



Burlington County Institute of Technology

Medford Campus

Career and Technical Programs

Career Cluster: *Manufacturing*

Program Name: *Welding Technology/Welder*

Program Title: *Welding Technology*

CIP Code: *480508*

Board Approval Date: October, 2023



Program of Study

- Grade 9
 - ◆ Introduction to Welding
 - ◆ Principles of Welding
- Grade 10
 - ◆ Arc Welding Theory I
 - ◆ Arc Welding Lab
 - ◆ Arc Welding Theory II
- Grade 11
 - ◆ Metal Fabrication
 - ◆ CNC Thermal Cutting
 - ◆ Advance Welding Lab
- Grade 12
 - ◆ AWS Theory I
 - ◆ AWS Theory II
 - ◆ AWS Proficiency Lab
 - ◆ Advance Metal Design



→ Program Descriptor

- ◆ Welding Technology follows the AWS(American Welding Society) SENSE program. Which will provide students with the opportunity to achieve various AWS SENSE Certifications. Students can use their acquired skills in many career paths such as Fabrication, Pipe Welding, Industrial Maintenance, Weld Inspector and into post secondary education. The program involves both hands-on and theory lessons, building the students' knowledge base on math, measurements, welding processes and design. Branching into career and continued education options with welding after completion of the program. With the welding industry growing students will get an introduction into Computer Aided Design and Programming.

→ Program Outcome

- ◆ Graduates of this program should be able to communicate technical information both verbally and in writing effectively, demonstrate mathematical skills and application of scientific principles in problem solving, and apply critical thinking and problem solving skills to analyze data, in the creation of experimental procedures and analysis of the outcome.

→ Work Based Learning Opportunities

- ◆ Career Preparation: Simulated Workplace Environment
- ◆ Career Preparation: School-to-Work

→ Industry Valued Credentials

- ◆ American Welding Society (AWS): Certified Welder
- ◆ OSHA 10



Course Descriptions

1. Grade 9

- a. *Introduction to Welding*: This course provides a comprehensive introduction to the world of welding, emphasizing safety protocols and regulations essential for secure welding practices. It traces the historical evolution and future trends in welding to foster a deeper comprehension of the field. Through hands-on experience with Virtual Reality Welding Machines, students will acquire fundamental skills in arc welding. The curriculum encompasses foundational knowledge in electricity, shop procedures, and professional ethics. Key topics covered encompass weld positions, terminology, measurements, and various metal types. Course projects will integrate these core skills to demonstrate proficiency, with an emphasis on practical application. Furthermore, students will gain insights into the diverse career pathways within the welding industry.
- b. *Principles of Welding*: This class centers on imparting essential welding principles, encompassing the basics of thermal and mechanical cutting techniques, as well as the art of fusing materials together. Emphasis is placed on the safe operation of OxyFuel torches and equipment, ensuring proper setup and shutdown procedures. Students will also explore alternative mechanical cutting methods employing tools like shears and saws. An in-depth understanding of the Shielded Metal Arc Welding (SMAW) process and its associated equipment will be covered, encompassing considerations such as polarity, electrode selection, and the use of appropriate safety gear. The course serves as the initial step toward achieving proficiency in line with the American Welding Society (AWS) SENSE standards.

2. Grade 10

- a. *Arc Welding Theory I*: This course provides students with an overview of arc welding techniques, including SMAW (Shielded Metal Arc Welding), GMAW (Gas Metal Arc Welding), FCAW (Flux Core Arc Welding), and GTAW (Gas Tungsten Arc Welding). Students will gain a comprehensive understanding of each welding process, its associated equipment, and the essential safety precautions. Additionally, the course covers the types of gasses used in conjunction with these processes. Furthermore, students will explore thermal cutting with Plasma Arc, delving into its operational principles, safety considerations,



and setup procedures. The course also addresses the interpretation of welding blueprints, encompassing the reading and comprehension of industry-standard weld symbols frequently encountered in various welding applications.

- b. *Arc Welding Lab*: This course provides students with invaluable hands-on experience in a welding shop environment. Students will acquire essential skills for safely handling and utilizing shielding gas, including proper storage techniques. The curriculum also encompasses equipment maintenance, adjustment procedures, and the full workflow from interpreting weld blueprints, material preparation, welding, to final inspection. Additionally, students will gain proficiency in material and supply storage, as well as tracking product and equipment usage. The course offers comprehensive coverage of Shielded Metal Arc Welding (SMAW) and Gas Metal Arc Welding (GMAW) techniques, ensuring students develop practical expertise in the field."
- c. *Arc Welding Theory II*: This course equips students with the expertise to excel in welding 'out of position' using Shielded Metal Arc Welding (SMAW) and Gas Metal Arc Welding (GMAW) techniques. The focus is on mastering horizontal, vertical, and overhead welding positions, enabling students to weld effectively in challenging orientations. Topics covered include electrode selection, machine setup, and hazard awareness associated with 'out of position' welding. Additionally, students will gain proficiency in weld joint preparation and setup procedures. The course explores the direct correlation between polarity and amperage in SMAW for 'out of position' welding. Furthermore, students will be introduced to Flux Core Arc Welding (FCAW) and Gas Tungsten Arc Welding (GTAW), including equipment setup and operation. These additional skills will empower students with versatile capabilities that connect seamlessly with diverse career opportunities upon graduation.

3. Grade 11

- a. *Metal Fabrication*: This course centers on the practical application of welding skills in the field of metal fabrication. Students will learn the art of assembling materials through mechanical means, gaining insights into the when and how of selecting and utilizing various mechanical fasteners, including bolts, rivets, screws, and more. Training will also cover the safe operation of essential shop equipment such as shears, brakes, ironworkers, drills/drill presses, and hydraulic presses. Additionally, students will acquire project planning skills, including project layout, scheduling, and cost calculations involving materials, supplies, and labor.



- b. *CNC Thermal Cutting*: This course provides students with a comprehensive introduction to Computer Controlled Thermal Cutting, with a focus on Plasma Arc technology as its foundation. Topics covered include the fundamental components of a CNC Plasma Cutter, such as the power unit, controller, table, gantry, and dust control systems. Students will learn basic programming and design principles for creating projects, including the generation of shapes, text, and the importation of objects. Setting up the cutting machine, considering material types and sizes, and making critical selections like voltage, amperes, and travel speed will be explored. Maintenance procedures, safety measures concerning dust and smoke hazards, and machine adjustments will also be addressed. Additionally, the course delves into alternative methods of material cutting, such as laser and water-based energy techniques.
- c. *Advanced Welding Lab*: This course provides students with a dynamic and hands-on learning experience, allowing them to further enhance their welding proficiency. Students will extensively utilize a wide range of welding equipment available in the shop, including SMAW, GMAW, FCAW, and GTAW welders. In addition to welding processes, students will gain expertise in the use of fabrication and cutting equipment, utilizing these tools to undertake skill projects that align with AWS SENSE Proficiency standards. Emphasis is placed on fostering a culture of shop safety and the development of strong personal safety practices. As students delve into advanced welding techniques, they will also explore mathematical and measurement concepts essential for the preparation of precise weld drawings. This course equips students with the skills and knowledge necessary for successful careers in welding while promoting safety, technical excellence, and mathematical proficiency.

4. Grade 12

- a. *AWS Theory I*: This course is designed to prepare welding students for AWS SENSE (American Welding Society's Schools Excelling through National Skills Education) Certification, a valuable credential for their future careers. The curriculum covers the first five modules of SENSE, including Occupational Orientation, Safety and Health, Print Reading and Symbols, SMAW Theory, and GMAW Theory. In the Occupational Orientation module, students will develop skills in time management, understanding verbal and written instructions, and maintaining a safe and organized work environment. Safety and Health topics will encompass Personal Protective Equipment (PPE) usage and best practices in shop safety. The course also includes comprehensive instruction in welding print interpretation and symbol recognition. Students will have the opportunity to refresh their knowledge and skills in Shielded Metal Arc Welding (SMAW) and Gas Metal Arc Welding (GMAW) processes. Additionally, they will gain a deep



understanding of the specific requirements and expectations for each module, ensuring they are well-prepared to pursue AWS SENSE Certification upon graduation.

