Assessment: Selected Modules of NCCER Welding Level 1 and 2 *or* AWS Sense Level 1

Prerequisite: None

Student Learning Outcomes:

NCCER Welding Level 2

Module 29201-09—Welding Symbols

1. Identify and explain the various parts of a welding symbol.
2. Identify and explain fillet and groove weld symbols.
3. Read welding symbols on drawings, specifications, and welding procedure specifications.
4. Interpret welding symbols from a print.

Module 29202-09—Reading Welding Detail Drawings

1. Identify and explain a welding detail drawing.
2. Identify and explain lines, material fills, and sections.
3. Identify and explain object views.
4. Identify and explain dimensioning.
5. Identify and explain notes and bill of materials.
6. Interpret basic elements of a welding detail drawing.
7. Sketch or draw basic welding drawings.

Module 29203-09—Physical Characteristics and Mechanical Properties of Metal

1. Identify and explain the composition and classification of base metals.
2. Explain and demonstrate field identification methods for base metals.
3. Identify and explain the physical characteristics and mechanical properties of metals.
4. Identify and explain forms and shapes of structural metals.
5. Explain metallurgical considerations for welding metals.

Module 29204-09—Pre-heating and Post-Heating of Metals

1. Explain and demonstrate how to preheat metals.
2. Describe maintaining interpass temperature.
3. Explain post-weld heat treatment of metals.
4. Explain the effects of preheat and post-heat on metals: Heat-affected zone (HAZ), Cracking, Grain or crystal structure.
5. Relate information on construction drawings to actual locations on the print.
6. Recognize different classifications of construction drawings.
7. Interpret and use drawing dimensions.

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.

4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 3: Drawing and Welding Symbol Interpretation

1. Interprets basic elements of a drawing or sketch.
2. Interprets welding symbol information.
3. Fabricates parts from a drawing or sketch

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

Supplemental/Reinforcement Material:

NCCER Welding Core Curriculum

Module 00105-09--Introduction to Construction Drawings

1. Recognize and identify basic construction drawing terms, components, and symbols.
2. Relate information on construction drawings to actual locations on the print.
3. Recognize different classifications of construction drawings.
4. Interpret and use drawing dimensions.

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TECHNICAL CERTIFICATE REQUIRED COURSES

Course Number and Name: **WLT 1155 Pipe Welding**

Classification: Technical Certificate Core Requirement

Description: This course is designed to give the student experience in pipe welding procedures.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
5	1	8	135

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate safety precautions, and identify pipe weld test positions.
2. Describe differences in pipe and tubing and describe faults in pipe welding.
3. Use correct methods for preparation and fitting of pipe, and demonstrate correct pipe welding procedures.
4. Perform open V-grooved pipe welds and bend tests.
    a. Fabricate and weld a 2G and 5G open root V-grooved pipe weld using multiple positions using E-6010, E-7018, or other instructor approved electrodes.
    b. Pass a 6G guided bend test on an open root.

AND

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 1252 Advanced Pipe Welding**

Classification: Technical Certificate Core Requirement

Description: This course is designed to give the student advanced pipe welding techniques using shielded metal arc and gas tungsten arc welding processes.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
2	1	2	45

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Fabricate and weld pipe according to specifications using multiple positions.
    a. Fabricate and weld an open root V-grooved pipe weld using the downhill technique.
    b. Fabricate and weld an open root V-grooved multiple diameter pipe weld utilizing the GTAW process.

2. Perform open butt V-groove pipe welds using multiple positions and bend tests.
    a. Fabricate and weld an open root V-grooved pipe weld using GTAW and E-7018 electrodes.
    b. Pass a 6G guided bend test on open root V-grooved pipe weld using GTAW and E-7018 electrodes as per AWS D1.1 Code.

AND

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
8. Identify common destructive testing methods.
9. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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TECHNICAL ELECTIVE COURSES

Course Number and Name: **WLT 1162 Gas Metal Arc Aluminum Welding**

Classification: Technical Elective

Description: This course is designed to give the student experience in Gas Metal Aluminum Welding.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
2	1	2	45

National Assessment: None

Pre-requisite: Instructor Approved

Student Learning Outcomes:

1. Identify aluminum alloys, aluminum weld ability, and results of welding aluminum.
    a. List advantages of aluminum alloys.
    b. Identify factors that make aluminum difficult to weld.

2. Perform multi-pass welds.
    a. Fabricate and weld multi-pass fillet welds.
    b. Fabricate and weld 2G and 3G V-grooved butt joint.

AND

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.
7. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 2812 Welding Metallurgy**

Classification: Technical Elective

Description: This course is designed to give the student experience in the concept of metallurgy and how metals react to internal and external strains and temperature changes.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
2	2	0	30

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Explore metals and effect that heat has on these metals.
    a. Identify different types of metals by ASTM classification, and describe the characteristics and uses.
    b. Identify the effect different ranges of heat have on base metal.
    c. Identify the different structures of metal.

2. Explore the use hardness testing equipment.
    a. Identify and describe the use of hardness testing equipment.
    b. Safely perform hardness testing procedures.

3. Explore the Heat Affected Zone on weldments.
    a. Describe the effect of the heat input on the weld area.
    b. Describe methods of prevention and correction of damage to the base metal.

AND

NCCER Welding Level 1

Module 29106-09—Weld Quality

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
4. Identify common destructive testing methods.
5. Perform a visual inspection of fillet welds.

OR

AWS Sense Welding Level 1

Module 9: Welding Inspection and Testing Key Indicators

1. Examines cut surfaces and edges of prepared base metal parts.
2. Examines tacks, root passes, intermediate layers, and completed welds.

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Course Number and Name: **WLT 2913 Welding Code**

Classification: Technical Elective

Description: This course is designed to give the student experience in the various welding codes and the experience in interpretation of these codes.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
3	3	0	45

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Explore AWS D1.1 Code.
    a. Examine how WPSs, PQRs, and WQTR are relevant to code.
    b. Examine various weld joints and weld configurations.
    c. Examine base materials and electrodes related to processes used under code provisions.

2. Explore API 1104 Code.
    a. Examine how WPSs, PQRs, and WQTR are relevant to code.
    b. Examine various weld joints and weld configurations.
    c. Examine base materials and electrodes related to processes used under code provisions.

3. Explore ASME Section 9 Code.
    a. Examine how WPSs, PQRs, and WQTR are relevant to code.
    b. Examine various weld joints and weld configurations.
    c. Examine base materials and electrodes related to processes used under code provisions.

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Course Number and Name: **WLT 1426** **Basic Fabrication for Pipefitting**

Classification: Technical Elective

Description: This course is designed for the use of pipefitting tools and equipment, different ways of cutting and fitting pipes, methods of calculating pipe fittings, and various types of fit-ups for different types of pipe.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
6	2	8	150

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Explain and identify the use of various pipefitting tools and equipment.
    a. Explain the safe use of tools and equipment.
    b. Identify the proper tools for each specific task.
    c. Identify and explain the use of the equipment for each specific task.

2. Describe and fabricate various pipe assemblies.
    a. Describe methods for preparing different types of pipe for fabrication.
    b. Estimate fitting take-out.
    c. Fabricate a butt weld pipe assembly.
    d. Fabricate a socket weld pipe assembly.
    e. Fabricate a screw pipe assembly.
    f. Fabricate a piping assembly from a blueprint.
    g. Fabricate a pipe hanger.

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Course Number and Name: **WLT 2514** **Fundamentals of Robotic Welding**

Classification: Technical Elective

Description: This course is designed to introduce the student to industrial robots. Topics to be covered include robotics history, industrial robot configurations, operation, and basic programming.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
4	2	4	90

National Assessment: None

Prerequisite: None

Student Learning Outcomes:

1. Describe the various major components of all robots.
    a. Explain the axes of movement.
    b. Label each major component.
    c. Identify four general types of work envelopes.
    d. Discuss three general forms of robot actuation.
    e. Identify different types of input devices used with robot controllers.
    f. Describe the characteristics of a robot that distinguish it from other types of automated machinery.

2. Demonstrate safety procedures used in the automated environment.
    a. Apply safety rules for personal and general shop safety including eye, ear, and body protection; general rules of shop conduct; and the use of safety color coding.
    b. Apply general safety rules for tool and equipment use including hand tools, air and electric power tools, and other shop equipment.
    c. Apply general safety rules associated with working on various robotics systems.
    d. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of firefighting devices.

3. Demonstrate the ability to operate robots.
    a. Evaluate robot performance.
    b. Apply basic programming skills.
    c. Identify and discuss end effectors.
    d. Identify and discuss visual and tactile sensors.
    e. Demonstrate basic troubleshooting techniques.

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Course Number and Name: **WLT 2524** **Advanced Robotic Welding**

Classification: Technical Elective

Description: This course teaches the operating systems and advanced programming methods of industrial robots. Actual industrial grade robots are used to train the student in the areas of operation, maintenance, troubleshooting, service procedures, and robotics applications.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
4	2	4	90

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate the ability to integrate a robot into a process.
    a. Write programs on industrial robots to perform simulated industrial processes to operate within the confines of each robot's work envelope.
    b. Demonstrate the improvement of the efficiency of an automated robotics process by reducing cycle time, decreasing memory usage, using advanced programming techniques, and so forth.

2. Demonstrate the ability to integrate peripheral equipment.
    a. Program and interface peripheral devices such as a programmable logic controller into robotics work cells.
    b. Interface contact and non-contact sensors into robotics work cell.

3. Demonstrate the ability to troubleshoot and maintain a robotics work cell.
    a. Locate and isolate faults in robotics applications.
    b. Demonstrate the use of test equipment and troubleshooting logic to repair faults.
    c. Perform routine maintenance procedures on robots with the use of checklists and service equipment (null servo valves, zero encoders, calibrate potentiometers, etc.).

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Course Number and Name: **WLT 191(1-5)** **Special Problem in Welding and Cutting Technology**

Classification: Technical Elective

Description: A course to provide students with an opportunity to utilize skills and knowledge gained in other Welding and Cutting Technology courses. The instructor and student work closely together to select a topic and establish criteria for completion of the project.

Hour Breakdown:

Scheduled Hours	Internship	Clock Hours
1	3	45
2	6	90
3	9	135
4	12	180
5	15	225
6	18	270

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
    a. Use a written plan that details the activities and projects to be completed.
    b. Perform written occupational objectives in the special problem.

2. Assess accomplishment of objectives.
    a. Prepare daily written assessments of accomplishment of objectives.
    b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

3. Use and follow a set of written guidelines for the special problem.
    a. Develop and follow a set of written guidelines for the special problem.

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Course Number and Name: **WLT 192(1-6) Supervised Work Experience in Welding and Cutting Technology**

Classification: Technical Elective

Description: A course that is a cooperative program between industry and education designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of one semester hour per 45 industrial contact hours.

Hour Breakdown:

Scheduled Hours	Internship	Clock Hours
1	3	45
2	6	90
3	9	135
4	12	180
5	15	225
6	18	270

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Follow a set of instructor-written guidelines for the supervised work experience program.
2. Apply skills needed to be a viable member of the workforce.
    a. Prepare a description of skills to be developed in the supervised work experience program.
    b. Practice skills needed to be a viable member of the workforce.
3. Practice human relationship skills in the supervised work experience program.
4. Practice positive work habits, responsibilities, and ethics.
5. Develop written occupational objectives in the supervised work experience program.
6. Assess performance of occupational skills.
    a. Prepare daily written assessments of work performance as specified in the occupational objectives.
    b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

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Course Number and Name: **WLT 1931** **Welding Seminar I**

Classification: Technical Elective

Description: Instruction is designed to facilitate activities incorporated in the Skills USA (VICA) and professional organizations related to each student's career goal. This course will allow regular assembly of students to accomplish goals and objectives set by the Skills USA club, related organizations, and committees of these organizations. Leadership skills, understanding and participation in group projects, rapport with peers, community service and educational enrichment are encouraged.

Hour Breakdown:

Scheduled Hours	Clinical	Clock Hours
1	2	30

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
    a. Use a written plan that details the activities and projects to be completed.
    b. Perform written occupational objectives in the special problem.

2. Assess accomplishment of objectives.
    a. Prepare daily written assessments of accomplishment of objectives.
    b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

3. Use and follow a set of written guidelines for the special problem.
    b. Develop and follow a set of written guidelines for the special problem.

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Course Number and Name: **WLT 1941 Welding Seminar II**

Classification: Technical Elective

Description: Instruction is designed to facilitate activities incorporated in the Skills USA (VICA) and professional organizations related to each student's career goal. This course will allow regular assembly of students to accomplish goals and objectives set by the Skills USA club, related organizations, and committees of these organizations. Leadership skills, understanding and participation in group projects, rapport with peers, community service and educational enrichment are encouraged.

Hour Breakdown:

Scheduled Hours	Clinical	Clock Hours
1	2	30

National Assessment: None

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
   - ~~O~~a. Use a written plan that details the activities and projects to be completed.
   - ~~O~~b. Perform written occupational objectives in the special problem.

2. Assess accomplishment of objectives.
   - ~~O~~a. Prepare daily written assessments of accomplishment of objectives.
   - ~~O~~b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

3. Use and follow a set of written guidelines for the special problem.
   - c. Develop and follow a set of written guidelines for the special problem.

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Course Number and Name: **DDT 1114** **Fundamentals of Drafting**

Classification: Technical Elective

Description: The course is designed to teach the fundamentals and principles of drafting to provide the basic background needed for all other drafting courses.

Hour Breakdown:

Scheduled Hours	Lecture	Lab	Clock Hours
4	2	4	90

National Assessment:

Prerequisite: None

Student Learning Outcomes:

1. Discuss classroom procedures and drafting occupations.
    a. Describe proper classroom/lab procedures.
2. Describe the various occupations in drafting and their requirements.
   Explain and apply safety rules and regulations.
    a. Describe safety rules for drafting occupations.
    b. List and discuss hazardous materials found in the drafting area.
3. Apply proper techniques in technical drawings.
    a. Demonstrate the ability to scale drawings.
    b. Construct various angles.
    c. Recognize and construct the alphabet of lines.
4. Sketch and develop views of basic shapes.
    a. Develop a pictorial view from three principal views.
    b. Develop three principal views from a pictorial view.
    c. Complete three principal views when lines are missing.
5. Use geometric constructions.
    a. Construct tangent arcs and lines.
    b. Divide lines or arcs into equal and/or proportional parts.
    c. Develop geometric shapes.
6. Construct orthographic projections.
    a. Construct a top view, with front and right side views given.
    b. Construct a front view, with top and right side views given.
    c. Construct a right side view, with top and front views given.
    d. Develop a drawing consisting of three principal views.
7. Dimension objects.
    a. Recognize lines, symbols, features, and conventions used in dimensioning.
    b. Recognize and use size and location dimensions.
    c. Recognize and use general and local notes.
    d. Dimension a drawing using contour, chain, and baseline dimensioning.
8. Construct sectional views.
    a. Construct full and half sectional views.
    b. Recognize and construct removed, revolved, offset, and aligned sectional views.