- b. *AWS Theory II:* This course is designed to advance welding students' knowledge and skills, further preparing them for AWS SENSE (American Welding Society's Schools Excelling through National Skills Education) Certification before graduation. The curriculum focuses on the final four modules of SENSE, which encompass FCAW Theory (Flux Cored Arc Welding), GTAW Theory (Gas Tungsten Arc Welding), Thermal Cutting Processes, and Welding Inspection/Testing. Within the FCAW and GTAW Theory modules, students will revisit and reinforce their understanding of these advanced welding techniques, refining their skills and knowledge. The Thermal Arc Cutting section covers both manual and mechanized OxyFuel cutting, as well as manual Plasma Arc Cutting, providing comprehensive knowledge and practical experience. In the Welding Inspection and Testing module, students will gain insight into industry standards, equipping them with fundamental knowledge of inspection and testing requirements within the welding profession. This course ensures students are well-prepared to pursue AWS SENSE Certification and excel in the welding industry upon graduation.
- c. *AWS Proficiency Lab:* This course is designed to provide students with dedicated hands-on practice to prepare for their AWS SENSE Practical Exams. Students will have the opportunity to apply the skills they have acquired in Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), and Gas Tungsten Arc Welding (GTAW) procedures within the controlled environment of the weld booths. Emphasis will be placed on completing projects as required by AWS standards, including material preparation, layout, cutting, and prepping. This lab-based course enables students to refine their welding techniques and demonstrate proficiency in preparation for AWS certification exams.
- d. *Advanced Metal Design:* This dynamic course is designed to elevate students' proficiency in the art of metal design and fabrication. Building upon foundational skills, students will delve into the complexities of metalwork, exploring advanced techniques and applications. Topics will include precision metal cutting, intricate welding processes, and creative metal shaping. Students will have the opportunity to tackle ambitious metal design projects, incorporating elements of artistic expression and functional design. Emphasis will be placed on mastering diverse metalworking tools, developing design concepts, and refining craftsmanship. By the end of the course, students will have honed their abilities to transform raw metal into intricate, finely crafted pieces, preparing them for advanced opportunities in metal design and fabrication.



Curriculum Maps

Course: Safety

Unit: OSHA 10

Length: 1 Week

Standards

- 9.3.12.AG-FD.1 Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.
- 9.3.12.AC-CST.5 Apply practices and procedures required to maintain jobsite safety.
- 9.3.12.AR.2 Analyze the importance of health, safety and environmental management systems, policies and procedures common in arts, audio/video technology and communications activities and facilities.
- 9.3.12.ED.4 Evaluate and manage risks to safety, health and the environment in education and training settings.
- 9.3.HT-RFB.2 Demonstrate safety and sanitation procedures in food and beverage service facilities.
- 9.3.HU-ED.5 Evaluate safety and sanitation procedures associated with the early childhood education environment to assure compliance and prevent potential hazards.
- 9.3.LW.4 Conduct law, public safety, corrections and security work tasks in accordance with employee and employer rights, obligations and responsibilities, including occupational safety and health requirements.
- 9.3.LW-ENF.8 Explain the appropriate techniques for managing crisis situations in order to maintain public safety.
- 9.3.MN.3 Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices.
- 9.3.MN-HSE.3 Demonstrates a safety inspection process to assure a healthy and safe manufacturing environment.
- 9.3.MN-HSE.5 Evaluate continuous improvement protocols and techniques in health, safety and/or environmental practices.
- 9.3.12.TD.5 Describe transportation, distribution and logistics employee rights and responsibilities and employers' obligations concerning occupational safety and health.



- 9.3.12.TD-HSE.1 Describe the health, safety and environmental rules and regulations in transportation, distribution and logistics workplaces.
- 9.3.12.TD-OPS.3 Comply with policies, laws and regulations in order to maintain safety, security and health and mitigate the economic and environmental risk of transportation operations.

Essential Question(s)

- Why is it important to practice safety?
- What do safe practices look like in my industry?
- How can I keep myself and others safe?

Content

- Walking working surfaces
- Emergency action plans
- Fire protection
- Electrocution hazards
- Personal protective equipment
- Hazard communication
- Materials handling, storage, use and disposal.

Skills

- Explain why OSHA is important to workers.
- Explain workers rights under OSHA
- Discuss employer responsibilities under OSHA.
- Discuss the use of OSHA standards.
- Explain how OSHA inspections are conducted.
- Utilize helpful worker safety and health resources.
- Identify hazards in the workplace associated with walking and working surfaces.



- Identify best practices for eliminating or controlling hazards associated with walking and working surfaces in the workplace.
- Recognize employer requirements to protect workers from walking and working surface hazards.
- Recognize benefits of an Emergency Action Plan.
- Identify elements of the Fire Protection Plan.
- Identify conditions under which evacuation actions may be necessary in an emergency situation.
- Identify conditions under which shelter-in-place may be necessary in an emergency situation.
- Identify characteristics of an effective emergency escape route.
- Recognize the five types of fire extinguishers, including the types of fires they can extinguish.
- Review requirements for proper maintenance of portable fire extinguishers.
- Identify major electrical hazards.
- Describe types of electrical hazards.
- Describe electrical protection methods.
- Recognize employer requirements to protect workers from electrical hazards.
- Recall employer responsibilities toward affected employees regarding PPE.
- Identify when face and head protection should be used.
- Recall which types of hand and foot protection should be used in a specific situation.
- Recognize the differences between respirator types.
- Identify the differences between full-body protection levels.
- Identify the employer's responsibilities under the HCS, including training requirements.
- Identify components of a Hazard Communication program.
- Describe requirements of the different types of Hazard Communication labels.
- Locate pertinent information about chemicals on labels, including other forms of hazard communication, to ensure "right to understanding" provisions of GHS requirements.
- Identify types of material handling equipment.
- Describe hazards associated with material handling activities (e.g., storage, use, and disposal).
- Identify methods to prevent hazards associated with material handling equipment.
- Recognize employer requirements to protect workers from material handling hazards
- Identify the main causes of machinery accidents.



- Recognize basic machinery parts that expose workers to hazards.
- Recognize workplace situations involving machinery that requires guarding.
- Identify the requirements for safeguards.
- Identify types of machine guards including types of devices used to safeguard machines.
- Identify strategies to control chemical hazards.
- Identify strategies to control biological hazards.
- Identify strategies to control physical hazards.
- Identify strategies to control ergonomic hazards.
- Identify OSHA requirements pertaining to bloodborne pathogens.
- List the potential routes of exposure from bloodborne pathogens.
- Identify the risks associated with Human Immunodeficiency Virus (HIV), Hepatitis B, and Hepatitis C Virus.
- Identify methods of preventing transmission of bloodborne pathogens & managing occupational exposures.
- Restate methods of the safe disposal of sharps.
- Recount steps which should be taken in the event of an exposure to a potential bloodborne pathogen.
- Recognize risk factors associated with work-related musculoskeletal disorders (MSD)s.
- Identify good posture.
- Describe safe lifting techniques.
- Identify ergonomic control methods for eliminating/reducing work-related MSDs.
- Identify the number one cause of death for U.S. teens.
- List eight risk factors for young drivers.
- Identify the biggest risk factor for young drivers.
- Define distracted driving.
- Provide examples and/or causes of distracted driving.
- Identify the biggest risk factor for distracted driving
- Discuss the risk of having other young passengers in the car.
- List some actions employers should take to keep employees safe while driving.
- List some actions employees can take to safely drive on the job.
- Define the term violence.
- Recall who is at risk for encountering workplace violence.



- Describe workplace violence prevention strategies.
- Identify how to StartSafe and StaySafe to prevent or lessen workplace violence.
- Recognize the costs of workplace accidents.
- Recognize the benefits of implementing an effective safety and health program.
- Describe the elements of an effective safety and health program.
- Identify three methods to prevent workplace hazards.

Assessments

- OSHA 10 Assessment and Certificate

Course: CTE

Unit: Career Awareness

Length: Woven Throughout

Standards

- 9.2.12.CAP.1: Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
- 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.



- 9.2.12.CAP.7: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
- 9.2.12.CAP.8: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
- 9.2.12.CAP.9: Locate information on working papers, what is required to obtain them, and who must sign them.
- 9.2.12.CAP.10: Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans)
- 9.2.12.CAP.11: Demonstrate an understanding of Free Application for Federal Student Aid (FAFSA) requirements to apply for postsecondary education
- 9.2.12.CAP.12: Explain how compulsory government programs (e.g., Social Security, Medicare) provide insurance against some loss of income and benefits to eligible recipients.
- 9.2.12.CAP.13: Analyze how the economic, social, and political conditions of a time period can affect the labor market.
- 9.2.12.CAP.14: Analyze and critique various sources of income and available resources (e.g., financial assets, property, and transfer payments) and how they may substitute for earned income
- 9.2.12.CAP.15: Demonstrate how exemptions, deductions, and deferred income (e.g., retirement or medical) can reduce taxable income.
- 9.2.12.CAP.16: Explain why taxes are withheld from income and the relationship of federal, state, and local taxes (e.g., property, income, excise, and sales) and how the money collected is used by local, county, state, and federal governments. •
- 9.2.12.CAP.17: Analyze the impact of the collective bargaining process on benefits, income, and fair labor practice. •
- 9.2.12.CAP.18: Differentiate between taxable and nontaxable income from various forms of employment (e.g., cash business, tips, tax filing and withholding). •
- 9.2.12.CAP.19: Explain the purpose of payroll deductions and why fees for various benefits (e.g., medical benefits) are taken out of pay, including the cost of employee benefits to employers and self-employment income.
- 9.2.12.CAP.20: Analyze a Federal and State Income Tax Return



- 9.2.12.CAP.21: Explain low-cost and low-risk ways to start a business.
- 9.2.12.CAP.22: Compare risk and reward potential and use the comparison to decide whether starting a business is feasible.
- 9.2.12.CAP.23: Identify different ways to obtain capital for starting a business

Essential Question(s)

- How does one prepare for a career?
- How does one improve marketability?
- Why is career planning important?
- What are the risks in starting a business?

Content

- There are strategies to improve one's professional value and marketability.
- Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
- An individual's income and benefit needs and financial plan can change over time.
- Securing an income involve an understanding of the costs and time in preparing for a career field, interview and negotiation skills, job searches, resume development, prior experience, and vesting and retirement plans
- Understanding income involves an analysis of payroll taxes, deductions and earned benefits.
- There are ways to assess a business's feasibility and risk and to align it with an individual's financial goals

Skills

- Act as a responsible and contributing community member and employee.
- Attend to financial well-being.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Plan education and career paths aligned to personal goals.



- Use technology to enhance productivity, increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

Assessments

- Career Research Project
- Resume/Cover Letter

Course: Introduction to Welding

Length: Semester

Standards

- 9.3.MN.1 Evaluate the nature and scope of the Manufacturing Career Cluster and the role of manufacturing in society and in the economy.
- 9.3.MN.2 Analyze and summarize how manufacturing businesses improve performance.
- 9.3.MN.3 Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices.
- 9.3.MN.4 Describe career opportunities and means to achieve those opportunities in each of the Manufacturing Career Pathways.
- 9.3.MN.5 Describe government policies and industry standards that apply to manufacturing.
- 9.3.MN.6 Demonstrate workplace knowledge and skills common to manufacturing.

Essential Question(s)

- How has the historical evolution of welding shaped the practices and technologies used in modern welding, and what trends are driving its future advancements?



- What are the critical safety protocols and regulations that every welder must adhere to, and how do they contribute to secure welding practices?
- How does hands-on experience with Virtual Reality Welding Machines enhance students' fundamental skills in arc welding, and what are the key advantages of virtual training in welding education?
- In what ways does a strong foundation in electricity, shop procedures, and professional ethics benefit welders, and how do these foundational elements support safe and effective welding practices?
- Why is a thorough understanding of weld positions, terminology, measurements, and various metal types crucial for welders, and how are these concepts applied in practical welding projects that demonstrate proficiency?

Content

- Introduction to Welding:
 - History and evolution of welding
 - Importance of safety in welding
 - Welding regulations and standards
- Welding Equipment and Tools:
 - Overview of welding equipment
 - Types of welding machines
 - Selection and maintenance of welding tools
- Virtual Reality Welding Training:
 - Introduction to virtual reality welding simulations
 - Hands-on practice with virtual reality welding machines
 - Developing basic arc welding skills in a virtual environment
- Fundamentals of Electricity:
 - Understanding electrical circuits
 - Electrical safety precautions in welding
 - Basic electrical concepts relevant to welding
- Shop Skills and Safety:
 - Safe workshop practices



- Proper handling of materials and equipment
 - Hazard identification and mitigation
- Work Ethics in Welding:
 - Professionalism in the welding industry
 - Ethical considerations in welding projects
 - Workplace communication and teamwork
- Welding Techniques:
 - Types of welding processes (e.g., arc welding, MIG, TIG)
 - Welding positions and their significance
 - Practical welding demonstrations and exercises
- Terminology and Measurements:
 - Essential welding terminology
 - Measurement tools and techniques used in welding
 - Precision and accuracy in welding measurements
- Types of Metals in Welding:
 - Overview of metal properties
 - Common types of metals used in welding (e.g., steel, aluminum)
 - Metal identification and selection for welding projects
- Welding Project Integration:
 - Application of welding skills in practical projects
 - Project planning and execution
 - Combining welding, measurement, and safety knowledge
- Career Options in Welding:
 - Exploration of welding career pathways
 - Educational and certification requirements
 - Job roles and opportunities in the welding industry

Skills

- Introduction to Welding:



- Understand the historical development and evolution of welding techniques and their significance in various industries.
- Recognize the paramount importance of safety in welding and its role in preventing accidents and injuries.
- Familiarize with welding regulations and standards, ensuring compliance with industry requirements and best practices.
- Welding Equipment and Tools:
 - Gain proficiency in identifying and describing various welding equipment components and their functions.
 - Differentiate between types of welding machines and select the appropriate machine for specific welding tasks.
 - Develop the skills necessary to maintain welding tools and equipment, ensuring their operational integrity.
- Virtual Reality Welding Training:
 - Grasp the concept of virtual reality welding simulations and their application in skill development.
 - Engage in hands-on practice with virtual reality welding machines to refine basic arc welding skills in a safe and controlled virtual environment.
- Fundamentals of Electricity:
 - Comprehend the fundamentals of electrical circuits and how they relate to welding equipment.
 - Implement electrical safety measures when working with welding machinery to minimize hazards.
 - Apply basic electrical concepts to welding processes, ensuring safe and effective operation.
- Shop Skills and Safety:
 - Cultivate a culture of safe workshop practices, focusing on accident prevention and the well-being of all individuals in the welding environment.
 - Demonstrate proper techniques for handling materials and equipment, minimizing the risk of damage or injury.
 - Develop the skills to identify potential hazards in the workshop and take measures to mitigate risks.
- Work Ethics in Welding:
 - Embrace professionalism within the welding industry by adhering to ethical principles and conduct.



- Reflect on ethical considerations in welding projects, including honesty, integrity, and environmental responsibility.
 - Improve workplace communication and teamwork skills, recognizing their significance in collaborative welding projects.
- Welding Techniques:
 - Gain knowledge of various welding processes, including arc welding, MIG, and TIG, and their applications in different scenarios.
 - Understand welding positions and their significance in achieving weld quality and strength.
 - Participate in practical welding demonstrations and exercises to build hands-on skills and confidence.
- Terminology and Measurements:
 - Acquire a comprehensive understanding of essential welding terminology and its practical application in communication.
 - Utilize measurement tools and techniques employed in welding, emphasizing precision and accuracy in measurements.
 - Apply measurement skills to ensure the exact fit and alignment of welding components and materials.
- Types of Metals in Welding:
 - Explore the properties of metals used in welding and their impact on the welding process.
 - Identify common types of metals employed in welding, such as steel and aluminum, and select the appropriate metal for specific welding projects.
 - Develop skills for metal identification and selection, ensuring compatibility with project requirements.
- Welding Project Integration:
 - Apply welding skills acquired in the course to practical welding projects, integrating measurement and safety knowledge.
 - Plan and execute welding projects, demonstrating project management abilities and precision in welding tasks.
 - Consolidate welding, measurement, and safety knowledge in the successful completion of projects.
- Career Options in Welding:
 - Explore diverse welding career pathways and understand the educational and certification prerequisites for each.



- Identify various job roles and employment opportunities in the welding industry, providing insight into potential career trajectories.

Assessments

- Safety Procedures Assessment:
 - Objective: Evaluate students' understanding of safety protocols and regulations in welding.
 - Assessment: Written safety exam covering safety measures, equipment usage, and emergency procedures.
- Virtual Welding Proficiency Test:
 - Objective: Assess students' skills acquired through virtual reality welding simulations.
 - Assessment: Practical welding test using Virtual Reality Welding Machines to demonstrate proficiency in arc welding techniques.
- Written Examination on Core Concepts:
 - Objective: Assess students' understanding of foundational welding knowledge, including electricity, terminology, measurements, and metal types.
 - Assessment: Written exam with multiple-choice questions, short answers, and explanations.
- Welding Skills Demonstration:
 - Objective: Evaluate students' practical welding skills.
 - Assessment: Hands-on welding test where students demonstrate proficiency in various welding processes and positions.

Course: Principles of Welding

Length: Semester



Standards

- 9.3.MN-HSE.1 Demonstrate the safe use of manufacturing equipment.
- 9.3.MN-HSE.2 Develop safety plans for production processes that meet health, safety and environmental standards.
- 9.3.MN-HSE.3 Demonstrate a safety inspection process to assure a healthy and safe manufacturing environment.
- 9.3.MN-HSE.4 Evaluate a system of health, safety and/or environmental programs, projects, policies or procedures to determine compliance.
- 9.3.MN-HSE.5 Evaluate continuous improvement protocols and techniques in health, safety and/or environmental practices.
- 9.3.MN-HSE.6 Conduct job safety and health analysis for manufacturing jobs, equipment and processes.
- 9.3.MN-HSE.7 Develop the components of a training program based on environmental health and safety regulations.

Essential Question(s)

- How do the fundamental principles of welding contribute to the creation of strong and durable metal joints, and what are the safety measures required for secure welding practices?
- What are the key distinctions between thermal and mechanical cutting methods, and how do they impact material preparation and welding projects in a workshop setting?
- How does an understanding of fusion welding processes enhance the ability to join materials effectively, and what role does heat play in achieving fusion in welding?
- What are the essential skills and precautions needed for the safe operation of OxyFuel torches, and how can the knowledge of OxyFuel cutting and welding be applied practically?
- How does Shielded Metal Arc Welding (SMAW) differ from other welding processes, and what considerations go into selecting the right electrodes, polarity, and safety gear for SMAW applications?