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RECOMMENDED TOOLS AND EQUIPMENT

Capitalized Items

Access to some tools and equipment may be provided by Machine Shop, Electrical, Plumbing/Pipefitting, Automotive, and Welding Program facilities.

1. Oxyfuel burning table with dross pan and replaceable slats (4 ft x 8 ft x 31 in.) (1)
2. OSHA approved exhaust system (1)
3. Guided bend test jig or machine (hydraulic) (1)
4. Plasma arc cutting device with min. 1/2 in. cutting depth with accessories (2)
5. Combination (multi-process) machine with power source (6 or 8 pack) with cables and accessories for 4 GTAW and 4 GMAW setup with accessories (13)
6. Shielded metal arc welding machines (AC/DC - constant current 250-300 amp @ 60%) with cables and with accessories (13)
7. Oxyfuel gas cutting equipment with regulators, hoses, torch, tips, cart, and accessories (5 sets)
8. Machine oxyfuel gas cutting equipment with regulators, hoses, torch, tips, rails or track, and accessories (1 set)
9. Leather jacket, cape, sleeves or apron, and leather gloves (1 set per student)
10. Ironworker with accessories (70 ton) (1)
11. Large drill press with accessories (1)
12. Small drill press with accessories (1)
13. Band saw (vertical or horizontal) (1)
14. Portable abrasive cutoff saw (min. 16 in.) (1)
15. Heavy-duty four-wheel material mover (1)
16. Crane (A-frame) heavy duty, with 5 T electric hoist (1)
17. Pipe bevel machine for mild steel (oxyfuel) (1)
18. Welder, engine driven (200 A, constant current/constant voltage @ 60% duty cycle) (1)
19. Electrode shop oven (1)
20. AWS Welding Educator's Library, Miami, FL: American Welding Society, 1995
21. Microcomputer with CD-ROM, SVGA graphics card, and modem and operating software (20)
22. Fork lift (1)

Non-Capitalized Items

1. First aid kit (2)
2. Emergency eye wash station (1)
3. Workbench with medium duty vise (4)
4. 8-in. C-clamps (1 per student)
5. 4 1/2-in. right angle grinder (5)
6. 9-in. right angle grinder (5)
7. Work area protective screens (as required) (1 for each welding booth)
8. Framing squares (24 in. x 18 in.) (6)
9. Compressed air hose (50 ft) with retractable reel (2)
10. Compressed air regulator (1)
11. Male and female quick couples and adaptors (2)
12. Hose repair kit with crimping tool for oxyfuel cutting equipment (2)
13. Safety glasses with side shields (1 per student)
14. Burning goggles (1 per student)
15. Face shield (10 per program)
16. #5 Filter plate/lens for burning goggles (1 per student)
17. Clear cover plate/lens for burning goggles (2 per student)
18. Welding helmet #10 shaded filter plate/lens, with head gear and accessories (20)

19. Welding lenses to match helmet, #11 shaded filter plate/lens (6 sets)
20. Clear cover plate/lens for welding helmets (2 per student)
21. Stainless steel wire brush (20)
22. 16-oz ball-peen hammer (4)
23. 4-lb shop hammer (4)
24. Electric hand drill (1/2 inch chuck) (2)
25. Retractable extension cords (4)
26. Center punches (1 set)
27. Metal scribe (6)
28. Steel dividers (radius maker, min. 6 in.) (2)
29. Steel tape measure (minimum 10 ft) (20)
30. Combination square set (4)
31. Chipping hammer (20)
32. 10 inch mill file (half round-bastard cut) (20)
33. Cold chisels (1 set)
34. Adjustable wrenches (12 in., 10 in., 8 in., 6 in.) (1 set)
35. Tank wrench (2)
36. 10-in. groove or slip joint pliers (8)
37. 6-in. combination side cutting/needle nose pliers (10)
38. 10-in. vise grips (4)
39. 10-in. vise grip clamp or tongs (20)
40. Allen or hex wrenches, standard and metric (1/16 - 3/8) (2 sets)
41. Screwdrivers, flat head (1 set)
42. Screwdrivers, Phillips head (1 set)
43. Oxyfuel friction lighter, with flints and tip cleaners (12)
44. Fillet gages (2 sets)
45. Pedestal grinder (2)
46. Jack stands (2 sets)
47. Carbon arc gouging whip (5)
48. Steel wire brush (20)
49. AWS Safety in Welding and Cutting (ANSI/ASC Z49.1-88). Miami, FL: American Welding Society, 1988 (1)

Recommended Instructional Aids

It is recommended that instructors have access to the following items:

1. Screen, projection (1 per program)
2. Overhead projector (1) and Cutting Technology
3. Video out (Microcomputer to TV monitor) (1)
4. Interactive presentation board with accessories (1)

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INTEGRATED PATHWAY COURSE NUMBER CROSSWALK

The Mississippi Integrated Pathway Model is designed to allow students to complete coursework in smaller semester credit hour courses. Content from each module can be found in the courses listed in the first column of the following table.

Traditional Course Number	Integrated Pathway Course Number	Aligned Industry Certification
WLT 1173 Introduction to Welding Safety	WLT 1111 Welding Safety, Math, and Hand Tools	NCCER Core Curriculum • Module 00101-09— Basic Safety • Module 00102-09—Introduction to Construction Math • Module 00103-09—Introduction to Hand Tools NCCER Welding Level 1 • Module 29101-09—Welding Safety
	WLT 1121 Welding Power Tools, Drawings, and Rigging	NCCER Core Curriculum • Module 00104-09—Introduction to Power Tools • Module 00105-09—Introduction to Construction Drawing • Module 00106-09—Basic Rigging
	WLT 1131 Communication Skills, Employability Skills, and Materials Handling	NCCER Core Curriculum • Module 00107-09—Basic Communication Skills • Module 00108-09—Basic Employability Skills • Module 00109-09—Introduction to Materials Handling
WLT 1115 Shielded Metal Arc Welding I	WLT 1141 SMAW Basic Metal Preparation	NCCER Welding Level 1 • Module 29105-09—Base Metal Preparation
	WLT 1151 SMAW Equipment and Setup	NCCER Welding Level 1 • Module 29107-09—SMAW-Equipment and Setup
	WLT 1171 SMAW Electrodes	NCCER Welding Level 1 • Module 29108-09—Shielded Metal Arc Welding-Electrodes
	WLT 1181 SMAW Beads and Fillet Welds	NCCER Welding Level 1 • Module 29109-09—SMAW-Beads and Fillet Welds
	WLT 1191 SMAW Weld Quality	NCCER Welding Level 1 • Module 29106-09—Weld Quality

WLT 1225 Shielded Metal Arc Welding II	WLT 1211 SWAM Joint Fit-Up and Alignment	NCCER Welding Level 1 • Module 29110-09—Joint Fit-Up and Alignment
	WLT 1221 SWAM Groove Welds and Backing	NCCER Welding Level 1 • Module 29111-09—SMAW- Groove Welds with Backing
	WLT 1241 SWAM Open V-Groove Welds	NCCER Welding Level 1 • Module 29112-09—Open V-Groove Welds
	WLT 1261 SMAW II Weld Quality I	NCCER Welding Level 1 • Module 29106-09—Weld Quality
	WLT 1271 SMAW II Weld Quality II	NCCER Welding Level 1 • Module 29106-09—Weld Quality
WLT 1313 Cutting Processes	WLT 1311 Oxyfuel Cutting	NCCER Welding Level 1 • Module 29102-09—Oxyfuel Cutting • Module 29106-09—Weld Quality
	WLT 1321 Plasma Arc Cutting	NCCER Welding Level 1 • Module 29103-09—Plasma Arc Cutting • Module 29106-09—Weld Quality
	WLT 1331 Air Carbon Arc Cutting and Gouging	NCCER Welding Level 1 • Module 29104-09—Air Carbon Arc Cutting and Gouging (GMAW Only) • Module 29106-09—Weld Quality
WLT Gas Metal Arc Welding (GMAW)	WLT 1342 GMAW Equipment and Filler Metals	NCCER Welding Level 1 • Module 29205-09—GMAW and FCAW: Equipment and Filler Metals (GMAW Only) • Module 29106-09—Weld Quality
	WLT 1352 GMAW Plate	NCCER Welding Level 1 • Module 29206-09—GMAW and FCAW: Plate (GMAW Only) • Module 29106-09—Weld Quality
WLT 1143 Flux Cored Arc Welding (FCAW)	WLT 1361 FCAW Equipment and Filler Metals	NCCER Welding Level 1 • Module 29205-09—GMAW and FCAW: Equipment and Filler Metals (FCAW Only)
	WLT 1371 FCAW Plate	NCCER Welding Level 1 • Module 29206-09—GMAW and FCAW: Plate (FCAW Only)
	WLT 1381 FCAW Weld Quality	NCCER Welding Level 1 • Module 29106-09—Weld Quality (FCAW Only)
WLT 1135 Gas Tungsten Arc Welding (GTAW)	WLT1412 GTAW: Equipment and Filler Metals	NCCER Welding Level 2 • Module 29207-09—GTAW: Equipment and Filler Metals
	WLT 1422 GTAW: Plate	NCCER Welding Level 2 • Module 29208-09—GTAW: Plate

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	WLT 1431 GTAW Weld Quality	NCCER Welding Level 1 • Module 29106-09—Weld Quality (GTAW)
WLT 1232 Blueprint Reading, Welding Symbols, and Metallurgy	WLT 1451 Welding Symbols and Drawings	NCCER Welding Level 2 • Module 29201-09—Welding Symbols • Module 29202-09—Reading Welding Detail Drawings
	WLT 1461 Metallurgy	NCCER Welding Level 2 • Module 29203-09—Physical Characteristics and Mechanical Properties of Metal • Module 29204-09—Pre-heating and Post-Heating of Metals NCCER Welding Level 1 • Module 29106-09—Weld Quality (GTAW)

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STUDENT COMPETENCY PROFILE

Student competency profiles are not required, but can assist instructors in documenting student performance.

Student Name: _____

Date Student Mastered Material	**Course Number and Name**	**NCCER Credential and Module**
	WLT 1173 Introduction to Welding Safety	NCCER Core Curriculum Module 00101-09—Basic Safety Module 00102-09—Introduction to Construction Math Module 00103-09—Introduction to Hand Tools Module 00104-09—Introduction to Power Tools Module 00105-09—Introduction to Construction Drawing Module 00106-09—Basic Rigging Module 00107-09—Basic Communication Skills Module 00108-09—Basic Employability Skills Module 00109-09—Introduction to Materials Handling NCCER Welding Level 1 Module 29101-09—Welding Safety OR AWS Sense Level 1 Module 1: Occupational Orientation Module 2: Safety and Health of Welders

	WLT 1115 Shielded Metal Arc Welding I	NCCER Welding Level 1 Module 29105-09—Base Metal Preparation Module 29107-09—SMAW-Equipment and Setup Module 29108-09—Shielded Metal Arc Welding-Electrodes Module 29109-09—SMAW-Beads and Fillet Welds Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 4: Shielded Metal Arc Welding (SMAW) Module 9: Welding Inspection And Testing Key Indicators
	WLT 1225 Shielded Metal Arc Welding II	NCCER Welding Level 1 Module 29110-09—Joint Fit-Up and Alignment Module 29111-09—SMAW- Groove Welds with Backing Module 29112-09—Open V-Groove Welds Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 4: Shielded Metal Arc Welding (SMAW) *(Continued from WLT 1115)* MODULE 9: WELDING INSPECTION AND TESTING KEY INDICATORS
	WLT 1314 Cutting Processes	NCCER Welding Level 1 Module 29102-09—Oxyfuel Cutting Module 29103-09—Plasma Arc Cutting Module 29104-09—Air Carbon Arc Cutting and Gouging Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 8: Thermal Cutting Processes Module 9: Welding Inspection and Testing Key Indicators
	WLT 1124 Gas Metal Arc Welding (GMAW)	NCCER Welding Level 2 *(Only GMAW components)* Module 29205-09—GMAW and FCAW: Equipment and Filler Metals Module 29206-09—GMAW and FCAW: Plate NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 5: Gas Metal Arc Welding (GMAW-S, GMAW Spray Transfer) Module 9: Welding Inspection And Testing Key Indicators

	WLT 1143 Flux Cored Arc Welding (FCAW)	NCCER Welding Level 2 Module 29205-09—GMAW and FCAW: Equipment and Filler Metals Module 29206-09—GMAW and FCAW: Plate NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 6: Flux Cored Arc Welding (FCAW-G/GM, FCAW-S) Module 9: Welding Inspection And Testing Key Indicators
	WLT 1135 Gas Tungsten Arc Welding (GTAW)	NCCER Welding Level 2 Module 29207-09—GTAW: Equipment and Filler Metals Module 29208-09—GTAW: Plate NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 7: Gas Tungsten Arc Welding (GTAW) Module 9: Welding Inspection and Testing Key Indicators
	WLT 1232 Blueprint Reading, Welding Symbols, and Metallurgy	NCCER Welding Level 2 Module 29201-09—Welding Symbols Module 29202-09—Reading Welding Detail Drawings Module 29203-09—Physical Characteristics and Mechanical Properties of Metal Module 29204-09—Pre-heating and Post-Heating of Metals NCCER Welding Level 1 Module 29106-09—Weld Quality OR AWS Sense Level 1 Module 3: Drawing and Welding Symbol Interpretation Module 9: Welding Inspection and Testing Key Indicators

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CURRICULUM DEFINITIONS AND TERMS

- Course Name – A common name that will be used by all community colleges in reporting students

- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students

- Classification – Courses may be classified as the following:
    - Career Certificate Required Course – A required course for all students completing a career certificate.
    - Technical Certificate Required Course – A required course for all students completing a technical certificate.
    - Technical Elective – Elective courses that are available for colleges to offer to students.

- Description – A short narrative that includes the major purpose(s) of the course

- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course

- Corequisites – A listing of courses that may be taken while enrolled in the course

- Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
    - Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
    - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
    - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
    - Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career–technical programs
    - Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas

- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.

- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:

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- Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework
- Revising or extending the student learning outcomes
- Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)

2009 Mississippi Curriculum Framework

Postsecondary Welding and Cutting Technology

(Program CIP: 48.0508 – Welding Technology/Welder)

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Standards in this document are based on information from the following organizations:

Standards and Guidelines for Welding and Cutting Programs	American Welding Society Standards EG2.0-95. (2005). 550 N.W. LeJeune Road, Miami, Florida 33126. Retrieved August 10, 2005 from http://www.aws.org/
Related Academic Standards	CTB/McGraw-Hill LLC. (1994). *Tests of adult basic education, forms 7 and 8.* Monterey, CA: Author. Reproduced with permission of CTB/McGraw-Hill LLC. TABE is a registered trademark of The McGraw-Hill Companies, Inc. Copyright © 1994 by CTB/McGraw-Hill LLC. Reproduction of this material is permitted for educational purposes only.
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National Educational Technology Standards for	Reprinted with permission from *National Educational Technology Standards for Students: Connecting*

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~~Preface~~

~~Welding and Cutting Technology~~

~~Welding is an important industry in the U.S. The process is used in the manufacture of thousands of products and is involved in the infrastructure of most construction. According to the Bureau of Labor Statistics (2008), there are more than 80 different techniques available to welders. With this information, it should be clear that there will always be a need for trained welders. However, while there are welders coming through our educational systems, industry is reporting a lack of skilled welders available for hire. Ondov and Smith (2009) stated, "…evidence of a skilled workforce decline has surfaced—precipitated by increasingly ill-prepared new workers, steadily depleting stock of highly skilled and educated workers and the decrease in domestic manufacturing" (p. 37).~~

~~Postsecondary CTE programs must ensure labor market responsiveness and alignment with industry-recognized standards. Funding would be used to build and support strong linkages and partnerships with employers and to develop programs responsive to the labor market. Professional development for faculty must include opportunities to keep knowledge and skills current with the needs of business and industry and to understand and be able to demonstrate applications of knowledge, based on workplace needs (Brand, 2003, p.11).~~

~~Needs of the Workforce~~

~~Levi (2007) stated that there was a predicted shortage in most areas of manufacturing and welders were included in that shortage. The American Welding Society (AWS) claimed that the supply will be exceeded by the demand for skilled welders by next year. The Bureau of Labor Statistics (2007) gave a reason welding would be a good field to enter was because employers are reporting they are not able to hire enough qualified welders.~~

~~This means that industry and schools are offering enticements to encourage students to enter the welding industry. Levi (2007) mentioned that industry offers tuition reimbursement and scholarships to students and bonuses and higher salaries to employees to further their educations. Schools offer apprenticeships to give students hands-on experience during their educational program.~~

~~The outlook for the state shows an increase in employment projected through the year 2016 for all welding occupations except boilermakers, which is predicted to hold steady. There are jobs predicted to open in all areas due to attrition and retirement (Table 1). Salaries for the welding occupations are listed in Table 2.~~

Table 1: Employment projections for the State of Mississippi

Occupational Employment Projections, Year 2006 Projected to Year 2016 State of Mississippi						
Standard Occupational Classification (SOC)		2006 Employment	2016 Projected Employment	Projected Employment Growth 2006 to 2016		Total Projected Avg. Annual Job Openings
Code	Occupation			Number	Percent	
47-2011	Boilermakers	240	240	0	0.00%	15
47-2152	Plumbers, Pipefitters, and Steamfitters	5,680	6,630	950	16.70%	220
47-2211	Sheet Metal Workers	2,190	2,590	400	18.30%	90
47-2221	Structural Iron and Steel Workers	850	1,000	150	17.60%	30
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	790	940	150	19.00%	55
51-4121	Welders, Cutters, Solderers, and Brazers	7,140	8,290	1,150	16.10%	315
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	300	350	50	16.70%	15

Mississippi Department of Employment Security, 2007

Table 2: Salaries for Welding Professions in Mississippi

Standard Occupational Classification (SOC)		Employment	Average Hourly	Average Annual	Entry Hourly	Entry Annual	Exp Hourly	Exp Annual
Code	Occupation							
47-2011	Boilermakers	400	$24.44	$50,830	$17.72	$36,860	$27.80	$57,810
47-2152	Plumbers, Pipefitters, and Steamfitters	6070	$17.89	$37,210	$11.81	$24,570	$20.93	$43,530
47-2211	Sheet Metal Workers	1,760	$13.96	$29,030	$10.64	$22,130	$15.62	$32,480
47-2221	Structural Iron and Steel Workers	870	$14.90	$31,000	$10.21	$21,240	$17.25	$35,880
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	840	$11.32	$23,540	$8.62	$17,940	$12.66	$26,340

51-4121	Welders, Cutters, Solderers, and Brazers	N/A	$16.10	$33,480	$11.96	$24,870	$18.17	$37,780
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	320	$13.45	$27,970	$10.35	$21,520	$15.00	$31,200

Mississippi Department of Employment Security, 2007

Nationwide, there is predicted to be a net increase in all areas of welding occupations, including boilermakers (Table 3).

Table 3: National employment predictions, 2006-2016

2006 National Employment Matrix code and title		Employment		Change, 2006-2016		Total job openings due to growth and net replacements, 2006-2016
		Number		Number	Percent	
		2006	2016			
47-2011	Boilermakers	18,000	20,000	2,000	14.0	9,000
47-2152	Plumbers, Pipefitters, and Steamfitters	502,000	555,000	53,000	10.6	157,000
47-2211	Sheet Metal Workers	189,000	201,000	13,000	6.8	59,000
47-2221	Structural Iron and Steel Workers	72,000	76,000	4,000	6.0	28,000
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	85,000	95,000	10,000	11.9	32,000
51-4120	Welding, soldering, and brazing workers	462,000	484,000	22,000	4.8	120,000
51-4121	Welders, Cutters, Solderers, and Brazers	409,000	430,000	21,000	5.1	107,000
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	53,000	54,000	2,000	3.0	13,000

Bureau of Labor Statistics, 2007

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Curriculum

With over 80 different processes used in the welding industry (U.S. Bureau of Labor Statistics, 2007), programs have to determine which ones are going to be in the most demand in their area of the field. With programs in some areas concentrating on underwater welding processes because of the predominance of offshore drilling and other programs being located in areas with industry that use semiautomatic machinery, programs will have to decide which types of welding training they wish to concentrate on providing.

The following national standards were referenced in each course of the curriculum:

- CTB/McGraw-Hill LLC *Tests of Adult Basic Education, forms 7 and 8* Academic Standards
- *21st Century Skills*
- *American Welding Society Standards EG2.0-95*

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Industry and instructor comments, along with current research, were considered by the curriculum revision team during the revision process, and changes were made as needed and appropriate. Many of the skills and topics noted in the research were already included in the curriculum framework. Specific changes made to the curriculum at the fall 2009 curriculum revision meeting include the following:

- Competencies and objectives were reviewed to ensure accuracy and appropriateness.
- The reference list was updated.
- The Recommended Tools and Equipment list was updated.
- A 2-year technical degree was developed.
- Six electives were added at the request of industry and instructors.

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Assessment

The career and technical assessment in Mississippi (MS-CPAS2) encourages improvement through assessment as well as tests for mastery of standards and competencies within each program area. The assessment is scored on multiple levels allowing teachers and administrators to understand student performance. The class level score report yields comparative data among and between students in a class within a particular program. The district level score shows the class's performance comparative to the program within a single district, while the state report shows assessment performance of all the districts. Teachers and administrators should use MS-CPAS2 score reports to assess strengths and weaknesses to improve instruction. The other goal of the assessment is to demonstrate mastery of competencies related to on-the-job performance.

Best Practices

Teachers are expected to use a wide variety of teaching strategies throughout the curriculum to instruct competencies in various methods. Teachers should develop strategies that reflect academic achievement, problem solving, and industry needs for daily use in the classroom.

Professional Learning

It is suggested that instructors participate in professional learning related to the following concepts:

- How to use the program Blackboard site
- Differentiated instruction – To learn more about differentiated instruction, please go to http://www.paec.org/teacher2teacher/additional_subjects.html, and click on Differentiated Instruction. Work through this online course, and review the additional resources.

Articulation

Statewide articulations are subject to change as secondary and postsecondary curriculum revisions occur.

All articulations listed in this document are effective as of July 1, 2008, unless otherwise noted.

SEC Program	PS Program	PS Courses
S Welding Theory & Applications (CIP 48.0508)	PS Welding & Cutting Tech (CIP 48.0508)	WLV 1116 – Shielded Metal Arc Welding I

Statewide Guidelines on Articulated Credit

Eligibility

- To be eligible for articulated credit, a student must do the following:
  - Complete the articulated Secondary Vocational Program
  - Score 80% or higher on the Mississippi Career Planning and Assessment System (MS CPAS) in his or her secondary program of study
- To be awarded articulated credit, a student must do the following:
  - Complete application for articulated credit at the community or junior college
  - Enroll in the community or junior college within 18 months of graduation
  - Successfully complete 12 non-developmental career/technical or academic credit hours in the corresponding articulated postsecondary career-technical program of study

How MS CPAS will be documented

- The Research and Curriculum Unit (RCU) of Mississippi State University will provide the SBCJC a list of all secondary CTE students scoring at or above the 80 percentile for the articulated programs.
- The SBCJC will forward the list of students eligible for articulated credit to the colleges.

Transcripting of Articulated Credit

- Students must complete 12 non-developmental career/technical or academic credit hours in the articulated postsecondary career-technical program of study before the articulated credit is transcripted.
- No grade will be given on the transcript for articulated courses; only hours granted will be transcripted (thus resulting in no change in quality points).

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~~*Time Limit*~~

- ~~MS CPAS scores will be accepted to demonstrate competencies for up to 18 months after high school graduation.~~

~~*Cost*~~

- ~~No costs will be assessed on hours earned through articulated credit.~~

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~~Foreword~~

~~As the world economy continues to evolve, businesses and industries must adopt new practices and processes in order to survive. Quality and cost control, work teams and participatory management, and an infusion of technology are transforming the way people work and do business. Employees are now expected to read, write, and communicate effectively; think creatively, solve problems, and make decisions; and interact with each other and the technologies in the workplace. Vocational–technical programs must also adopt these practices in order to provide graduates who can enter and advance in the changing work world.~~

~~The curriculum framework in this document reflects these changes in the workplace and a number of other factors that impact on local vocational–technical programs. Federal and state legislation calls for articulation between high school and community college programs, integration of academic and vocational skills, and the development of sequential courses of study that provide students with the optimum educational path for achieving successful employment. National skills standards, developed by industry groups and sponsored by the U.S. Department of Education and Labor, provide vocational educators with the expectations of employers across the United States. All of these factors are reflected in the framework found in this document.~~

~~Each postsecondary program of instruction consists of a program description and a suggested sequence of courses that focus on the development of occupational competencies. Each vocational–technical course in this sequence has been written using a common format that includes the following components:~~

- ~~Course Name—A common name that will be used by all community/junior colleges in reporting students~~
- ~~Course Abbreviation—A common abbreviation that will be used by all community/junior colleges in reporting students~~
- ~~Classification—Courses may be classified as the following:~~
  - ~~Vocational–technical core—A required vocational–technical course for all students~~
  - ~~Area of concentration (AOC) core—A course required in an area of concentration of a cluster of programs.~~
  - ~~Vocational–technical elective—An elective vocational–technical course~~
  - ~~Related academic course—An academic course that provides academic skills and knowledge directly related to the program area~~
  - ~~Academic core—An academic course that is required as part of the requirements for an associate degree~~
- ~~Description—A short narrative that includes the major purpose(s) of the course and the recommended number of hours of lecture and laboratory activities to be conducted each week during a regular semester~~
- ~~Prerequisites—A listing of any courses that must be taken prior to or on enrollment in the course~~

- Corequisites – A listing of courses that may be taken while enrolled in the course

- Competencies and Suggested Objectives – A listing of the competencies (major concepts and performances) and of the suggested student objectives that will enable students to demonstrate mastery of these competencies

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
    - Additional competencies and objectives within the course related to topics not found in the State framework, including activities related to specific needs of industries in the community college district
    - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
    - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/revised
    - Activities that implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational–technical skills and coursework, school-to-work transition activities, and articulation of secondary and postsecondary vocational–technical programs
    - Individualized learning activities, including worksite learning activities, to better prepare individuals in the courses for their chosen occupational area

- Sequencing of the course within a program is left to the discretion of the local district. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

- Programs that offer an Associate of Applied Science degree must include a minimum 15 semester credit hour academic core. Specific courses to be taken within this core are to be determined by the local district. Minimum academic core courses are as follows:
    - 3 semester credit hours – Math/Science Elective
    - 3 semester credit hours – Written Communications Elective
    - 3 semester credit hours – Oral Communications Elective
    - 3 semester credit hours – Humanities/Fine Arts Elective
    - 3 semester credit hours – Social/Behavioral Science Elective

It is recommended that courses in the academic core be spaced out over the entire length of the program so that students complete some academic and vocational–technical courses each semester. Each community/junior college has the discretion to select the actual courses that are required to meet this academic core requirement.

1. In instances where secondary programs are directly related to community and junior college programs, competencies and suggested objectives from the high school programs are listed as Baseline Competencies. These competencies and objectives reflect skills and knowledge that are directly related to the community and junior college vocational–technical program. In adopting the curriculum framework, each community and junior college is asked to give assurances that:
    2. Students who can demonstrate mastery of the Baseline Competencies do not receive duplicate instruction and
    3. Students who cannot demonstrate mastery of this content will be given the opportunity to do so.

4. The roles of the Baseline Competencies are to do the following:
    5. Assist community/junior college personnel in developing articulation agreements with high schools
    6. Ensure that all community and junior college courses provide a higher level of instruction than their secondary counterparts

7. The Baseline Competencies may be taught as special "Introduction" courses for 3–6 semester hours of institutional credit that will not count toward associate degree requirements. Community and junior colleges may choose to integrate the Baseline Competencies into ongoing courses in lieu of offering the "Introduction" courses or may offer the competencies through special projects or individualized instruction methods.

8. Technical elective courses have been included to allow community colleges and students to customize programs to meet the needs of industries and employers in their area.

In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:

- Adding new competencies and suggested objectives
- Revising or extending the suggested objectives for individual competencies
- Integrating baseline competencies from associated high school programs
- Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the State Board for Community and Junior Colleges [SBCJC] of the change)

In addition, the curriculum framework as a whole may be customized by doing the following:

1. Resequencing courses within the suggested course sequence
2. Developing and adding a new course that meets specific needs of industries and other clients in the community or junior college district (with SBCJC approval)
3. Utilizing the technical elective options in many of the curricula to customize programs

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Table of Contents

~~Program Description~~

~~The Welding and Cutting Technology curriculum is designed to prepare the student for entry-level employment in the field of welding and cutting. The curriculum includes Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), Plasma Arc Cutting (PAC), Carbon Arc Cutting, Oxyfuel Cutting, and Gas Tungsten Arc Welding (GTAW). Electives are available in advanced levels of welding and cutting.~~

~~National Standards Developed by American Welding Society (AWS)~~

~~The welding competencies required in this curriculum were developed to coincide with the Guide for the Training and Qualification of Welding Personnel: Entry-Level Welders (AWS EG2.0-95) and Specification for Qualification and Certification for Entry-Level Welders (AWS QC 10-95), developed by the American Welding Society and funded by the U.S. Department Education under Grant V.244 B 3006. The contributions of this resource are hereby acknowledged.~~

~~The American Welding Society provides a series of reference materials to support this curriculum. For additional information on AWS Educational Membership contact: American Welding Society, AWS Education Department, 550 NW LeJeune Road, Miami, FL 33161, (800) 443-WELD, FAX: (305) 443-7559, (www.aws.org).~~

~~Industry standards are based on the *American Welding Society Standards EG2.0-95*.~~

~~Articulation~~

~~There are no articulation agreements for this program.~~

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Suggested Course Sequence*
Welding and Cutting Certificate

Baseline Competencies for Welding and Cutting**

FIRST YEAR

6 sch Shielded Metal Arc Welding I (WLV 1116)
6 sch Shielded Metal Arc Welding II (WLV 1226)
3 sch Flux Cored Arc Welding (WLV 1143)
1 sch Welding Safety, Inspection and Testing Principles (WLV 1171)
2 sch Drawing and Welding Symbol Interpretation (WLV 1232)

18 sch

6 sch Gas Tungsten Arc Welding (WLV 1136)
4 sch Gas Metal Arc Welding (WLV 1124)
4 sch Cutting Processes (WLV 1314)
4 sch Electives†

18 sch

A Basic SMAW Certificate will be offered to students who exit the Welding and Cutting program after the first semester.

* Students who lack entry-level skills in math, English, science, and so forth will be provided related studies.

** Baseline competencies are taken from the high school Metal Trades program. Students who can document mastery of these competencies will not receive duplicate instruction. Students who cannot demonstrate mastery will be required to do so.

† ELECTIVES

Other instructor-approved electives
Pipe Welding (WLV 1155)
Advanced Pipe Welding (WLV 1252)
Gas Metal Arc Aluminum Welding (WLV 1162)
Welding Code (WLV 2913)
Welding Metallurgy (WLV 2812)
Special Problem in Welding and Cutting Technology [(WLV 191(1-3)]
Supervised Work Experience in Welding and Cutting Technology [WLV 192(1-6)]
Work-Based Learning I, II, III, IV, V, and VI [WBL 191(1-3), WBL 192(1-3), WBL 193(1-3), WBL 291(1-3), WBL 292(1-3), and WBL 293(1-3)]

Suggested Course Sequence*
Welding and Cutting Technology

Baseline Competencies for Welding and Cutting**

FIRST YEAR

6 sch Shielded Metal Arc Welding I (WLV 1116)
6 sch Shielded Metal Arc Welding II (WLV 1226)
3 sch Flux Cored Arc Welding (WLV 1143)
1 sch Welding Safety, Inspection and Testing Principles (WLV 1171)
2 sch Drawing and Welding Symbol Interpretation (WLV 1232)

18 sch

6 sch Gas Tungsten Arc Welding (WLV 1136)
4 sch Gas Metal Arc Welding (WLV 1124)
4 sch Cutting Processes (WLV 1314)
4 sch Electives†

18 sch

A Basic SMAW Certificate will be offered to students who exit the Welding and Cutting program after the first semester.

* Students who lack entry-level skills in math, English, science, and so forth will be provided related studies.

** Baseline competencies are taken from the high school Metal Trades program. Students who can document mastery of these competencies will not receive duplicate instruction. Students who cannot demonstrate mastery will be required to do so.

† ELECTIVES

Other instructor-approved electives
Basic Fabrication for Pipefitting (PPV 1426)
Fundamentals of Drafting (DDT 1114)
Fundamentals of Robotics (ROT 1113)
Industrial Maintenance Math and Measurement (IMM1122)
Industrial Robotics (ROT 1313)
Pipe Welding (WLV 1155)
Advanced Pipe Welding (WLV 1252)
Gas Metal Arc Aluminum Welding (WLV 1162)
Special Problem in Welding and Cutting Technology [(WLV 191(1-3)]
Steel Ship Building and Marine Construction (PPV 1823)
Supervised Work Experience in Welding and Cutting Technology [WLV 192(1-6)]
Work-Based Learning I, II, III, IV, V, and VI [WBL 191(1-3), WBL 192(1-3), WBL 193(1-3), WBL 291(1-3), WBL 292(1-3), and WBL 293(1-3)]

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Suggested Course Sequence*
Welding and Cutting Technology

Baseline Competencies for Welding and Cutting**

SECOND YEAR

3 sch Humanities/Fine Arts Elective
3 sch Written Communications Elective
3 sch Computer Application
3 sch Metallurgy
3-6 sch Technical Elective†
15-18 sch

3 sch Math/Science Elective
3 sch Oral Communications Elective
3 sch Social Science/ Behavioral Science Elective
3 sch Weld Code
3-6 sch Technical Elective†
15-18 sch

* Students who lack entry-level skills in math, English, science, and so forth will be provided related studies.

** Baseline competencies are taken from the high school Metal Trades program. Students who can document mastery of these competencies will not receive duplicate instruction. Students who cannot demonstrate mastery will be required to do so.

† ELECTIVES

Other instructor approved electives
Basic Fabrication for Pipefitting (PPV 1426)
Fundamentals of Drafting (DDT 1114)
Fundamentals of Robotics (ROT 1113)
Industrial Maintenance Math and Measurement (IMM1122)
Industrial Robotics (ROT 1313)
Pipe Welding (WLV 1155)
Advanced Pipe Welding (WLV 1252)
Gas Metal-Arc Aluminum Welding (WLV 1162)
Special Problem in Welding and Cutting Technology [(WLV 191(1-3)]
Steel Ship Building and Marine Construction (PPV 1823)
Supervised Work Experience in Welding and Cutting Technology [WLV 192(1-6)]
Work-Based Learning I, II, III, IV, V, and VI [WBL 191(1-3), WBL 192(1-3), WBL 193(1-3), WBL 291(1-3), WBL 292(1-3), and WBL 293(1-3)]

Welding and Cutting Courses

Course Name: Shielded Metal Arc Welding I

Course Abbreviation: WLV 1116

Classification: Vocational–Technical Core

Description: This course is designed to teach students welding techniques using E-6010 electrodes. (6 sch: 1-hr lecture, 10-hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Discuss and apply shielded metal arc welding operations. a. Perform safety inspections of equipment and accessories. b. Demonstrate safety rules required in the industrial workplace. c. Make minor external repairs to equipment and accessories. d. Set up shielded metal arc welding operations on carbon steel.
2. Perform welds for fillet and groove welding within a limited thickness range using E-6010 or other instructor approved electrodes on plain carbon steel. a. Apply safety rules required in the industrial workplace. b. Operate shielded metal arc welding equipment. c. Make fillet and groove welds in all positions on carbon steel. d. Perform 3-G and 4-G limited thickness qualification tests on steel plate.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 – Orientation and Safety
AWS2 – Drawing and Welding Symbol Interpretation
AWS3 – Shielded Metal Arc Welding (SMAW)
AWS10 Welding Inspection and Testing Principles

Related Academic Standards

R1 – Interpret Graphic Information (forms, maps, reference sources)
R2 – Words in Context (same and opposite meaning)
R3 – Recall Information (details, sequence)
R4 – Construct Meaning (main idea, summary/paraphrase, compare–contrast, cause–effect)
R5 – Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
M1 – Addition of Whole Numbers (no regrouping, regrouping)
M2 – Subtraction of Whole Numbers (no regrouping, regrouping)
M3 – Multiplication of Whole Numbers (no regrouping, regrouping)
M4 – Division of Whole Numbers (no remainder, remainder)

M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

Workplace Skills for the 21st Century

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues

T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Course Name: Gas Metal Arc Welding (GMAW)

Course Abbreviation: WLV 1124

Classification: Vocational- Technical Core

Description: This course is designed to give the student experience in various welding applications with the GMAW welder including short circuiting and/or pulsed transfer. (4 sch: 1 hr lecture, 6 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore gas metal arc welding operations. a. Describe and perform safety rules and inspections of equipment and accessories. b. Make minor external repairs to equipment and accessories. c. Set up for gas metal arc welding operations on plain carbon steel.
2. Perform welds for 2F, 3F, and 4F fillet and groove welding within a limited thickness range of plain carbon steel material. a. Apply safety rules required in the industrial workplace. b. Operate gas metal arc welding equipment. c. Short circuit transfer: Make fillet and groove welds on plain carbon steel.

STANDARDS

American Welding Society Standards EG2.0 95

AWS1 Orientation and Safety
AWS2 Drawing and Welding Symbol Interpretation
AWS4 Gas Metal Arc Welding (GMAW)
AWS10 Welding Inspection and Testing Principles

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)
R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
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M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents

M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
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S1 Vowel (short, long)
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WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
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National Educational Technology Standards for Students

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T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
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Course Name: Gas Tungsten Arc Welding (GTAW)

Course Abbreviation: WLV 1136

Classification: Vocational- Technical Core

Description: This course is designed to give the student experience in various welding applications using the GTAW process. (6 sch: 1 hr lecture, 10 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore equipment for gas tungsten arc welding operations. a. Perform safety inspections of equipment and accessories. b. Demonstrate safety rules required in the industrial workplace. c. Make minor external repairs to equipment and accessories. d. Set up for gas tungsten arc welding operations on plain carbon steel, aluminum, and stainless steel. e. Apply safety rules required in the industrial workplace.
2. Safely perform groove welds within a limited thickness range of carbon steel. a. Operate gas tungsten arc welding equipment. b. Make 2F, 1G welds on aluminum. c. Make 2F, 3F, 1G, 2G welds on stainless steel or carbon steel using stainless steel filler rod.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 Orientation and Safety
AWS2 Drawing and Welding Symbol Interpretation
AWS6 Gas Tungsten Arc Welding (GTAW)
AWS10 Welding Inspection and Testing Principles

Related Academic Standards

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R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
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A8 Estimation (rounding, estimation)
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L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

Workplace Skills for the 21st Century

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools

T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Course Name: Flux Cored Arc Welding (FCAW)

Course Abbreviation: WLV 1143

Classification: Vocational- Technical Core

Description: This course is designed to give the student experience using FCAW process. (3 sch: 1 hr lecture, 4 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore equipment for flux cored arc welding operations. a. Perform safety inspections of equipment and accessories. b. Apply safety rules required in the industrial workplace. c. Make minor external repairs to equipment and accessories. d. Set up for flux cored arc welding operations on plain carbon steel.
2. Safely perform fillet and groove welding within a limited thickness range of carbon steel. a. Make fillet welds in the 2F, 3F, and 4F positions. b. Make groove welds in the 2G, 3G, and 4G positions.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 Orientation and Safety
AWS2 Drawing and Welding Symbol Interpretation
AWS5 Flux Cored Arc Welding (FCAW)
AWS10 Welding Inspection and Testing Principles

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)
R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)

A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

Workplace Skills for the 21st Century

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Miller Electric Manufacturing Company. Retrieved September 10, 2005, from http://www.millerwelds.com/

~~*Thermadyne Holdings Corporation*. Retrieved September 10, 2005, from http://www.thermadyne.com/~~

Course Name: Pipe Welding

Course Abbreviation: WLV 1155

Classification: Vocational- Technical Elective

Description: This course is designed to give the student experience in pipe welding procedures. (5 sch: 1 hr lecture, 8 hr lab)

Prerequisites: Shielded Metal Arc Welding I (WLV 1116), Shielded Metal Arc Welding II (WLV 1226)

Competencies and Suggested Objectives
1. Demonstrate safety precautions, and identify pipe weld test positions.
2. Describe differences in pipe and tubing and describe faults in pipe welding.
3. Use correct methods for preparation and fitting of pipe, and demonstrate correct pipe welding procedures.
4. Perform open V-grooved pipe welds and bend tests. a. Fabricate and weld a 2G and 5G open V-grooved pipe weld using multiple positions using E-6010, E-7018, or other instructor approved electrodes. b. Pass a 6G guided bend test on an open butt.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 - Orientation and Safety
AWS2 - Drawing and Welding Symbol Interpretation
AWS3 - Shielded Metal Arc Welding (SMAW)
AWS10 Welding Inspection and Testing Principles

Related Academic Standards

R1 - Interpret Graphic Information (forms, maps, reference sources)
R2 - Words in Context (same and opposite meaning)
R3 - Recall Information (details, sequence)
R4 - Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)
R5 - Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
M1 - Addition of Whole Numbers (no regrouping, regrouping)
M2 - Subtraction of Whole Numbers (no regrouping, regrouping)
M3 - Multiplication of Whole Numbers (no regrouping, regrouping)
M4 - Division of Whole Numbers (no remainder, remainder)
M5 - Decimals (addition, subtraction, multiplication, division)
M6 - Fractions (addition, subtraction, multiplication, division)
M7 - Integers (addition, subtraction, multiplication, division)
M8 - Percents
M9 - Algebraic Operations

A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

Workplace Skills for the 21st Century

WP1 Allocates resources (time, money, materials and facilities, and human resources).
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WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Course Name: Gas Metal Arc Aluminum Welding

Course Abbreviation: WLV 1162

Classification: Vocational–Technical Elective

Description: This course is designed to give the student experience in Gas Metal Aluminum Welding. (2 sch: 1 hr lecture, 2 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Identify aluminum alloys, aluminum weld ability, and results of welding aluminum. a. List advantages of aluminum alloys. b. Identify factors that make aluminum difficult to weld.
2. Perform multi-pass welds. a. Fabricate and weld multi-pass fillet welds. b. Fabricate and weld 2G and 3G V-grooved butt joint.

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AWS4 Gas Metal Arc Welding (GMAW)
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T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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PROPOSED FINAL COPY

Course Name: Welding Safety, Inspection, and Testing Principles

Course Abbreviation: WLV 1171

Classification: Vocational- Technical Core

Description: This course is designed to give the student experience in safety procedures, inspection, and testing of welds. (1 sch: 2 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Describe local program and vocational center policies and procedures. a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, and transportation regulations.
2. Describe employment opportunities and responsibilities. a. Describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities.
3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA. a. Demonstrate effective team building and leadership skills. b. Practice appropriate work ethics.
4. Demonstrate the ability to follow verbal and written instructions and communicate effectively for job situations.
5. Discuss the history of welding to include materials, terminology, and techniques.
6. Describe general safety rules for working in a shop/lab and industry. 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. 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 employer's substances abuse policy and how it relates to safety. g. Explain the safety procedures when working near pressurized or high temperature.
7. Identify and apply safety around welding operations. 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*.
8. Identify and explain use of various barriers and confinements. a. Explain the safety requirements for working in confined areas. b. Explain and practice lockout/tagout procedures. c. Explain the different barriers and barricades and how they are used. d. Recognize and explain personal protective equipment. e. Inspect and care for personal protective equipment.

9. Explain lifting and the use of ladders.
   a. Identify and explain the procedures for lifting heavy objects.
   b. Inspect and safely work with various ladders.
10. Explain the Material Safety Data Sheet (MSDS).
   a. Explain the function of the MSDS.
   b. Interpret the requirements of the MSDS.
11. Explain fires.
   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.
12. Explain safety in and around electrical situations.
   a. Explain injuries when electrical contact occurs.
   b. Explain safety around electrical hazards.
   c. Explain action to take when an electrical shock occurs.
13. Perform visual inspection of completed welds.
   a. Examine cut surfaces and edges of prepared base metal parts.
   b. Examine tack, intermediate layers, and completed welds.
14. Perform removal of test specimen, preparation of test specimen, free bend test, and analysis of test specimen.
   a. Apply safety rules required in the industrial workplace.
   b. Remove, prepare, and bend designated weld areas for root, face, and bend specimens, per AWS QC 10-95.
   c. Visually inspect face and root bend specimens, and evaluate for compliance with AWS QC 10-95.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 Orientation and Safety
AWS2 Drawing and Welding Symbol Interpretation
AWS3 Shielded Metal Arc Welding (SMAW)
AWS4 Gas Metal Arc Welding (GMAW)
AWS5 Flux Cored Arc Welding (FCAW)
AWS6 Gas Tungsten Arc Welding (GTAW)
AWS7 Oxyfuel Gas Cutting
AWS8 Air Carbon Arc Cutting (CAC-A)
AWS9 Plasma Arc Cutting (PAC)
AWS10 Welding Inspection and Testing Principles

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S3 Structural Unit (root, suffix)

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T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
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Course Name: Shielded Metal Arc Welding II

Course Abbreviation: WLV 1226

Classification: Vocational- Technical Core

Description: This course is designed to teach students welding techniques using E-7018 electrodes. (6 sch: 1 hr lecture, 10 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore equipment for shielded metal arc welding operations. a. Perform safety inspections of equipment and accessories. b. Demonstrate safety rules required in the industrial workplace. c. Make minor external repairs to equipment and accessories. d. Set up shielded metal arc welding operations on plain carbon steel.
2. Safely perform welds for 2f, 3F and 4F fillet and groove welding within a limited thickness range using E-7018 or other instructor approved electrodes on plain carbon steel. a. Perform 3-G and 4-G limited thickness qualification tests on plain carbon steel plate.