Content



- Introduction to Welding:
 - Overview of welding as a fabrication process
 - Importance of safety in welding practices
 - Historical context and evolution of welding
- Thermal and Mechanical Cutting:
 - Principles and techniques of thermal cutting (e.g., OxyFuel cutting)
 - Utilizing mechanical cutting tools (e.g., shears, saws) for material preparation
 - Safe operation and best practices in cutting processes
- Fusion Welding Fundamentals:
 - Understanding fusion welding processes
 - Overview of materials suitable for fusion welding
 - Examining the role of heat and fusion in welding
- OxyFuel Torch Operation:
 - Safe operation and handling of OxyFuel torches
 - Equipment setup and shutdown procedures
 - Practical application of OxyFuel cutting and welding
- Shielded Metal Arc Welding (SMAW):
 - In-depth exploration of the SMAW welding process
 - Electrode selection and polarity considerations
 - Proper use of safety gear and equipment
- AWS SENSE Proficiencies:
 - Introduction to the American Welding Society (AWS) SENSE program
 - Setting the foundation for AWS SENSE welding proficiencies
 - Skill development and practice aligned with AWS standards
- Materials and Metal Selection:
 - Identifying different types of metals and alloys
 - Selecting materials suitable for specific welding applications
 - Material properties and their impact on welding
- Welding Safety and Personal Protective Equipment (PPE):



- Emphasizing safety in welding environments
- Identifying potential hazards and safety measures
- Proper usage and maintenance of personal protective equipment
- Workshop Setup and Organization:
 - Creating an efficient and safe welding workspace
 - Organizing tools and materials for welding projects
 - Implementing housekeeping and workspace maintenance practices
- Entry-Level Welding Projects:
 - Hands-on welding projects to apply acquired skills
 - Practical exercises in cutting, fusion welding, and SMAW
 - Demonstrating proficiency and competence in welding techniques

Skills

- Introduction to Welding:
 - Understanding of basic welding principles
 - Knowledge of welding safety protocols
 - Awareness of the historical context of welding
- Thermal and Mechanical Cutting:
 - Proficiency in thermal cutting techniques (e.g., OxyFuel cutting)
 - Competence in using mechanical cutting tools (e.g., shears, saws)
 - Safe operation of cutting equipment
- Fusion Welding Fundamentals:
 - Ability to explain fusion welding processes
 - Selection of appropriate materials for fusion welding
 - Application of heat and fusion in welding practice
- OxyFuel Torch Operation:
 - Safe handling and operation of OxyFuel torches
 - Skill in setting up and shutting down OxyFuel equipment
 - Practical experience in OxyFuel cutting and welding



- Shielded Metal Arc Welding (SMAW):
 - Proficiency in the SMAW welding process
 - Competence in electrode selection and polarity adjustments
 - Proper use of safety gear and equipment
- AWS SENSE Proficiencies:
 - Progress toward achieving AWS SENSE welding standards
 - Skill development aligned with AWS proficiency requirements
 - Demonstrating proficiency in welding techniques
- Materials and Metal Selection:
 - Identification of different metals and alloys
 - Selection of appropriate materials for specific welding tasks
 - Understanding material properties and their relevance to welding
- Welding Safety and PPE:
 - Adherence to safety practices in welding environments
 - Identification of potential welding hazards and safety precautions
 - Competence in using and maintaining personal protective equipment
- Workshop Setup and Organization:
 - Creation of a safe and efficient welding workspace
 - Organization of tools and materials for welding projects
 - Implementation of workspace maintenance and housekeeping practices
- Entry-Level Welding Projects:
 - Hands-on welding skills for practical application
 - Proficiency in cutting, fusion welding, and SMAW techniques
 - Demonstration of competence in welding processes through projects

Assessments

- Practical Welding Skills Assessment:
 - Objective: Assess students' hands-on welding skills and proficiency.
-



- Assessment: Hands-on welding test where students demonstrate their ability to perform fusion welding and SMAW techniques, with an emphasis on safety and precision.
- Welding Project Portfolio and Presentation:
 - Objective: Evaluate students' practical application of welding principles and skills.
 - Assessment: Compilation of welding projects showcasing students' work, including documentation, photographs, and a presentation explaining project planning, execution, and safety measures.
- AWS SENSE SMAW Project Completion:
 - Objective: Assess students' proficiency in Shielded Metal Arc Welding (SMAW) through completion of AWS SENSE SMAW projects.
 - Assessment: Evaluation of students' SMAW project work, including adherence to AWS SENSE standards and quality of welds.

Course: ARC Welding Theory I

Length: Semester

Standards

- 9.3.MN-MIR.1 Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance.
- 9.3.MN-MIR.2 Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment.
- 9.3.MN-MIR.3 Diagnose equipment problems and effectively repair manufacturing equipment.
- 9.3.MN-MIR.4 Investigate and employ techniques to maximize manufacturing equipment performance.
- 9.3.MN-MIR.5 Implement a preventative maintenance schedule to maintain manufacturing equipment, tools and workstations.
- 9.3.MN-MIR.6 Implement an effective, predictive and preventive manufacturing equipment maintenance



- program.

Essential Question(s)

- How do different arc welding processes, such as SMAW, GMAW, FCAW, and GTAW, differ in terms of their operational principles, applications, and advantages?
- What are the critical safety protocols and procedures that must be adhered to in welding environments, and how do they contribute to secure welding practices?
- How does the selection of welding gases impact the quality and effectiveness of various welding processes, and what considerations guide the choice of gases for specific applications?
- What are the fundamental principles behind plasma arc cutting, and how can these principles be applied to safely and efficiently cut materials in welding projects?
- How does the interpretation of welding blueprints, including weld symbols and drawings, enhance the ability to plan, execute, and communicate welding projects within an industrial context?

Content

- Introduction to Welding Processes:
 - Overview of arc welding as a fusion welding technique
 - Different types of arc welding processes (SMAW, GMAW, FCAW, GTAW)
 - Historical context and evolution of arc welding
- Welding Equipment and Machinery:
 - Understanding the equipment used in arc welding processes
 - Components and functions of welding machines
 - Maintenance and safety considerations for welding equipment
- Safety Protocols in Welding:
 - Importance of safety in welding practices
 - Personal protective equipment (PPE) and its usage
 - Hazard identification and mitigation in welding environments
- Gas Usage in Welding:



- Types of gases used in various welding processes
 - Gas selection criteria for specific welding applications
 - Handling and storage of welding gases
- Plasma Arc Cutting:
 - Principles of plasma arc cutting
 - Safety measures and hazard prevention in plasma arc cutting
 - Setup and operation of plasma arc cutting equipment
- Welding Blueprint Interpretation:
 - Reading and understanding welding prints and drawings
 - Interpretation of weld symbols and their significance
 - Application of welding blueprints in industry contexts

Skills

- Introduction to Welding Processes:
 - Identify and differentiate between various arc welding processes.
 - Explain the basic principles behind each welding process.
 - Recognize the historical context and evolution of arc welding.
- Welding Equipment and Machinery:
 - Operate welding machines effectively and safely.
 - Identify and understand the components of welding equipment.
 - Perform routine maintenance on welding machinery.
- Safety Protocols in Welding:
 - Apply safety protocols and best practices in welding environments.
 - Properly use personal protective equipment (PPE) for welding tasks.
 - Identify and mitigate potential safety hazards in welding areas.
- Gas Usage in Welding:
 - Select appropriate gases for specific welding processes.
 - Handle welding gases safely and efficiently.
 - Ensure proper storage and maintenance of gas cylinders.



- Plasma Arc Cutting:
 - Operate plasma arc cutting equipment effectively and safely.
 - Understand the principles of plasma arc cutting.
 - Identify and mitigate hazards associated with plasma arc cutting.
- Welding Blueprint Interpretation:
 - Read and interpret welding prints, drawings, and symbols.
 - Apply knowledge of weld symbols to practical welding projects.
 - Use welding blueprints for project planning and execution in industrial contexts.

Assessments

- Welding Process Proficiency Test:
 - Objective: Evaluate students' understanding of different arc welding processes.
 - Assessment: Written test with questions about the operational principles, applications, and advantages of SMAW, GMAW, FCAW, and GTAW.
 - Safety Procedures and Hazard Identification Assessment:
 - Objective: Assess students' knowledge of safety protocols and hazard identification in welding environments.
 - Assessment: Practical assessment where students identify and address safety hazards in a simulated welding workspace.
 - Welding Blueprint Interpretation Project:
 - Objective: Evaluate students' ability to read and interpret welding prints, drawings, and symbols.
 - Assessment: Students are presented with welding blueprints and tasked with interpreting weld symbols and creating a welding plan based on the provided blueprints.
 - Practical Welding Skills Demonstration:
 - Objective: Assess students' hands-on welding skills and proficiency.
 - Assessment: Hands-on welding practical test where students demonstrate their ability to perform welding processes, with a focus on safety and precision.
-



Course: Arc Welding Lab

Length: Semester

Standards

- 9.3.MN-MIR.1 Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance.
- 9.3.MN-MIR.2 Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment.
- 9.3.MN-MIR.3 Diagnose equipment problems and effectively repair manufacturing equipment.
- 9.3.MN-MIR.4 Investigate and employ techniques to maximize manufacturing equipment performance.
- 9.3.MN-MIR.5 Implement a preventative maintenance schedule to maintain manufacturing equipment, tools and workstations.
- 9.3.MN-MIR.6 Implement an effective, predictive and preventive manufacturing equipment maintenance program.