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PROPOSED FINAL COPY

Course Name: Drawing and Welding Symbol Interpretation

Course Abbreviation: WLV 1232

Classification: Vocational- Technical Core

Description: This course is designed to give the student experience in reading welding symbols and drawings. (2 sch: 1 hr lecture, 2 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Prepare parts from simple sketches or drawings. a. Interpret basic elements of a drawing or sketch. b. Interpret welding symbol information.
2. Lay out and fit up joints from welding symbol information. a. Demonstrate lay-out principles. b. Fit up joints from welding symbol information.
3. Perform welding operations to prepare a welded fabrication from simple sketches or drawings.

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A4 Pre-Algebra and Algebra (equations, inequality)
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L5 Punctuation (comma, semicolon)
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S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

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T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
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Course Name: Advanced Pipe Welding

Course Abbreviation: WLV 1252

Classification: Vocational–Technical Elective

Description: This course is designed to give the student advanced pipe welding techniques using shielded metal arc and gas tungsten arc welding processes. (2 sch: 1 hr lecture, 2 hr lab)

Prerequisites: Pipe Welding (WLV 1155)

Competencies and Suggested Objectives
1. Fabricate and weld pipe according to specifications using multiple positions. a. Fabricate and weld an open butt V-grooved pipe weld using the downhill technique. b. Fabricate and weld an open butt V-grooved multiple diameter pipe weld utilizing the GTAW process.
2. Perform open butt V-groove pipe welds using multiple positions and bend tests. a. Fabricate and weld an open butt V-grooved pipe weld using GTAW and E-7018 electrodes. b. Pass a 6G guided bend test on open butt V-grooved pipe weld using GTAW and E-7018 electrodes as per AWS D1.1 Code.

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Course Name: Cutting Processes

Course Abbreviation: WLV 1314

Classification: Vocational–Technical Core

Description: This course is designed to give the student experience in oxyfuel cutting principles and practices, air carbon cutting and gouging, and plasma arc cutting. (4 sch: 2 hr lecture, 4 hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore manual oxyfuel gas cutting operations. a. Perform safety inspections of equipment and accessories. b. Make minor external repairs to equipment and accessories. c. Set up and operate for manual oxyfuel gas cutting operations on plain carbon steel. d. Perform straight cutting, shape cutting, and bevel cutting operations on plain carbon steel. e. Remove welds from plain carbon steel using weld washing techniques.
2. Explore oxyfuel gas cutting equipment (track burner) to perform cutting operations. a. Perform safety inspections of equipment and accessories. b. Make minor external repairs to equipment and accessories. c. Set up and operate for machine oxyfuel gas cutting (track burner) operations on plain carbon steel. d. Perform straight and bevel cutting operations on plain carbon steel.
3. Explore metal removal using the carbon arc cutting process. a. Perform safety inspections of equipment and accessories. b. Make minor external repairs to equipment and accessories. c. Set up and operate for manual air carbon arc gouging and cutting operations on plain carbon steel. d. Perform metal removal operations on plain carbon steel.
4. Explore the manual plasma arc cutting process. a. Perform safety inspections of equipment and accessories. b. Make minor external repairs to equipment and accessories. c. Set up and operate manual plasma arc cutting equipment on plain carbon steel, aluminum, and stainless steel for cutting straight lines and shapes.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 – Orientation and Safety
AWS2 – Drawing and Welding Symbol Interpretation
AWS7 – Oxyfuel Gas Cutting
AWS8 – Air Carbon Arc Cutting (CAC-A)
AWS9 – Plasma Arc Cutting (PAC)

~~AWS10 Welding Inspection and Testing Principles~~

~~*Related Academic Standards*~~

~~R1 Interpret Graphic Information (forms, maps, reference sources)~~
~~R2 Words in Context (same and opposite meaning)~~
~~R3 Recall Information (details, sequence)~~
~~R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)~~
~~R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)~~
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~~M3 Multiplication of Whole Numbers (no regrouping, regrouping)~~
~~M4 Division of Whole Numbers (no remainder, remainder)~~
~~M5 Decimals (addition, subtraction, multiplication, division)~~
~~M6 Fractions (addition, subtraction, multiplication, division)~~
~~M7 Integers (addition, subtraction, multiplication, division)~~
~~M8 Percents~~
~~M9 Algebraic Operations~~
~~A1 Numeration (ordering, place value, scientific notation)~~
~~A2 Number Theory (ratio, proportion)~~
~~A3 Data Interpretation (graph, table, chart, diagram)~~
~~A4 Pre-Algebra and Algebra (equations, inequality)~~
~~A5 Measurement (money, time, temperature, length, area, volume)~~
~~A6 Geometry (angles, Pythagorean theory)~~
~~A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)~~
~~A8 Estimation (rounding, estimation)~~
~~L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)~~
~~L2 Sentence Formation (fragments, run-on, clarity)~~
~~L3 Paragraph Development (topic sentence, supporting sentence, sequence)~~
~~L4 Capitalization (proper noun, titles)~~
~~L5 Punctuation (comma, semicolon)~~
~~L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)~~
~~S1 Vowel (short, long)~~
~~S2 Consonant (variant spelling, silent letter)~~
~~S3 Structural Unit (root, suffix)~~

~~*Workplace Skills for the 21st Century*~~

~~WP1 Allocates resources (time, money, materials and facilities, and human resources).~~
~~WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.~~
~~WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.~~

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WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Course Name: Special Problem in Welding and Cutting Technology

Course Abbreviation: WLV 191(1-3)

Classification: Vocational-Technical Elective

Description: A course to provide students with an opportunity to utilize skills and knowledge gained in other Welding and Cutting Technology courses. The instructor and student work closely together to select a topic and establish criteria for completion of the project. (1-3 sch: 2-6 hr lab)

Prerequisites: Consent of instructor

Competencies and Suggested Objectives
1. Develop a written plan that details the activities and projects to be completed. a. Use a written plan that details the activities and projects to be completed. b. Perform written occupational objectives in the special problem.
2. Assess accomplishment of objectives. a. Prepare daily written assessments of accomplishment of objectives. b. Present weekly written reports to the instructor of activities performed and objectives accomplished.
3. Use and follow a set of written guidelines for the special problem. a. Develop and follow a set of written guidelines for the special problem.

STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

SUGGESTED REFERENCES

Specific references for this course will depend upon the nature of the problem under investigation.

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Course Name: Supervised Work Experience in Welding and Cutting Technology

Course Abbreviation: WLV 192(1-6)

Classification: Vocational-Technical Elective

Description: A course that is a cooperative program between industry and education designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of one semester hour per 45 industrial contact hours. (1-6 sch: 3-18 hr externship)

Prerequisite: Consent of instructor and completion of at least one semester of advanced coursework in Welding and Cutting Technology

Competencies and Suggested Objectives
1. Follow a set of instructor-written guidelines for the supervised work experience program.
2. Apply skills needed to be a viable member of the workforce. a. Prepare a description of skills to be developed in the supervised work experience program. b. Practice skills needed to be a viable member of the workforce.
3. Practice human relationship skills in the supervised work experience program.
4. Practice positive work habits, responsibilities, and ethics.
5. Develop written occupational objectives in the supervised work experience program.
6. Assess performance of occupational skills. a. Prepare daily written assessments of work performance as specified in the occupational objectives. b. Present weekly written reports to the instructor of activities performed and objectives accomplished.

STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

SUGGESTED REFERENCES

Specific references for this course will depend upon the nature of the problem under investigation.

Course Name: Welding Metallurgy

Course Abbreviation: WLV 2812

Classification: Vocational- Technical Elective

Description: This course is designed to give the student experience in the concept of metallurgy and how metals react to internal and external strains and temperature changes. (2 sch: 2 hr lec, 1 lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore metals and effect that heat has on these metals. a. Identify different types of metals by ASTM classification, and describe the characteristics and uses. b. Identify the effect different ranges of heat have on base metal. c. Identify the different structures of metal.
2. Explore the use hardness testing equipment. a. Identify and describe the use of hardness testing equipment. b. Safely perform hardness testing procedures.
3. Explore the Heat Affected Zone on weldments. a. Describe the effect of the heat input on the weld area. b. Describe methods of prevention and correction of damage to the base metal.

STANDARDS

American Welding Society Standards EG2.0-95

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AWS2 Drawing and Welding Symbol Interpretation
AWS3 Shielded Metal Arc Welding (SMAW)
AWS4 Gas Metal Arc Welding (GMAW)
AWS5 Flux Cored Arc Welding (FCAW)
AWS6 Gas Tungsten Arc Welding (GTAW)
AWS7 Oxyfuel Gas Cutting
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AWS9 Plasma Arc Cutting (PAC)
AWS10 Welding Inspection and Testing Principles

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R2 Words in Context (same and opposite meaning)
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A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
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L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
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WP1 Allocates resources (time, money, materials and facilities, and human resources).
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Course Name: Welding Code

Course Abbreviation: WLV 2913

Classification: Vocational- Technical Elective

Description: This course is designed to give the student experience in the various welding codes and the experience in interpretation of these codes. (3 sch: lecture)

Prerequisites: None

Competencies and Suggested Objectives
1. Explore AWS D1.1 Code. a. Examine how WPSs, PQRs, and WQTR are relevant to code. b. Examine various weld joints and weld configurations. c. Examine base materials and electrodes related to processes used under code provisions.
2. Explore API 1104 Code. a. Examine how WPSs, PQRs, and WQTR are relevant to code. b. Examine various weld joints and weld configurations. c. Examine base materials and electrodes related to processes used under code provisions.
3. Explore ASME Section 9 Code. a. Examine how WPSs, PQRs, and WQTR are relevant to code. b. Examine various weld joints and weld configurations. c. Examine base materials and electrodes related to processes used under code provisions.

STANDARDS

American Welding Society Standards EG2.0-95

AWS1 Orientation and Safety
AWS2 Drawing and Welding Symbol Interpretation
AWS3 Shielded Metal Arc Welding (SMAW)
AWS4 Gas Metal Arc Welding (GMAW)
AWS5 Flux Cored Arc Welding (FCAW)
AWS6 Gas Tungsten Arc Welding (GTAW)
AWS7 Oxyfuel Gas Cutting
AWS8 Air Carbon Arc Cutting (CAC-A)
AWS9 Plasma Arc Cutting (PAC)
AWS10 Welding Inspection and Testing Principles

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)
R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)

M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject–verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

Workplace Skills for the 21st Century

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Course Name: Fundamentals of Drafting

Course Abbreviation: DDT 1114

Classification: Vocational- Technical Core

Description: Fundamentals and principles of drafting to provide the basic background needed for all other drafting courses. (4 sch: 2 hr lecture, 4 hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Discuss classroom procedures and drafting occupations. a. Describe proper classroom/lab procedures. b. Describe the various occupations in drafting and their requirements.
2. Explain and apply safety rules and regulations. a. Describe safety rules for drafting occupations. b. List and discuss hazardous materials found in the drafting area.
3. Apply proper techniques in technical drawings. a. Demonstrate the ability to scale drawings. b. Construct various angles. c. Recognize and construct the alphabet of lines.
4. Sketch and develop views of basic shapes. a. Develop a pictorial view from three principal views. b. Develop three principal views from a pictorial view. c. Complete three principal views when lines are missing.
5. Use geometric constructions. a. Construct tangent arcs and lines. b. Divide lines or arcs into equal and/or proportional parts. c. Develop geometric shapes.
6. Construct orthographic projections. a. Construct a top view, with front and right side views given. b. Construct a front view, with top and right side views given. c. Construct a right side view, with top and front views given. d. Develop a drawing consisting of three principal views.
7. Dimension objects. a. Recognize lines, symbols, features, and conventions used in dimensioning. b. Recognize and use size and location dimensions. c. Recognize and use general and local notes. d. Dimension a drawing using contour, chain, and baseline dimensioning.
8. Construct sectional views. a. Construct full and half sectional views. b. Recognize and construct removed, revolved, offset, and aligned sectional views.

STANDARDS

American Design Drafting Association Skill Standards

DDS1 General Drafting Terminology
DDS2 View Identification
DDS3 Dimensioning Standards & Terminology
DDS4 Sections View Standards & Terminology
DDS5 Orthographic Projections Standards & Terminology
DDS6 General Drafting Standards

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)
R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
S2 Consonant (variant spelling, silent letter)

Workplace Skills for the 21st Century

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision-making, problem-solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T2 Social, ethical, and human issues
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Course Name: Industrial Maintenance Math and Measurement

Course Abbreviation: IMM 1122

Classification: Vocational- Technical Core

Description: Mathematical and measurement procedures and instruments related to industrial maintenance. (2 sch: 1 hr lecture, 2 hr lab) [May be taught as a 60 contact hour lab in open entry-open exit vocational programs]

Prerequisite: None

Competencies and Suggested Objectives
1. Demonstrate calculations with decimal and fractional numbers. a. Add, subtract, multiply, and divide decimal numbers. b. Add, subtract, multiply, and divide fractions. c. Convert decimal to fraction and fraction to decimal.
2. Demonstrate basic geometric and trigonometric functions. a. Calculate area and circumference of circles. b. Calculate the volume of cubes and cylinders. c. Identify the parts of a right triangle. d. Identify and apply the basic trigonometric functions associated with right triangle measurement including use of a trigonometry table. e. Calculate angles or lengths of a line in a right triangle as associated with piping and machining jobs.
3. Demonstrate the use of measuring tools using English and/or metric measurement systems. a. Measure objects using a steel rule to the nearest 1/16th of an inch and 1 millimeter. b. Measure objects using micrometers. c. Measure objects using a vernier caliper. d. Measure objects using a dial indicator. e. Convert selected measurements from English to metric and metric to English.

STANDARDS

Contren Best Practices

CORE

INTRODUCTION TO CONSTRUCTION MATH

MAT1 Add, subtract, multiply, and divide whole numbers, with and without a calculator.
MAT2 Use a standard ruler and a metric ruler to measure.
MAT3 Add, subtract, multiply, and divide fractions.
MAT4 Add, subtract, multiply, and divide decimals, with and without a calculator.
MAT5 Convert decimals to percents and percents to decimals.
MAT6 Convert fractions to decimals and decimals to fractions.
MAT7 Explain what the metric system is and how it is important in the construction trade.
MAT8 Recognize and use metric units of length, weight, volume, and temperature.
MAT9 Recognize some of the basic shapes used in the construction industry and apply basic

~~geometry to measure them.~~

~~INDUSTRIAL MAINTENANCE LEVEL V~~

~~PRECISION MEASURING TOOLS~~

~~PMT1 Use levels.~~
~~PMT2 Use feeler gauges.~~
~~PMT3 Use calipers.~~
~~PMT4 Use micrometers.~~
~~PMT5 Use dial indicators.~~
~~PMT6 Use protractors.~~
~~PMT7 Use parallels and gauge blocks.~~
~~PMT8 Use trammels.~~
~~PMT9 Use precision straightedges.~~
~~PMT10 Use speed measurement tools.~~
~~PMT11 Use pyrometers.~~

~~*Related Academic Standards*~~

~~R1 Interpret Graphic Information (forms, maps, reference sources)~~
~~R2 Words in Context (same and opposite meaning)~~
~~R3 Recall Information (details, sequence)~~
~~R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)~~
~~R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)~~
~~M1 Addition of Whole Numbers (no regrouping, regrouping)~~
~~M2 Subtraction of Whole Numbers (no regrouping, regrouping)~~
~~M3 Multiplication of Whole Numbers (no regrouping, regrouping)~~
~~M4 Division of Whole Numbers (no remainder, remainder)~~
~~M5 Decimals (addition, subtraction, multiplication, division)~~
~~M6 Fractions (addition, subtraction, multiplication, division)~~
~~A3 Data Interpretation (graph, table, chart, diagram)~~
~~A4 Pre-Algebra and Algebra (equations, inequality)~~
~~A5 Measurement (money, time, temperature, length, area, volume)~~
~~A6 Geometry (angles, Pythagorean theory)~~
~~A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)~~
~~A8 Estimation (rounding, estimation)~~
~~L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)~~
~~L2 Sentence Formation (fragments, run-on, clarity)~~
~~L3 Paragraph Development (topic sentence, supporting sentence, sequence)~~
~~L4 Capitalization (proper noun, titles)~~
~~L5 Punctuation (comma, semicolon)~~
~~L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)~~
~~S1 Vowel (short, long)~~
~~S2 Consonant (variant spelling, silent letter)~~
~~S3 Structural Unit (root, suffix)~~

21st Century Skills

CS2 – Financial, Economic, and Business Literacy
CS3 – Civic Literacy
CS4 – Information and Communication Skills
CS5 – Thinking and Problem-Solving Skills
CS6 – Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

General Industrial Maintenance Books

Chastain, L. (2004). *Industrial mechanics and maintenance*. Upper Saddle River, NJ: Pearson Prentice Hall.

Green, D., & Gosse, J. (2005). *Industrial maintenance*. Homewood, IL: American Technical.

Kemp, A. (1999). *Industrial mechanics*. Homewood, IL: American Technical.

Kibbe, R. (2002). *Mechanical systems for industrial maintenance*. Upper Saddle River, NJ: Pearson Prentice Hall.

Knotek, R., & Stenerson, J. (2006). *Mechanical principles and systems for industrial maintenance*. Upper Saddle River, NJ: Pearson Prentice Hall.

National Center for Construction Education and Research. (1998). *Industrial maintenance level 5*. Upper Saddle River, NJ: Pearson Prentice Hall.

Industrial Maintenance Math and Measurement

Boatwright, D. (1996). *Practical problems in mathematics for industrial technology*. Albany, NY: Delmar.

Carman, R., & Saunders, H. (2005). *Mathematics for the trades: A guided approach*. Upper Saddle River, NJ: Pearson Prentice Hall.

Cook, N. (2004). *Mathematics for technical trades*. Upper Saddle River, NJ: Pearson Prentice Hall.

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National Center for Construction Education and Research. (2004). *Core curriculum*. Upper Saddle River, NJ: Pearson Prentice Hall.

Video

~~Coastal Skills Training. (n.d.). *Basic shop math* [Videotape]. (Available from Coastal Skills Training, 3083 Brickhouse Court, Virginia Beach, VA 23452)~~

PROPOSED FINAL COPY

Course Name: Basic Fabrication for Pipefitting

Course Abbreviation: PPV 1426

Classification: Vocational–Technical Elective

Description: Use of pipefitting tools and equipment, different ways of cutting and fitting pipes, methods of calculating pipe fittings, and various types of fit-ups for different types of pipe (6 sch: 2-hr lecture, 8-hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Explain and identify the use of various pipefitting tools and equipment. a. Explain the safe use of tools and equipment. b. Identify the proper tools for each specific task. c. Identify and explain the use of the equipment for each specific task.
2. Describe and fabricate various pipe assemblies. a. Describe methods for preparing different types of pipe for fabrication. b. Estimate fitting take-out. c. Fabricate a butt weld pipe assembly. d. Fabricate a socket weld pipe assembly. e. Fabricate a screw pipe assembly. f. Fabricate a piping assembly from a blueprint. g. Fabricate a pipe hanger.

STANDARDS

Contren Learning Series Best Practices

Level Two

DRAWINGS AND DETAIL SHEETS

DDP1 Identify parts of drawings.
DDP2 Identify types of drawings.
DDP3 Make field sketches.
DDP4 Interpret drawing indexes and line lists.

PIPEFITTING TRADE MATH

PTF1 Identify and explain the use of special measuring devices.
PTF2 Use tables of weights and measurements.
PTF3 Use formulas to solve basic problems.
PTF4 Solve area problems.
PTF5 Solve volume problems
PTF6 Solve circumference problems.
PTF7 Solve right triangle problems using the Pythagorean theorem.

THREADED PIPE FABRICATION

TPF1 Identify and explain the materials used in threaded piping systems.
TPF2 Identify and explain pipe fittings.
TPF3 Read and interpret screwed fitting joint drawings.
TPF4 Identify and explain types of threads.
TPF5 Determine pipe lengths between joints.
TPF6 Thread and assemble piping and valves.
TPF7 Calculate offsets.

SOCKET WELD PIPE FABRICATION

SWP1 Identify and explain types of socket weld piping materials.
SWP2 Identify and explain socket weld fittings.
SWP3 Read and interpret socket weld piping drawings.
SWP4 Determine pipe lengths between socket weld fittings.
SWP5 Fabricate socket weld fitting to pipe.

BUTT WELD PIPE FABRICATION

BWP1 Identify butt weld piping materials and fittings.
BWP2 Read and interpret butt weld piping drawings.
BWP3 Prepare pipe ends for fit up.
BWP4 Determine pipe lengths between fittings.
BWP5 Select and install backing rings.
BWP6 Perform alignment procedures for various types of fittings.

Level Three

ADVANCED BLUEPRINT READING

ABR1 Identify symbols and abbreviations on P&IDs.
ABR2 Identify piping arrangement drawings.
ABR3 Read and interpret coordinates, control points, and elevation.
ABR4 Read and interpret P&IDs, plan views, and section views.
ABR5 Identify isometric drawings.
ABR6 Read isometric drawings taken from plan views.
ABR7 Draw isometric drawings.

STANDARDS AND SPECIFICATIONS

SAS1 Understand and interpret pipefitting standards and codes.
SAS2 Read and interpret pipefitting specifications.
SAS3 Identify pipe and components according to specifications.

Level Four

ADVANCED PIPE FABRICATION

APF1 Calculate simple piping offsets.
APF2 Calculate three-line, 45° equal-spread offsets around a vessel.
APF3 Calculate three-line, 45° unequal-spread offsets.
APF4 Fabricate tank heating coils.
APF5 Perform mitering procedures.
APF6 Lay out three- and four-piece mitered turns.
APF7 Lay out 45° laterals, using references.
APF8 Fabricate dummy legs and trunnions out of pipe, using references.
APF9 Perform geometric layout of pipe laterals and supports.

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS1 – Global Awareness
CS2 – Financial, Economic, and Business Literacy
CS3 – Civic Literacy
CS4 – Information and Communication Skills
CS5 – Thinking and Problem-Solving Skills
CS6 – Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Books

Hamilton, J. (1989). *Pipe fitter's math guide*. Clinton, NC: Construction Trades Press.

Joyce, M. A. (2003). *Blueprint reading and drafting for plumbers*. Delmar Thomson Learning.

Menon, E. S. (2005). *Piping calculations manual* (2nd ed.). McGraw-Hill.

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National Center for Construction Education and Research. (2007). *Pipefitting level 3*. Upper Saddle River, NJ: Pearson Prentice Hall.

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Woodson, R. D. (2005). *Plumber's and pipe fitter's calculations manual* (2nd ed.). McGraw-Hill.

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American Fire Sprinkler Association. Retrieved October 10, 2007, from http://www.firesprinkler.org/

International Code Council. ICC contractor/trades licensing. In *Certification and Testing*. Retrieved September 27, 2007, from http://www.iccsafe.org/contractor

U.S. Department of Labor, Bureau of Labor Statistics. (2006, August 4). Pipelayers, plumbers, pipefitters, and steamfitters. In *Occupational Outlook Handbook, 2006-07 Edition*. Retrieved October 15, 2007, from http://www.bls.gov/oco/ocos211.htm

~~Journals and Magazines~~

~~International Code Council. (n.d.). *Building Safety Journal*. Retrieved September 25, 2007, from http://www.buildingsafetyjournal.org~~

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Course Name: Steel Ship Building and Marine Construction

Course Abbreviation: PPV 1823

Classification: Vocational–Technical Elective

Description: Structure of a ship and abbreviation of parts and sections of ships. Also, various types of piping systems, including both building and marine pipefitting systems (3 sch: 2–hr lecture, 2–hr lab)

Prerequisites: None

Competencies and Suggested Objectives
1. Identify and label various parts of a ship on a drawing. a. Label and define the following parts of a ship: (1) Different decks (2) Forward and aft (3) Port and starboard (4) Beam (5) Frames (6) Sections (7) Engine room (8) Bulkheads (9) Center line (10) Ship holes and compartments (11) Inner bottoms
2. Identify and explain the various lines used on ship drawings. a. Identify and explain the use of various coding of lines. b. Identify and explain the main and auxiliary steam line. c. Identify and explain the air condition/refrigeration lines. d. Identify and explain the drain lines. e. Identify and explain the fuel oil, lube oil, and fuel transfer lines. f. Identify and explain the hydraulic and compressed air lines.
3. Identify and explain various systems. a. Identify and explain the venting, fire main, and water systems. b. Identify and explain the coding systems used for various ship systems.

STANDARDS

Contren Learning Series Best Practices

Level Two

PIPING SYSTEMS

PPS1 Identify and explain the types of piping systems.
PPS2 Identify piping systems according to color–coding.
PPS3 Explain the effects and corrective measures for thermal expansion in piping systems.

PPS4 Explain types and applications of pipe insulation.

DRAWINGS AND DETAIL SHEETS

DDP1 Identify parts of drawings.
DDP2 Identify types of drawings.
DDP3 Make field sketches.
DDP4 Interpret drawing indexes and line lists.

Related Academic Standards

R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary and paraphrase, compare and contrast, cause and effect)
R5 Evaluate and Extend Meaning (fact and opinion, predict outcomes, point of view)
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)
S3 Structural Unit (root, suffix)

21st Century Skills

CS1 – Global Awareness
CS2 – Financial, Economic, and Business Literacy
CS3 – Civic Literacy
CS4 – Information and Communication Skills
CS5 – Thinking and Problem-Solving Skills
CS6 – Interpersonal and Self-Directional Skills

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Books

Hamilton, J. (1989). *Pipe fitter's math guide*. Clinton, NC: Construction Trades Press.

Joyce, M. A. (2003). *Blueprint reading and drafting for plumbers*. Delmar Thomson Learning.

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International Code Council. ICC contractor/trades licensing. In *Certification and Testing*. Retrieved September 27, 2007, from http://www.iccsafe.org/contractor

U.S. Department of Labor, Bureau of Labor Statistics. (2006, August 4). Pipelayers, plumbers, pipefitters, and steamfitters. In *Occupational Outlook Handbook, 2006-07 Edition*. Retrieved October 15, 2007, from http://www.bls.gov/oco/ocos211.htm

Journals and Magazines

~~International Code Council. (n.d.). *Building Safety Journal*. Retrieved September 25, 2007, from http://www.buildingsafetyjournal.org~~

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Course Name: Fundamentals of Robotics

Course Abbreviation: ROT 1113

Classification: Vocational- Technical Elective

Description: This course is designed to introduce the student to industrial robots. Topics to be covered include robotics history, industrial robot configurations, operation, and basic programming. (3 sch: 2 hr lecture, 2 hr lab)

Prerequisite: None

Competencies and Suggested Objectives
1. Describe the various major components of all robots. a. Explain the axes of movement. b. Label each major component. c. Identify four general types of work envelopes. d. Discuss three general forms of robot actuation. e. Identify different types of input devices used with robot controllers. f. Describe the characteristics of a robot that distinguish it from other types of automated machinery.
2. Demonstrate safety procedures used in the automated environment. a. Apply safety rules for personal and general shop safety including eye, ear, and body protection; general rules of shop conduct; and the use of safety color coding. b. Apply general safety rules for tool and equipment use including hand tools, air and electric power tools, and other shop equipment. c. Apply general safety rules associated with working on various robotics systems. d. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of fire fighting devices.
3. Demonstrate the ability to operate robots. a. Evaluate robot performance. b. Apply basic programming skills. c. Identify and discuss end effectors. d. Identify and discuss visual and tactile sensors. e. Demonstrate basic troubleshooting techniques.

STANDARDS

ITEA Standards

Standard 1 — Students will develop an understanding of the characteristics and scope of technology.
Standard 2 — Students will develop an understanding of the core concepts of technology.
Standard 3 — Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4 — Students will develop an understanding of the cultural, social, economic, and political effects of technology.

Standard 5 – Students will develop an understanding of the effects of technology on the environment.
Standard 6 – Students will develop an understanding of the role of society in the development and use of technology.
Standard 13 – Students will develop abilities to assess the impact of products and systems.
Standard 14 – Students will develop an understanding of and be able to select and use medical technologies.
Standard 15 – Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16 – Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17 – Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18 – Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19 – Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20 – Students will develop an understanding of and be able to select and use construction technologies.

Related Academic Standards

R1 – Interpret Graphic Information (forms, maps, reference sources)
R2 – Words in Context (same and opposite meaning)
R3 – Recall Information (details, sequence)
R4 – Construct Meaning (main idea, summary/paraphrase, compare–contrast, cause–effect)
R5 – Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)
M1 – Addition of Whole Numbers (no regrouping, regrouping)
M2 – Subtraction of Whole Numbers (no regrouping, regrouping)
M3 – Multiplication of Whole Numbers (no regrouping, regrouping)
M4 – Division of Whole Numbers (no remainder, remainder)
M5 – Decimals (addition, subtraction, multiplication, division)
M6 – Fractions (addition, subtraction, multiplication, division)
M7 – Integers (addition, subtraction, multiplication, division)
M8 – Percents
M9 – Algebraic Operations

21st Century Skills

CS1 – Global Awareness
CS2 – Financial, Economic, and Business Literacy
CS3 – Civic Literacy
CS4 – Information and Communication Skills
CS5 – Thinking and Problem-Solving Skills
CS6 – Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Ewen, P., Schurter, N., & Gundersen, E. P. (2005). *Applied physics.* Upper Saddle River, NJ: Prentice Hall.