Essential Question(s)

- How do safety protocols and adherence to shop rules contribute to a secure and productive welding shop environment, and what are the responsibilities of individuals within a welding team?
- What are the key considerations for the safe handling and storage of shielding gases, and how does the choice of shielding gas impact various welding processes?
- How does routine maintenance and troubleshooting of welding equipment ensure optimal performance and safety, and what are the critical equipment adjustment procedures?
- What is the comprehensive workflow from interpreting welding blueprints to the final inspection of welded joints, and how does attention to detail contribute to weld quality?
- What are effective practices for material and supply storage in a welding shop, and how does efficient inventory management support the timely completion of welding projects?



Content

- Introduction to Weld Shop Operations:
 - Overview of a welding shop environment
 - Importance of safety and adherence to shop rules
 - Understanding the roles and responsibilities of welders
- Shielding Gas Handling and Storage:
 - Safe handling of shielding gases
 - Proper storage techniques and precautions
 - Recognizing the importance of shielding gases in welding processes
- Welding Equipment Maintenance:
 - Routine maintenance of welding equipment
 - Equipment adjustment procedures and troubleshooting
 - Ensuring equipment is in optimal working condition
- Weld Workflow:
 - Interpreting and understanding welding blueprints
 - Material preparation for welding projects
 - Welding techniques and processes
 - Final inspection and quality control
- Material and Supply Storage:
 - Effective storage practices for welding materials and supplies
 - Inventory management and organization in the shop
 - Tracking and replenishing welding consumables
- Shielded Metal Arc Welding (SMAW):
 - In-depth exploration of the SMAW welding process
 - Electrode selection, polarity, and settings
 - SMAW techniques and applications
- Gas Metal Arc Welding (GMAW):
 - Comprehensive coverage of GMAW welding process



- Selection of shielding gas and wire
- GMAW techniques and practical applications

Skills

- Introduction to Weld Shop Operations:
 - Adherence to safety protocols in a welding shop environment
 - Compliance with shop rules and regulations
 - Awareness of roles and responsibilities within the welding team
- Shielding Gas Handling and Storage:
 - Safe handling and use of shielding gases
 - Proper storage and handling of gas cylinders
 - Recognizing the significance of shielding gases in welding processes
- Welding Equipment Maintenance:
 - Routine maintenance of welding machines and tools
 - Ability to troubleshoot and address equipment issues
 - Ensuring equipment is in optimal working condition for safe operation
- Weld Workflow:
 - Interpretation of welding blueprints and understanding project requirements
 - Proficiency in material preparation, including cutting and cleaning
 - Competence in various welding techniques and processes
 - Ability to conduct final inspections and ensure weld quality
- Material and Supply Storage:
 - Effective organization and storage of welding materials and supplies
 - Inventory management skills, including tracking usage and replenishment
 - Ensuring availability of required consumables for welding projects
- Shielded Metal Arc Welding (SMAW):
 - Proficiency in SMAW welding process
 - Electrode selection based on project requirements
 - Proper adjustment of polarity and settings



- Execution of SMAW techniques and applications
- Gas Metal Arc Welding (GMAW):
 - Competence in GMAW welding process
 - Selection of appropriate shielding gas and wire
 - Application of GMAW techniques in practical welding scenarios

Assessments

- Safety and Shop Compliance Evaluation:
 - Objective: Assess students' knowledge of safety protocols and shop rules.
 - Assessment: A written test covering safety procedures, shop regulations, and responses to hypothetical shop scenarios.
- Equipment Maintenance and Troubleshooting Practical Assessment:
 - Objective: Evaluate students' ability to perform routine equipment maintenance and address common equipment issues.
 - Assessment: Hands-on assessment where students perform maintenance tasks on welding machines and troubleshoot equipment problems.
- Welding Workflow Project and Inspection with AWS SENSE Projects:
 - Objective: Assess students' ability to follow the complete welding workflow, from blueprint interpretation to final inspection, and the completion of AWS SENSE projects.
 - Assessment: Students complete a welding project that includes interpreting a blueprint, material preparation, welding, and a final inspection. This project also integrates the completion of AWS SENSE projects, which are evaluated for adherence to industry standards and project quality.



Standards

- 9.3.MN-PPD.1 Produce quality products that meet manufacturing standards and exceed customer satisfaction.
- 9.3.MN-PPD.2 Research, design and implement alternative manufacturing processes to manage production of new and/or improved products.
- 9.3.MN-PPD.3 Monitor, promote and maintain a safe and productive workplace using techniques and solutions that ensure safe production of products.
- 9.3.MN-PPD.4 Implement continuous improvement processes in order to maintain quality within manufacturing production.
- 9.3.MN-PPD.5 Develop procedures to create products that meet customer needs.

Essential Question(s)

- How do advanced welding techniques for horizontal, vertical, and overhead positions differ from standard welding, and what are the key challenges associated with these orientations?
- What factors influence the selection of electrodes and the precise setup of welding machines for SMAW and GMAW, and how do these choices impact welding outcomes?
- What are the primary hazards and safety protocols specific to 'out of position' welding, and how can welders effectively mitigate risks while maintaining productivity?
- What are the critical steps in weld joint preparation and setup procedures, and how do these procedures contribute to the integrity and quality of welded joints?
- How does the direct correlation between polarity and amperage in SMAW affect welding performance, and what strategies can be employed to achieve stable and high-quality welds in challenging positions?

Content

- Advanced 'Out of Position' Welding Techniques:
 - Mastery of welding in horizontal, vertical, and overhead positions



- Techniques for maintaining weld quality in challenging orientations
 - Addressing common challenges and difficulties in 'out of position' welding
- Electrode Selection and Machine Setup:
 - In-depth exploration of electrode types and their suitability for specific applications
 - Precise machine setup procedures for SMAW and GMAW
 - Fine-tuning welding parameters for optimal results
- Hazard Awareness and Safety Protocols:
 - Comprehensive understanding of hazards associated with 'out of position' welding
 - Implementation of safety protocols and precautions
 - Hazard mitigation strategies and emergency responses
- Weld Joint Preparation and Setup Procedures:
 - Proficiency in weld joint preparation techniques
 - Setup and alignment of workpieces for various welding positions
 - Ensuring clean and secure weld joints for quality welds
- Polarity and Amperage Control in SMAW:
 - Understanding the relationship between polarity and amperage in SMAW
 - Proper adjustment of polarity settings for 'out of position' welding
 - Maintaining weld stability and quality through amperage control
- Introduction to Flux Core Arc Welding (FCAW):
 - Overview of the FCAW welding process and its applications
 - Equipment setup and operation for FCAW
 - Hands-on experience with FCAW techniques
- Introduction to Gas Tungsten Arc Welding (GTAW):
 - Exploration of the GTAW welding process and its advantages
 - Setup and operation of GTAW equipment
 - Skill development in GTAW welding techniques

Skills

- Advanced 'Out of Position' Welding Techniques:



- Demonstrate proficiency in welding in horizontal, vertical, and overhead positions.
 - Execute welding techniques to maintain weld quality in challenging orientations.
 - Identify and troubleshoot common challenges encountered during 'out of position' welding.
- Electrode Selection and Machine Setup:
 - Select appropriate electrodes based on project requirements.
 - Set up welding machines accurately for SMAW and GMAW processes.
 - Fine-tune welding parameters, including voltage and wire feed speed, for optimal results.
- Hazard Awareness and Safety Protocols:
 - Identify potential hazards associated with 'out of position' welding.
 - Implement safety protocols, including the use of personal protective equipment (PPE).
 - Respond effectively to welding-related emergencies and accidents.
- Weld Joint Preparation and Setup Procedures:
 - Prepare weld joints with precision, including beveling and cleaning.
 - Align and secure workpieces for welding in various positions.
 - Ensure the integrity and cleanliness of weld joints to meet quality standards.
- Polarity and Amperage Control in SMAW:
 - Understand the relationship between polarity and amperage in SMAW.
 - Adjust and control polarity settings for 'out of position' welding.
 - Maintain stable and high-quality welds through precise amperage control.
- Introduction to Flux Core Arc Welding (FCAW):
 - Describe the FCAW welding process and its applications.
 - Set up FCAW welding equipment correctly.
 - Practice FCAW welding techniques with a focus on safety and quality.
- Introduction to Gas Tungsten Arc Welding (GTAW):
 - Explain the GTAW welding process and its advantages.
 - Configure GTAW equipment for various welding scenarios.
 - Develop proficiency in GTAW welding techniques for precise and high-quality welds.

Assessments



- Advanced Welding Techniques Performance Assessment:
 - Objective: Evaluate students' proficiency in 'Out of Position' welding techniques, including horizontal, vertical, and overhead positions.
 - Assessment: Hands-on welding test where students demonstrate their ability to weld in challenging orientations with a focus on quality, stability, and adherence to safety protocols. The assessment includes the completion of welding projects related to 'Out of Position' welding.
- Welding Equipment Setup and Troubleshooting Evaluation:
 - Objective: Assess students' competence in electrode selection, machine setup, and troubleshooting for SMAW and GMAW processes.
 - Assessment: Practical assessment where students select appropriate electrodes, set up welding machines, and troubleshoot common equipment issues. This assessment includes a written component to explain equipment setup choices.

Course: Metal Fabrication

Length: Semester

Standards

- 9.3.MN-PPD.1 Produce quality products that meet manufacturing standards and exceed customer satisfaction.
- 9.3.MN-PPD.2 Research, design and implement alternative manufacturing processes to manage production of new and/or improved products.
- 9.3.MN-PPD.3 Monitor, promote and maintain a safe and productive workplace using techniques and solutions that ensure safe production of products.
- 9.3.MN-PPD.4 Implement continuous improvement processes in order to maintain quality within manufacturing production.



- 9.3.MN-PPD.5 Develop procedures to create products that meet customer needs

Essential Question(s)

- How does the choice of mechanical fasteners impact the strength, durability, and overall integrity of fabricated metal structures, and what criteria guide the selection of the most suitable fastening method?
- What are the key safety protocols and hazard mitigation strategies that ensure a secure and productive working environment in a metal fabrication shop, and how do they contribute to injury prevention?
- How do the properties of different metals and alloys influence material selection for specific fabrication projects, and what considerations are essential when choosing materials for durability, weight, and cost-effectiveness?
- What are the critical quality control measures and inspection techniques employed in metal fabrication, and how do they ensure the precision and reliability of fabricated components?
- How does a comprehensive understanding of project planning, including layout, scheduling, and cost estimation, contribute to the successful execution of metal fabrication projects, and what strategies optimize project efficiency and resource allocation?

Content

- Introduction to Metal Fabrication:
 - Overview of metal fabrication as a field
 - Historical evolution and importance in various industries
- Mechanical Fasteners:
 - Types of mechanical fasteners (bolts, rivets, screws, etc.)
 - Selection criteria for choosing the appropriate fastener
 - Techniques for mechanically joining materials
- Shop Equipment and Tools:
 - Safe operation of shop equipment, including shears, brakes, ironworkers, drills/drill presses, and hydraulic presses



- Maintenance and care of fabrication tools
- Project Planning and Scheduling:
 - Layout and design principles for metal fabrication projects
 - Project scheduling and time management
 - Cost estimation and budgeting for materials, supplies, and labor
- Material Selection and Characteristics:
 - Understanding different types of metals and alloys
 - Properties of materials relevant to fabrication
 - Material suitability for specific projects
- Welding Techniques in Metal Fabrication:
 - Welding processes commonly used in metal fabrication (e.g., SMAW, GMAW, GTAW)
 - Weld joint preparation and techniques
 - Weld quality and inspection
- Safety Protocols in Metal Fabrication:
 - Safety procedures and precautions in the fabrication shop
 - Hazard identification and mitigation
 - Personal protective equipment (PPE) and its use
- Quality Control and Inspection:
 - Inspection methods and tools for assessing fabrication quality
 - Quality standards and industry best practices
 - Corrective actions for quality improvement
- Finishing and Surface Treatment:
 - Techniques for finishing fabricated metal components
 - Surface treatment methods (e.g., painting, powder coating)
 - Enhancing the appearance and durability of fabricated products
- Hands-on Fabrication Projects:
 - Practical application of fabrication skills through hands-on projects
 - Applying learned techniques to create fabricated products



Skills

- Introduction to Metal Fabrication:
 - Understand the role and significance of metal fabrication in various industries.
 - Recognize the historical development and evolution of metal fabrication processes.
- Mechanical Fasteners:
 - Identify and differentiate between various types of mechanical fasteners.
 - Determine the appropriate mechanical fastener for specific fabrication applications.
 - Demonstrate the ability to effectively use mechanical fasteners to join materials.
- Shop Equipment and Tools:
 - Safely operate essential fabrication equipment and tools, following industry best practices.
 - Perform routine maintenance and care for fabrication equipment to ensure optimal functionality.
- Project Planning and Scheduling:
 - Plan and layout metal fabrication projects effectively.
 - Create project schedules and manage time efficiently.
 - Calculate project costs, including materials, supplies, and labor.
- Material Selection and Characteristics:
 - Identify different types of metals and alloys commonly used in fabrication.
 - Evaluate material properties and suitability for specific fabrication projects.
- Welding Techniques in Metal Fabrication:
 - Demonstrate proficiency in welding processes commonly employed in metal fabrication.
 - Prepare weld joints accurately and execute welds meeting industry standards.
 - Inspect and assess weld quality to ensure structural integrity.
- Safety Protocols in Metal Fabrication:
 - Adhere to safety procedures and protocols in the fabrication shop.
 - Identify potential hazards in the fabrication environment and implement safety measures.
 - Properly utilize personal protective equipment (PPE) for a safe working environment.
- Quality Control and Inspection:
 - Employ inspection methods and tools to evaluate the quality of fabricated components.



- Ensure compliance with quality standards and industry best practices.
 - Take corrective actions to address quality deficiencies and improve fabrication outcomes.
- Finishing and Surface Treatment:
 - Apply finishing techniques to fabricated metal components.
 - Implement surface treatment methods to enhance durability and appearance.
 - Achieve desired finishing results in fabricated products.
- Hands-on Fabrication Projects:
 - Apply learned fabrication techniques to complete hands-on projects.
 - Demonstrate the ability to create fabricated products that meet specified requirements and quality standards.

Assessments

- Fabrication Project Portfolio:
 - Objective: Assess students' practical skills and ability to apply fabrication techniques learned throughout the course.
 - Assessment: Students will complete a series of fabrication projects, including joining materials using mechanical fasteners and welding, creating finished components. They will document their projects with photographs, technical drawings, and written descriptions, demonstrating proficiency in various fabrication methods.
 - Safety and Hazard Mitigation Presentation:
 - Objective: Evaluate students' understanding of safety protocols and hazard awareness in metal fabrication.
 - Assessment: Students will create a presentation outlining safety protocols, hazard identification, and mitigation strategies specific to a metal fabrication environment. They will present their findings to the class, emphasizing the importance of safety in the workplace.
-



Course: CNC Thermal Cutting

Length: Semester

Standards

- 9.3.MN-PPD.1 Produce quality products that meet manufacturing standards and exceed customer satisfaction.
- 9.3.MN-PPD.2 Research, design and implement alternative manufacturing processes to manage production of new and/or improved products.
- 9.3.MN-PPD.3 Monitor, promote and maintain a safe and productive workplace using techniques and solutions that ensure safe production of products.
- 9.3.MN-PPD.4 Implement continuous improvement processes in order to maintain quality within manufacturing production.
- 9.3.MN-PPD.5 Develop procedures to create products that meet customer needs

Essential Question(s)

- How does Computer Numerical Control (CNC) technology revolutionize thermal cutting processes, and what are its advantages in modern manufacturing
- What are the critical components of a CNC Plasma Cutter, and how do they collaborate to ensure precise and efficient material processing, particularly when working with DXF-based designs?
- How do CNC programming and the utilization of DXF files enhance the precision and versatility of material cutting and design creation in CNC Plasma cutting?
- What factors influence the selection of materials, voltage, amperes, and travel speed when planning CNC Plasma cutting projects with DXF-based designs, and how do these choices impact project outcomes?
- In what ways do alternative material processing methods, such as laser cutting and water-based cutting, complement CNC Plasma cutting, and how can DXF file integration optimize the versatility and applicability of these methods in various industries?

Content



- Introduction to CNC Plasma Cutting:
 - Overview of Computer Numerical Control (CNC) technology in thermal cutting.
 - Historical evolution and significance in modern manufacturing.
- Components of a CNC Plasma Cutter:
 - Understanding the key components, including the power unit, controller, cutting table, gantry system, and dust control mechanisms.
 - How each component contributes to the overall functionality of the machine.
- Basic Programming and Design with DXF Files:
 - Introduction to CNC programming for plasma cutting, including the use of DXF files.
 - Design principles for creating projects, including shapes, text, and object importation from DXF files.
- Machine Setup and Material Considerations:
 - Setting up a CNC Plasma Cutter for various cutting tasks.
 - Considerations for material selection based on type and size, incorporating DXF file designs.
- Voltage, Amperes, and Travel Speed:
 - The role of voltage and amperes in plasma cutting.
 - Determining appropriate travel speed for precise and efficient cutting, considering DXF-based designs.
- Machine Maintenance and Safety:
 - Routine maintenance procedures for CNC Plasma Cutters.
 - Identification and mitigation of dust and smoke hazards.
 - Adjustments and troubleshooting for machine optimization, including DXF-based projects.
- Alternative Material Processing Methods:
 - Exploring alternative cutting methods, including laser cutting and water-based cutting, with considerations for DXF file utilization.
 - Comparative analysis of these methods in terms of precision, speed, and applications.
- Project-Based Learning with DXF Files:
 - Applying CNC programming and design skills to real-world projects, incorporating DXF file designs.
 - Demonstrating proficiency in CNC Plasma cutting and alternative cutting techniques through hands-on projects with DXF file integration.