Katz, J. R. (2000). *Keys to science success.* Upper Saddle River, NJ: Prentice Hall.

National Science Standards. (1996). Washington, DC: National Academy Press.

Oaks, W. C., Leone, L. L., & Gunn, C. J. (2004). *Engineering your future: A comprehensive approach* (4th ed.). Wildwood, MO: Great Lakes Press.

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Course Name: Industrial Robotics

Course Abbreviation: ROT 1313

Classification: Vocational–Technical Elective

Description: This course teaches the operating systems and advanced programming methods of industrial robots. Actual industrial-grade robots are used to train the student in the areas of operation, maintenance, troubleshooting, service procedures, and robotics applications. (3 sch: 2-hr lecture, 2-hr lab)

Prerequisite: Fundamentals of Robotics (ROT 1113)

Competencies and Suggested Objectives
1. Demonstrate the ability to integrate a robot into a process. a. Write programs on industrial robots to perform simulated industrial processes to operate within the confines of each robot's work envelope. b. Demonstrate the improvement of the efficiency of an automated robotics process by reducing cycle time, decreasing memory usage, using advanced programming techniques, and so forth.
2. Demonstrate the ability to integrate peripheral equipment. a. Program and interface peripheral devices such as a programmable logic controller into robotics work cells. b. Interface contact and non-contact sensors into robotics work cell.
3. Demonstrate the ability to troubleshoot and maintain a robotics work cell. a. Locate and isolate faults in robotics applications. b. Demonstrate the use of test equipment and troubleshooting logic to repair faults. c. Perform routine maintenance procedures on robots with the use of checklists and service equipment (null servo valves, zero encoders, calibrate potentiometers, etc.).

STANDARDS

ITEA Standards

Standard 1 — Students will develop an understanding of the characteristics and scope of technology.
Standard 2 — Students will develop an understanding of the core concepts of technology.
Standard 3 — Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4 — Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5 — Students will develop an understanding of the effects of technology on the environment.
Standard 6 — Students will develop an understanding of the role of society in the development and use of technology.
Standard 13 — Students will develop abilities to assess the impact of products and systems.

~~Standard 14 Students will develop an understanding of and be able to select and use medical technologies.~~
~~Standard 15 Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.~~
~~Standard 16 Students will develop an understanding of and be able to select and use energy and power technologies.~~
~~Standard 17 Students will develop an understanding of and be able to select and use information and communication technologies.~~
~~Standard 18 Students will develop an understanding of and be able to select and use transportation technologies.~~
~~Standard 19 Students will develop an understanding of and be able to select and use manufacturing technologies.~~
~~Standard 20 Students will develop an understanding of and be able to select and use construction technologies.~~

~~*Related Academic Standards*~~

~~R1 Interpret Graphic Information (forms, maps, reference sources)~~
~~R2 Words in Context (same and opposite meaning)~~
~~R3 Recall Information (details, sequence)~~
~~R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)~~
~~R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)~~
~~M1 Addition of Whole Numbers (no regrouping, regrouping)~~
~~M2 Subtraction of Whole Numbers (no regrouping, regrouping)~~
~~M3 Multiplication of Whole Numbers (no regrouping, regrouping)~~
~~M4 Division of Whole Numbers (no remainder, remainder)~~
~~M5 Decimals (addition, subtraction, multiplication, division)~~
~~M6 Fractions (addition, subtraction, multiplication, division)~~
~~M7 Integers (addition, subtraction, multiplication, division)~~
~~M8 Percents~~
~~M9 Algebraic Operations~~

~~*21st Century Skills*~~

~~CS1 Global Awareness~~
~~CS2 Financial, Economic, and Business Literacy~~
~~CS3 Civic Literacy~~
~~CS4 Information and Communication Skills~~
~~CS5 Thinking and Problem-Solving Skills~~
~~CS6 Interpersonal and Self-Directional Skills~~

~~SUGGESTED REFERENCES~~

~~Ewen, P., Schurter, N., & Gundersen, E. P. (2005). *Applied physics.* Upper Saddle River, NJ: Prentice Hall.~~

~~Katz, J. R. (2000). *Keys to science success.* Upper Saddle River, NJ: Prentice Hall.~~

~~*National Science Standards.* (1996). Washington, DC: National Academy Press.~~

~~Oaks, W. C., Leone, L. L., & Gunn, C. J. (2004). *Engineering your future: A comprehensive approach* (4th ed.). Wildwood, MO: Great Lakes Press.~~

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Course Name: Work-Based Learning I, II, III, IV, V, and VI

Course Abbreviation: WBL 191(1-3), WBL 192(1-3), WBL 193(1-3), WBL 291(1-3), WBL 292(1-3), and WBL 293(1-3)

Classification: Vocational-Technical Elective

Description: A structured work-site learning experience in which the student, program area teacher, Work-Based Learning Coordinator, and worksite supervisor/mentor develop and implement an educational training agreement. Designed to integrate the student's academic and technical skills into a work environment. Includes regular meetings and seminars with school personnel for supplemental instruction and progress reviews. (1-3 sch: 3-9 hr externship)

Prerequisite: Concurrent enrollment in vocational-technical program area courses

Competencies and Suggested Objectives
1. Apply technical skills and related academic knowledge needed to be a viable member of the workforce. a. Apply technical skills needed to be a viable member of the workforce. b. Apply skills developed in other related courses in a work-based setting. c. Perform tasks detailed in an educational training agreement at the work setting.
2. Apply general workplace skills to include positive work habits and responsibilities necessary for successful employment. a. Demonstrate proactive human relationship skills in the work setting to include conflict resolution, team participation, leadership, negotiation, and customer/client service. b. Demonstrate time, materials, and resource management skills. c. Demonstrate critical thinking skills such as problem solving, decision making, and reasoning. d. Demonstrate acquiring, evaluating, organizing, maintaining, interpreting, and communicating information. e. Demonstrate positive work habits and acceptance of responsibilities necessary for successful employment.

STANDARDS

Specific standards for this course will depend upon the nature of the problem under investigation.

SUGGESTED REFERENCES

Specific references for use in this course will depend upon the nature of the problem under investigation.

~~Recommended Tools and Equipment~~

~~CAPITALIZED ITEMS~~

- ~~Oxyfuel burning table with dross pan and replaceable slats (4 ft x 8 ft x 31 in.) (1)~~
- ~~OSHA approved exhaust system (1)~~
- ~~Guided bend test jig or machine (hydraulic) (1)~~
- ~~Plasma arc cutting device with min. 1/2 in. cutting depth with accessories (2)~~
- ~~Combination (multi-process) machine with power source (6 or 8 pack) with cables and accessories for 4 GTAW and 4 GMAW setup with accessories (13)~~
- ~~Shielded metal arc welding machines (AC/DC - constant current 250-300 amp @ 60%) with cables and with accessories (13)~~
- ~~Oxyfuel gas cutting equipment with regulators, hoses, torch, tips, cart, and accessories (5 sets)~~
- ~~Machine oxyfuel gas cutting equipment with regulators, hoses, torch, tips, rails or track, and accessories (1 set)~~
- ~~Leather jacket, cape, sleeves or apron, and leather gloves (1 set per student)~~
- ~~Ironworker with accessories (70 ton) (1)~~
- ~~Large drill press with accessories (1)~~
- ~~Small drill press with accessories (1)~~
- ~~Band saw (vertical or horizontal) (1)~~
- ~~Portable abrasive cutoff saw (min. 16 in.) (1)~~
- ~~Heavy-duty four-wheel material mover (1)~~
- ~~Crane (A-frame) heavy duty, with 5-T electric hoist (1)~~
- ~~Pipe bevel machine for mild steel (oxyfuel) (1)~~
- ~~Welder, engine driven (200-A, constant current/constant voltage @ 60% duty cycle) (1)~~
- ~~Electrode shop oven (1)~~
- ~~AWS Welding Educator's Library, Miami, FL: American Welding Society, 1995~~
- ~~Microcomputer with CD-ROM, SVGA graphics card, and modem and operating software (20)~~

~~NON-CAPITALIZED ITEMS~~

- ~~First aid kit (2)~~
- ~~Emergency eye wash station (1)~~
- ~~Workbench with medium duty vise (4)~~
- ~~8-in. C-clamps (1 per student)~~
- ~~4 1/2-in. right angle grinder (5)~~
- ~~9-in. right angle grinder (5)~~
- ~~Work area protective screens (as required) (1 for each welding booth)~~
- ~~Framing squares (24 in. x 18 in.) (6)~~
- ~~Compressed air hose (50-ft) with retractable reel (2)~~
- ~~Compressed air regulator (1)~~
- ~~Male and female quick couples and adaptors (2)~~
- ~~Hose repair kit with crimping tool for oxyfuel cutting equipment (2)~~
- ~~Safety glasses with side shields (1 per student)~~

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- ~~Burning goggles (1 per student)~~
- ~~Face shield (10 per program)~~
- ~~#5 Filter plate/lens for burning goggles (1 per student)~~
- ~~Clear cover plate/lens for burning goggles (2 per student)~~
- ~~Welding helmet #10 shaded filter plate/lens, with head gear and accessories (20)~~
- ~~Welding lenses to match helmet, #11 shaded filter plate/lens (6 sets)~~
- ~~Clear cover plate/lens for welding helmets (2 per student)~~
- ~~Stainless steel wire brush (20)~~
- ~~16 oz ball peen hammer (4)~~
- ~~4 lb shop hammer (4)~~
- ~~Electric hand drill (1/2 inch chuck) (2)~~
- ~~Retractable extension cords (4)~~
- ~~Center punches (1 set)~~
- ~~Metal scribe (6)~~
- ~~Steel dividers (radius maker, min. 6 in.) (2)~~
- ~~Steel tape measure (minimum 10 ft) (20)~~
- ~~Combination square set (4)~~
- ~~Chipping hammer (20)~~
- ~~10 inch mill file (half round bastard cut) (20)~~
- ~~Cold chisels (1 set)~~
- ~~Adjustable wrenches (12 in., 10 in., 8 in., 6 in.) (1 set)~~
- ~~Tank wrench (2)~~
- ~~10 in. groove or slip joint pliers (8)~~
- ~~6 in. combination side cutting/needle nose pliers (10)~~
- ~~10 in. vise grips (4)~~
- ~~10 in. vise grip clamp or tongs (20)~~
- ~~Allen or hex wrenches, standard and metric (1/16 - 3/8) (2 sets)~~
- ~~Screwdrivers, flat head (1 set)~~
- ~~Screwdrivers, Phillips head (1 set)~~
- ~~Oxyfuel friction lighter, with flints and tip cleaners (12)~~
- ~~Fillet gages (2 sets)~~
- ~~Pedestal grinder (2)~~
- ~~Jack stands (2 sets)~~
- ~~Carbon arc gouging whip (5)~~
- ~~Steel wire brush (20)~~
- ~~AWS Safety in Welding and Cutting (ANSI/ASC Z49.1 88). Miami, FL: American Welding Society, 1988 (1)~~

~~RECOMMENDED INSTRUCTIONAL AIDS~~

~~It is recommended that instructors have access to the following items:~~

1. ~~VCR (1 per program)~~
2. ~~TV, color monitor, 25 in. diameter (1 per program)~~
3. ~~Screen, projection (1 per program)~~
4. ~~Overhead projector (1)~~

PROPOSED FINAL COPY

~~1. Video out (Microcomputer to TV monitor) (1)~~
~~2. Interactive presentation board with accessories (1)~~

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Student Competency Profile for Welding and Cutting Technology

Student:_____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. Noted in parentheses beside each unit is the cluster competency from the MS-CPAS. This form may be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

As an alternative to the use of this form, you may note competency achievement by attaching a report showing comparable results for each student. Please indicate that you are using this alternative report by checking here. _____

Shielded Metal Arc Welding I (WLV 1116)

_____1. Discuss and apply shielded metal arc welding operations.
_____2. Perform welds for all position fillet and groove welding within a limited thickness range using E-6010 electrodes on plain carbon steel.

Gas Metal Arc Welding (GMAW) (WLV 1124)

_____1. Explore gas metal arc welding operations.
_____2. Perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.

Gas Tungsten Arc Welding (GTAW) (WLV 1136)

_____1. Explore equipment for gas tungsten arc welding operations.
_____2. Safely perform welds for all position fillet and groove welds within a limited thickness range of plain carbon steel material.

Flux Cored Arc Welding (FCAW) (WLV 1143)

_____1. Explore equipment for flux cored arc welding operations.
_____2. Safely perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.

Welding Safety, Inspection and Testing Principles (WLV 1171)

_____1. Describe local program and vocational center policies and procedures.
_____2. Describe employment opportunities and responsibilities.
_____3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.
_____4. Demonstrate the ability to follow verbal and written instructions, and communicate effectively for job situations.
_____5. Discuss the history of welding to include materials, terminology, and techniques.
_____6. Describe general safety rules for working in a shop/lab and industry.
_____7. Identify and apply safety around welding operations.

~~_____8. Identify and explain use of various barriers and confinements.~~
~~_____9. Explain lifting and the use of ladders.~~
~~_____10. Explain the Material Safety Data Sheet (MSDS).~~
~~_____11. Explain fires.~~
~~_____12. Explain safety in and around electrical situations.~~
~~_____13. Perform visual inspection of completed welds.~~
~~_____14. Perform removal of test specimen, preparation of test specimen, free bend test, and analysis of test specimen.~~

~~Shielded Metal Arc Welding II (WLV 1226)~~

~~_____1. Explore equipment for shielded metal arc welding operations.~~
~~_____2. Safely perform welds for all position fillet and groove welding within a limited thickness range using E-7018 electrodes on plain carbon steel.~~

~~Drawing and Welding Symbol Interpretation (WLV 1232)~~

~~_____1. Prepare parts from simple sketches or drawings.~~
~~_____2. Lay out and fit up joints from welding symbol information.~~
~~_____3. Perform welding operations to prepare a welded fabrication from simple sketches or drawings.~~

~~Cutting Processes (WLV 1314)~~

~~_____1. Explore manual oxyfuel gas cutting operations.~~
~~_____2. Explore oxyfuel gas cutting equipment (track burner) to perform cutting operations.~~
~~_____3. Explore metal removal using the carbon arc cutting process.~~
~~_____4. Explore the manual plasma arc cutting process.~~

~~Welding Code (WLV 2913)~~

~~_____1. Explore AWS D1.1 Code.~~
~~_____2. Explore API 1104 Code.~~
~~_____3. Explore ASME Section 9 Code.~~

Baseline Competencies

The following competencies and suggested objectives are taken from the publication *Mississippi Curriculum Framework for Metal Trades*. These competencies and objectives represent the baseline that was used to develop the community/junior college welding and cutting courses. Students enrolled in postsecondary courses should either (1) have documented mastery of these competencies or (2) be provided with these competencies before studying the advanced competencies in the Welding and Cutting Technology program.