Skills

- Introduction to CNC Plasma Cutting:
 - Understand the historical development and significance of CNC technology in thermal cutting processes.
 - Appreciate the role of CNC Plasma cutting in modern manufacturing and its diverse applications.
- Components of a CNC Plasma Cutter:
 - Identify and explain the functions of essential components, including the power unit, controller, cutting table, gantry system, and dust control mechanisms.
 - Comprehend how each component contributes to the overall operation and precision of the CNC Plasma Cutter.
- Basic Programming and Design with DXF Files:
 - Develop proficiency in CNC programming for plasma cutting, incorporating the utilization of DXF files for design.
 - Demonstrate the ability to create and manipulate designs, including shapes, text, and objects imported from DXF files.
- Machine Setup and Material Considerations:
 - Successfully set up a CNC Plasma Cutter for a variety of cutting tasks.
 - Evaluate and select suitable materials based on type and size, incorporating DXF-based designs into the material selection process.
- Voltage, Amperes, and Travel Speed:
 - Understand the relationship between voltage, amperes, and travel speed in plasma cutting.
 - Calculate and adjust these parameters to achieve precise and efficient cutting results, considering DXF-based designs.
- Machine Maintenance and Safety:
 - Execute routine maintenance procedures to ensure the CNC Plasma Cutter's optimal performance and longevity.
 - Identify potential dust and smoke hazards and implement safety measures to mitigate risks.



- Demonstrate the ability to adjust and troubleshoot the machine, particularly in the context of DXF-based projects.
- Alternative Material Processing Methods:
 - Explore alternative material processing techniques, such as laser cutting and water-based cutting, integrating DXF file designs into the process.
 - Conduct a comparative analysis of different cutting methods, considering factors like precision, speed, and suitability for specific applications.
- Project-Based Learning with DXF Files:
 - Apply CNC programming and design skills to real-world projects, emphasizing the integration of DXF file designs.
 - Showcase proficiency in CNC Plasma cutting and alternative cutting techniques through hands-on projects that incorporate DXF-based designs.

Assessments

- DXF-Based Design Project:
 - Objective: Assess students' ability to create, manipulate, and effectively use DXF files for CNC Plasma cutting projects.
 - Assessment: Students will select a complex design project that incorporates DXF file elements. They will create a detailed design plan, import DXF files, program the CNC Plasma Cutter, and execute the cutting process. The assessment will evaluate the precision and quality of the final product, along with their proficiency in DXF file utilization.
 - Material Selection and Process Optimization Analysis:
 - Objective: Evaluate students' understanding of material selection and process parameters in CNC Plasma cutting, particularly when working with DXF-based designs.
 - Assessment: Students will be given a set of material options and DXF-based design files. They must analyze the design, choose the most suitable material, and determine the optimal voltage, amperes, and travel speed settings for the CNC Plasma Cutter. They will justify their selections based on project requirements and present their analysis.
 - Comparative Material Processing Report:
-



- Objective: Assess students' ability to critically evaluate and compare different material processing methods, including CNC Plasma cutting with DXF file integration, laser cutting, and water-based cutting.
 - Assessment: Students will research and compile a comprehensive report that compares the advantages, disadvantages, precision, and application suitability of CNC Plasma cutting (with DXF files), laser cutting, and water-based cutting. They will present their findings, highlighting the strengths and weaknesses of each method and offering recommendations for specific scenarios.

Course: Advanced Welding Lab

Length: Semester

Standards

- 9.3.MN-MIR.1 Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance.
- 9.3.MN-MIR.2 Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment.
- 9.3.MN-MIR.3 Diagnose equipment problems and effectively repair manufacturing equipment.
- 9.3.MN-MIR.4 Investigate and employ techniques to maximize manufacturing equipment performance.
- 9.3.MN-MIR.5 Implement a preventative maintenance schedule to maintain manufacturing equipment, tools and workstations.
- 9.3.MN-MIR.6 Implement an effective, predictive and preventive manufacturing equipment maintenance program.

Essential Question(s)



- What advanced welding techniques are essential for producing high-quality welds in various positions, and how do these techniques contribute to welding proficiency and precision?
- How does a comprehensive understanding of welding equipment operation, setup, and troubleshooting enhance the efficiency and effectiveness of welding projects, and what considerations are crucial when selecting the right equipment for specific tasks?
- In what ways do fabrication and cutting equipment, including shears, brakes, and plasma cutters, complement welding processes, and how can their proficient use contribute to successful welding projects and fabrications?
- What are the key safety protocols and personal safety habits that welders must prioritize in the shop environment, and how do these practices promote a culture of safety and well-being in welding?
- How does the integration of mathematical concepts and precise measurement techniques impact the accuracy of weld drawings and the overall success of welding projects, and why are these skills crucial in the welding profession?

Content

- Advanced Welding Techniques:
 - In-depth exploration of advanced welding processes, including Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Core Arc Welding (FCAW), and Gas Tungsten Arc Welding (GTAW).
 - Mastery of welding positions, joint configurations, and welding procedures specific to each process.
- Utilization of Welding Equipment:
 - Comprehensive training in the operation of welding equipment, including welders, power sources, and auxiliary tools.
 - Hands-on experience with equipment setup, adjustment, and troubleshooting.
- Fabrication and Cutting Equipment:
 - Proficiency in using fabrication and cutting equipment, such as shears, brakes, ironworkers, plasma cutters, and oxyfuel torches.
 - Application of these tools in various welding projects and skill demonstrations.
- AWS SENSE Proficiency Projects:



- Completion of skill projects aligned with American Welding Society (AWS) SENSE Proficiency standards.
- Demonstration of competence in welding, fabrication, and related processes through project completion.
- Shop Safety and Personal Safety Habits:
 - Emphasis on safety protocols, shop safety best practices, and the importance of adhering to safety guidelines in the welding environment.
 - Development of strong personal safety habits to ensure the well-being of oneself and others.
- Mathematics and Measurement for Welding:
 - Application of mathematical concepts, including geometry, trigonometry, and algebra, in the context of welding and fabrication.
 - Precise measurement techniques and their significance in weld drawing preparation.
- Weld Drawing Preparation:
 - Instruction in the creation of accurate weld drawings, including symbols, specifications, and welding details.
 - Practice in interpreting and generating drawings for welding projects.
- Career Skills Development:
 - Exploration of career pathways in welding and related industries.
 - Skill development in areas such as resume building, job search strategies, and interview preparation to facilitate career success.

Skills

- Advanced Welding Techniques:
 - Develop mastery in advanced welding processes, including SMAW, GMAW, FCAW, and GTAW, by demonstrating proficiency in welding positions and joint configurations.
 - Successfully execute complex welding procedures, producing high-quality welds with precision and consistency.
- Utilization of Welding Equipment:



- Gain expertise in the operation of welding equipment, including setup, calibration, and troubleshooting for different welding processes.
- Demonstrate the ability to select the appropriate welding equipment and auxiliary tools for specific welding tasks.
- Fabrication and Cutting Equipment:
 - Proficiently operate fabrication and cutting equipment, such as shears, brakes, ironworkers, plasma cutters, and oxyfuel torches, to complete welding projects and fabrications.
 - Apply knowledge of equipment capabilities to enhance project efficiency and quality.
- AWS SENSE Proficiency Projects:
 - Successfully complete skill projects aligned with AWS SENSE Proficiency standards, meeting established criteria for welding quality and precision.
 - Exhibit competence in welding, fabrication, and project management skills through project execution.
- Shop Safety and Personal Safety Habits:
 - Understand and adhere to shop safety protocols, demonstrating a commitment to a safe working environment.
 - Develop and consistently practice strong personal safety habits to ensure personal well-being and that of fellow students.
- Mathematics and Measurement for Welding:
 - Apply mathematical concepts, including geometry, trigonometry, and algebra, to solve welding-related problems accurately.
 - Employ precise measurement techniques in welding projects and weld drawing preparation to meet design specifications.
- Weld Drawing Preparation:
 - Create accurate weld drawings that include welding symbols, specifications, and detailed welding instructions.
 - Interpret and generate weld drawings, ensuring they align with project requirements and industry standards.
- Career Skills Development:



- Explore various career pathways within the welding and related industries, gaining insight into potential roles and opportunities.
- Develop essential career skills, including resume building, job search strategies, and interview preparation, to enhance career readiness.

Assessments

- Welding Proficiency Test:
 - Objective: Evaluate students' mastery of advanced welding techniques (SMAW, GMAW, FCAW, GTAW) and their ability to produce high-quality welds in various positions.
 - Assessment: Students will be tasked with welding a series of test pieces that involve different joint configurations and positions. Welds will be inspected and assessed against established criteria to measure proficiency and precision.
 - Fabrication and Cutting Project Portfolio:
 - Objective: Assess students' competence in using fabrication and cutting equipment to complete welding projects and fabrications effectively.
 - Assessment: Students will compile a portfolio showcasing a selection of welding projects they've completed during the course. Each project will include documentation of equipment used, safety protocols followed, and project outcomes. A comprehensive assessment will evaluate project quality, equipment proficiency, and safety compliance.
 - AWS SENSE Project Completion:
 - Objective: Ensure students meet AWS SENSE Proficiency standards by completing a designated AWS project.
 - Assessment: Students will select an AWS SENSE project aligned with their skill level and career aspirations. They will plan, execute, and document the project, adhering to AWS guidelines and standards. The completed project will be evaluated for quality, precision, and compliance with AWS procedures.
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Course: AWS Theory I

Length: Semester

Standards

- 9.3.MN-MIR.1 Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance.
- 9.3.MN-MIR.2 Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment.
- 9.3.MN-MIR.3 Diagnose equipment problems and effectively repair manufacturing equipment.
- 9.3.MN-MIR.4 Investigate and employ techniques to maximize manufacturing equipment performance.
- 9.3.MN-MIR.5 Implement a preventative maintenance schedule to maintain manufacturing equipment, tools and workstations.
- 9.3.MN-MIR.6 Implement an effective, predictive and preventive manufacturing equipment maintenance program.