Baseline competencies may be integrated into existing courses in the curriculum or taught as special "Introduction" courses. The "Introduction" courses may be taught for up to six semester hours of institutional credit and may be divided into two courses. If the Baseline Competencies are to be taught as "Introduction" courses, each course should be at least three credit hours. The following course number(s) and description should be used:

Course Name(s): Introduction to Welding Technology I or Introduction to Welding Technology II

Course Abbreviation(s): WLV 100(3-6), WLV 1013, WLV 1023

Classification: Vocational-Technical Core

Description: These courses contain the baseline competencies and suggested objectives from the high school Metal Trades curriculum that directly relate to the community college Welding and Cutting Technology program. The courses are designed for students entering the community college who have had no previous training or documented experience in the field. (3-6 semester hours based upon existing skills for each student. May be divided into two courses for a maximum total of six hours of institutional credit)

Competencies and Suggested Objectives:

1. Describe local program and vocational/career technical center policies and procedures.
   a. Describe local program and vocational/career technical center policies and procedures including dress code, attendance, academic requirements, discipline, and transportation regulations.
2. Describe employment opportunities and responsibilities.
   a. Describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements.
   b. Describe basic employee responsibilities.
3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.
   a. Demonstrate effective teambuilding and leadership skills.
   b. Practice appropriate work ethics.
4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
5. Discuss the history of metal trades industry to include materials, terminology, and techniques.
6. Describe general safety rules for working in a shop/lab and industry.

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.
d. Explain the importance of reporting all on-the-job injuries and accidents.
e. Explain the need for evacuation policies and the importance of following them.
f. Explain the employer's substances abuse policy and how it relates to safety.

7. Explain the safety procedures when working near pressurized or high temperature. Identify and apply safety around metal trades operations.
   a. Use proper safety practices when performing metal trades operations.
   b. Recognize and explain personal protective equipment.
   c. Inspect and care for personal protective equipment.
8. Explain the Material Safety Data Sheet (MSDS).
   a. Explain the function of the MSDS.
   b. Interpret the requirements of the MSDS.
9. Explain fires.
   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.
10. Apply the four basic math skills with whole numbers, fractions, and percent.
    a. Add, subtract, multiply, and divide whole numbers, decimals, and fractions.
    b. Convert whole numbers to fractions, and convert fractions to whole numbers.
    c. Convert decimals to percent and percent to decimals.
    d. Convert fractions to decimals.
    e. Convert fractions to percent.
11. Use the metric system.
    a. Use a standard and metric ruler to measure.
    b. Explain what the metric system is and its importance.
    c. Recognize and use metric units of length, weight, volume, and temperature.
12. Apply basic mathematics for welding.
    a. Calculate area and volume of simple geometric figures.
    b. Apply basic math to solve simple geometric figures and problems.
13. Read, analyze, and design a blueprint.
    a. Identify terms and symbols commonly used on blueprints.
    b. Relate information on prints to real parts/models.
    c. Interpret various symbols to locate various elements.
    d. Interpret a plan to determine layout.
    e. Explain basic layout of a blueprint.
    f. Describe the information in a title block.
    g. Identify the lines used on blueprints.
    h. Explain an engineer's scale.
14. Demonstrate the use and maintenance of various hand and power tools.
    a. Identify and discuss the use of common hand and power tools.
    b. Discuss rules of safety.
    c. Select and demonstrate the use of tools.
    d. Explain the procedures for maintenance.
15. Identify and describe the safe operation of the types of power saws.
    a. Identify and describe rules for safe use of power saws.
    b. Describe factors that determine saw blade selection.

c. Describe factors to consider in the care and cleaning of power saws.
d. Lay out and cut stock with a band saw according to specifications.

16. Identify and describe the basic equipment, setup, and safety rules for proper use of equipment and prepare base metal for welding (SMAW and GMAW), oxy-fuel welding, and brazing.
a. Identify and explain joint design and considerations.
b. Prepare base metal joints for welding, oxy-fuel welding, and brazing.

17. Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.
a. Describe safety rules that apply to the pedestal grinder.
b. Inspect and maintain a pedestal grinder.

18. Identify and describe various fasteners, hangers, supports, hand tools, sheet metal machines, and terms.
a. Identify and describe the safe use of specialized hand tools and machines.
b. Identify common seams, locks, edges, and notches.
c. Describe the major fasteners used in sheet metal projects.
d. Describe the major hangers used in sheet metal.
e. Describe the major supports used in sheet metal.

~~Appendix A: American Welding Society Standards EG2.0-95~~[2]

~~AWS1 Orientation and Safety~~
~~AWS2 Drawing and Welding Symbol Interpretation~~
~~AWS3 Shielded Metal Arc Welding (SMAW)~~
~~AWS4 Gas Metal Arc Welding (GMAW)~~
~~AWS5 Flux Cored Arc Welding (FCAW)~~
~~AWS6 Gas Tungsten Arc Welding (GTAW)~~
~~AWS7 Oxyfuel Gas Cutting~~
~~AWS8 Air Carbon Arc Cutting (CAC-A)~~
~~AWS9 Plasma Arc Cutting (PAC)~~
~~AWS10 Welding Inspection and Testing Principles~~

~~[2] *American Welding Society Standards EG2.0-95.* (2005). Retrieved August 10, 2005, from http://www.aws.org/~~

Appendix B: Related Academic Standards[3]

Reading
R1 Interpret Graphic Information (forms, maps, reference sources)
R2 Words in Context (same and opposite meaning)
R3 Recall Information (details, sequence)
R4 Construct Meaning (main idea, summary/paraphrase, compare-contrast, cause-effect)
R5 Evaluate/Extend Meaning (fact/opinion, predict outcomes, point of view)

Mathematics Computation
M1 Addition of Whole Numbers (no regrouping, regrouping)
M2 Subtraction of Whole Numbers (no regrouping, regrouping)
M3 Multiplication of Whole Numbers (no regrouping, regrouping)
M4 Division of Whole Numbers (no remainder, remainder)
M5 Decimals (addition, subtraction, multiplication, division)
M6 Fractions (addition, subtraction, multiplication, division)
M7 Integers (addition, subtraction, multiplication, division)
M8 Percents
M9 Algebraic Operations

Applied Mathematics
A1 Numeration (ordering, place value, scientific notation)
A2 Number Theory (ratio, proportion)
A3 Data Interpretation (graph, table, chart, diagram)
A4 Pre-Algebra and Algebra (equations, inequality)
A5 Measurement (money, time, temperature, length, area, volume)
A6 Geometry (angles, Pythagorean theory)
A7 Computation in Context (whole numbers, decimals, fractions, algebraic operations)
A8 Estimation (rounding, estimation)

Language
L1 Usage (pronoun, tense, subject-verb agreement, adjective, adverb)
L2 Sentence Formation (fragments, run-on, clarity)
L3 Paragraph Development (topic sentence, supporting sentence, sequence)
L4 Capitalization (proper noun, titles)
L5 Punctuation (comma, semicolon)
L6 Writing Conventions (quotation marks, apostrophe, parts of a letter)

Spelling
S1 Vowel (short, long)
S2 Consonant (variant spelling, silent letter)

[3] CTB/McGraw-Hill LLC. (1994). *Tests of adult basic education, forms 7 and 8.* Monterey, CA: Author.

~~Appendix C: Workplace Skills for the 21st Century~~[4]

~~WP1 Allocates resources (time, money, materials and facilities, and human resources).~~
~~WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.~~
~~WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.~~
~~WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.~~
~~WP5 Selects, applies, and maintains/troubleshoots technology.~~
~~WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.~~
~~WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.~~
~~WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.~~

[4] ~~*Secretary's commission on achieving necessary skills.* (1991). Retrieved July 13, 2004, from http://wdr.doleta.gov/SCANS/~~

Appendix D: National Educational Technology Standards for Students[5]

T1 Basic operations and concepts
- Students demonstrate a sound understanding of the nature and operation of technology systems.
- Students are proficient in the use of technology.

T2 Social, ethical, and human issues
- Students understand the ethical, cultural, and societal issues related to technology.
- Students practice responsible use of technology systems, information, and software.
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

T3 Technology productivity tools
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
- Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.

T4 Technology communications tools
- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

T5 Technology research tools
- Students use technology to locate, evaluate, and collect information from a variety of sources.
- Students use technology tools to process data and report results.
- Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

T6 Technology problem-solving and decision-making tools
- Students use technology resources for solving problems and making informed decisions.
- Students employ technology in the development of strategies for solving problems in the real world.

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[5] International Society for Technology in Education. (2000). *National educational technology standards for students (NETS).* Retrieved July 13, 2004, from http://www.iste.org/

Appendix E: International Technology Education Association (ITEA) STL Content Standards[6]

Standard 1 – Students will develop an understanding of the characteristics and scope of technology.
Standard 2 – Students will develop an understanding of the core concepts of technology.
Standard 3 – Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4 – Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5 – Students will develop an understanding of the effects of technology on the environment.
Standard 6 – Students will develop an understanding of the role of society in the development and use of technology.
Standard 7 – Students will develop an understanding of the influences of technology on history.
Standard 8 – Students will develop an understanding of the attributes of design.
Standard 9 – Students will develop an understanding of engineering design.
Standard 10 – Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11 – Students will develop abilities to apply the design process.
Standard 12 – Students will develop abilities to use and maintain technological products and systems.
Standard 13 – Students will develop abilities to assess the impact of products and systems.
Standard 14 – Students will develop an understanding of and be able to select and use medical technologies.
Standard 15 – Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16 – Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17 – Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18 – Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19 – Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20 – Students will develop an understanding of and be able to select and use construction technologies.

[6] International Technology Education Association. (n.d.). *Listing of STL content standards.* Retrieved December 6, 2006, from http://www.iteaconnect.org/TAA/PDFs/ListingofSTLContentStandards.pdf

Appendix F: Contren Learning Series Best Practices (taken from the National Center for Construction Education and Research[7])

CORE

INTRODUCTION TO CONSTRUCTION MATH

MAT1 Add, subtract, multiply, and divide whole numbers, with and without a calculator.
MAT2 Use a standard ruler and a metric ruler to measure.
MAT3 Add, subtract, multiply, and divide fractions.
MAT4 Add, subtract, multiply, and divide decimals, with and without a calculator.
MAT5 Convert decimals to percents and percents to decimals.
MAT6 Convert fractions to decimals and decimals to fractions.
MAT7 Explain what the metric system is and how it is important in the construction trade.
MAT8 Recognize and use metric units of length, weight, volume, and temperature.
MAT9 Recognize some of the basic shapes used in the construction industry and apply basic geometry to measure them.

INDUSTRIAL MAINTENANCE

LEVEL V

PRECISION MEASURING TOOLS

PMT1 Use levels.
PMT2 Use feeler gauges.
PMT3 Use calipers.
PMT4 Use micrometers.
PMT5 Use dial indicators.
PMT6 Use protractors.
PMT7 Use parallels and gauge blocks.
PMT8 Use trammels.
PMT9 Use precision straightedges.
PMT10 Use speed measurement tools.
PMT11 Use pyrometers.

[7] *Contren learning series.* Retrieved September 19, 2007, from http://www.nccer.org/

~~**Pipefitting**~~

~~**Level Two**~~

~~**PIPING SYSTEMS**~~

~~PPS1 Identify and explain the types of piping systems.~~
~~PPS2 Identify piping systems according to color coding.~~
~~PPS3 Explain the effects and corrective measures for thermal expansion in piping systems.~~
~~PPS4 Explain types and applications of pipe insulation.~~

~~**DRAWINGS AND DETAIL SHEETS**~~

~~DDP1 Identify parts of drawings.~~
~~DDP2 Identify types of drawings.~~
~~DDP3 Make field sketches.~~
~~DDP4 Interpret drawing indexes and line lists.~~

~~**PIPEFITTING TRADE MATH**~~

~~PTF1 Identify and explain the use of special measuring devices.~~
~~PTF2 Use tables of weights and measurements.~~
~~PTF3 Use formulas to solve basic problems.~~
~~PTF4 Solve area problems.~~
~~PTF5 Solve volume problems~~
~~PTF6 Solve circumference problems.~~
~~PTF7 Solve right triangle problems using the Pythagorean theorem.~~

~~**THREADED PIPE FABRICATION**~~

~~TPF1 Identify and explain the materials used in threaded piping systems.~~
~~TPF2 Identify and explain pipe fittings.~~
~~TPF3 Read and interpret screwed fitting joint drawings.~~
~~TPF4 Identify and explain types of threads.~~
~~TPF5 Determine pipe lengths between joints.~~
~~TPF6 Thread and assemble piping and valves.~~
~~TPF7 Calculate offsets.~~

~~**SOCKET WELD PIPE FABRICATION**~~

~~SWP1 Identify and explain types of socket weld piping materials.~~
~~SWP2 Identify and explain socket weld fittings.~~
~~SWP3 Read and interpret socket weld piping drawings.~~
~~SWP4 Determine pipe lengths between socket weld fittings.~~
~~SWP5 Fabricate socket weld fitting to pipe.~~

~~**BUTT WELD PIPE FABRICATION**~~

~~BWP1 Identify butt weld piping materials and fittings.~~

~~BWP2 Read and interpret butt weld piping drawings.~~
~~BWP3 Prepare pipe ends for fit-up.~~
~~BWP4 Determine pipe lengths between fittings.~~
~~BWP5 Select and install backing rings.~~
~~BWP6 Perform alignment procedures for various types of fittings.~~

~~Level Three~~

~~ADVANCED BLUEPRINT READING~~

~~ABR1 Identify symbols and abbreviations on P&IDs.~~
~~ABR2 Identify piping arrangement drawings.~~
~~ABR3 Read and interpret coordinates, control points, and elevation.~~
~~ABR4 Read and interpret P&IDs, plan views, and section views.~~
~~ABR5 Identify isometric drawings.~~
~~ABR6 Read isometric drawings taken from plan views.~~
~~ABR7 Draw isometric drawings.~~

~~STANDARDS AND SPECIFICATIONS~~

~~SAS1 Understand and interpret pipefitting standards and codes.~~
~~SAS2 Read and interpret pipefitting specifications.~~
~~SAS3 Identify pipe and components according to specifications.~~

~~Level Four~~

~~ADVANCED PIPE FABRICATION~~

~~APF1 Calculate simple piping offsets.~~
~~APF2 Calculate three-line, 45° equal-spread offsets around a vessel.~~
~~APF3 Calculate three-line, 45° unequal-spread offsets.~~
~~APF4 Fabricate tank heating coils.~~
~~APF5 Perform mitering procedures.~~
~~APF6 Lay out three- and four-piece mitered turns.~~
~~APF7 Lay out 45° laterals, using references.~~
~~APF8 Fabricate dummy legs and trunnions out of pipe, using references.~~
~~APF9 Perform geometric layout of pipe laterals and supports.~~