Essential Question(s)

- Why is effective time management crucial for welding students, and how can it impact their success in welding projects and AWS SENSE Certification preparation?
- What role does Personal Protective Equipment (PPE) play in ensuring safety in a welding shop, and how can students select and use PPE effectively to mitigate workplace hazards?
- How does a deep understanding of welding prints and symbols enhance a welder's ability to plan and execute welding projects accurately, and why is this skill vital in the welding profession?
- What are the key principles and techniques associated with Shielded Metal Arc Welding (SMAW) and Gas Metal Arc Welding (GMAW), and how can proficiency in these processes contribute to AWS SENSE Certification readiness?
- What are the specific requirements and components of AWS SENSE Certification, and how can students develop a comprehensive plan to achieve certification while maintaining high standards of safety and professionalism in their work?



Content

- Occupational Orientation Module:
 - Time management techniques
 - Effective communication of verbal and written instructions
 - Workplace housekeeping and organization practices
 - Work ethic and professionalism
- Safety and Health Module:
 - Proper usage of Personal Protective Equipment (PPE)
 - Shop safety guidelines and practices
 - Hazard identification and mitigation
 - Emergency response procedures
- Print Reading and Symbols Module:
 - Interpretation of welding prints and drawings
 - Understanding welding symbols and their meanings
 - Application of symbols in welding projects
 - Reading and following project specifications
- SMAW Theory Module:
 - In-depth study of Shielded Metal Arc Welding (SMAW)
 - SMAW equipment components and functions
 - Electrode selection and usage
 - Welding techniques and positions in SMAW
- GMAW Theory Module:
 - Comprehensive exploration of Gas Metal Arc Welding (GMAW)
 - GMAW equipment setup and operation
 - Selection of appropriate shielding gases
 - Techniques and positions for effective GMAW welding
- AWS SENSE Certification Requirements:
 - Understanding the AWS SENSE program and its significance



- Examination of the specific requirements and criteria for AWS SENSE Certification
- Preparation strategies for AWS SENSE Certification exams
- Goal-setting and planning for successful certification attainment

Skills

- Occupational Orientation Module:
 - Develop time management skills to effectively prioritize tasks and meet project deadlines.
 - Demonstrate the ability to comprehend and follow verbal and written instructions in a welding shop environment.
 - Establish and maintain a safe, organized, and clean workspace, emphasizing housekeeping practices.
 - Cultivate a strong work ethic and professionalism when interacting with peers and instructors.
- Safety and Health Module:
 - Exhibit proficiency in selecting, using, and maintaining Personal Protective Equipment (PPE) appropriate for welding activities.
 - Identify potential hazards in a welding shop and implement safety measures to mitigate risks.
 - Effectively respond to emergency situations, including fire safety and first aid protocols.
 - Comply with shop safety guidelines, promoting a culture of safety among peers.
- Print Reading and Symbols Module:
 - Interpret welding prints and drawings accurately, recognizing key features and specifications.
 - Comprehend and apply welding symbols and annotations commonly found in welding prints.
 - Use welding prints to plan and execute welding projects, ensuring alignment with design specifications.
 - Communicate project requirements effectively through the interpretation of welding prints.
- SMAW Theory Module:
 - Acquire an in-depth understanding of the Shielded Metal Arc Welding (SMAW) process and its principles.
 - Identify and describe the components and functions of SMAW equipment, including power sources and electrodes.
 - Select appropriate electrodes based on project requirements and electrode classifications.



- Demonstrate proficiency in SMAW welding techniques, including various positions and joint configurations.
- GMAW Theory Module:
 - Develop a comprehensive knowledge of Gas Metal Arc Welding (GMAW) and its applications.
 - Configure and operate GMAW equipment, considering shielding gases and welding wire selection.
 - Determine suitable shielding gases based on material and project specifications.
 - Apply effective GMAW welding techniques, including proper positions and settings for optimal weld quality.
- AWS SENSE Certification Requirements:
 - Understand the purpose and significance of the AWS SENSE program in the welding industry.
 - Identify the specific requirements and criteria for AWS SENSE Certification, including examination components.
 - Develop a clear plan and strategies for preparing for AWS SENSE Certification exams.
 - Set personal goals for AWS SENSE Certification attainment and track progress toward certification readiness.

Assessments

- Welding Print Interpretation Project:
 - Objective: Assess students' competence in interpreting welding prints and symbols and applying this knowledge to real-world welding projects.
 - Assessment: Students will be provided with a welding print that includes project specifications and symbols. They will be tasked with planning and executing a welding project based on the print. The assessment will evaluate their ability to follow the print accurately.
 - AWS SENSE Certification Preparation Assessment:
 - Objective: Measure students' readiness for AWS SENSE Certification by evaluating their knowledge of AWS SENSE program requirements and their ability to develop a personalized certification preparation plan.
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- Assessment: Students will complete an assessment that includes questions related to AWS SENSE Certification requirements, examination components, and strategies for preparing for the certification exams. They will also outline their certification preparation plan.
- AWS Assessment (AWS SENSE Project Completion):
 - Objective: Ensure students meet AWS SENSE Certification standards by completing a designated AWS SENSE project.
 - Assessment: Students will select an AWS SENSE project aligned with their skill level and career aspirations. They will plan, execute, and document the project, adhering to AWS guidelines and standards. The completed project will be evaluated for quality, precision, and compliance with AWS procedures.

Course: AWS Theory II

Length: Semester

Standards

- 9.3.MN-MIR.1 Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance.
- 9.3.MN-MIR.2 Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment.
- 9.3.MN-MIR.3 Diagnose equipment problems and effectively repair manufacturing equipment.
- 9.3.MN-MIR.4 Investigate and employ techniques to maximize manufacturing equipment performance.
- 9.3.MN-MIR.5 Implement a preventative maintenance schedule to maintain manufacturing equipment, tools and workstations.
- 9.3.MN-MIR.6 Implement an effective, predictive and preventive manufacturing equipment maintenance program.



Essential Question(s)

- What are the advanced applications and advantages of Flux Cored Arc Welding (FCAW) and Gas Tungsten Arc Welding (GTAW), and how can they be applied in various welding scenarios and industries?
- How do equipment components, such as power sources and wire feeders for FCAW, and tungsten electrode selection for GTAW, impact the quality and efficiency of welding processes, and how can they be configured for optimal results?
- What are the key principles and techniques for thermal cutting processes, including manual and mechanized OxyFuel cutting, manual Plasma Arc Cutting, and contour cutting, and how can they be employed effectively in complex projects?
- Why is an understanding of industry standards for welding inspection and testing essential for weld quality assurance, and how can visual inspections and non-destructive testing (NDT) methods be utilized to assess welds against these standards?
- How can the knowledge and skills acquired in this course contribute to students' readiness for AWS SENSE Certification and their ability to excel in the welding profession upon graduation?

Content

- FCAW Theory (Flux Cored Arc Welding):
 - In-depth exploration of Flux Cored Arc Welding (FCAW) principles and applications
 - Equipment components and functions specific to FCAW
 - Electrode selection and usage in FCAW processes
 - Proficiency in FCAW welding techniques, including various positions and joint configurations
- GTAW Theory (Gas Tungsten Arc Welding):
 - Comprehensive study of Gas Tungsten Arc Welding (GTAW) and its advanced applications
 - GTAW equipment setup, operation, and maintenance
 - Selection of appropriate tungsten electrodes and shielding gases for GTAW
 - Advanced GTAW welding techniques, including specialized positions and materials
- Thermal Cutting Processes:
 - Manual and mechanized OxyFuel cutting techniques, equipment setup, and operation



- Theory and practice of manual Plasma Arc Cutting, including equipment and safety considerations
- Advanced cutting skills, precision cutting, and contour cutting techniques
- Welding Inspection and Testing:
 - Understanding industry standards for welding inspection and testing
 - Examination of welding quality criteria and acceptance criteria
 - Techniques for conducting visual inspections of welds
 - Introduction to non-destructive testing (NDT) methods and their applications

Skills

- FCAW Theory (Flux Cored Arc Welding):
 - Develop an in-depth understanding of Flux Cored Arc Welding (FCAW) principles, including its advantages and applications.
 - Identify and describe the components and functions of FCAW welding equipment, including power sources and wire feeders.
 - Select appropriate flux-cored electrodes based on project requirements, considering electrode classifications.
 - Demonstrate proficiency in FCAW welding techniques, including various welding positions and joint configurations.
- GTAW Theory (Gas Tungsten Arc Welding):
 - Acquire comprehensive knowledge of Gas Tungsten Arc Welding (GTAW) and its advanced applications in various industries.
 - Configure, operate, and maintain GTAW equipment, ensuring proper tungsten electrode selection and shielding gas usage.
 - Determine suitable tungsten electrode types for specific materials and welding projects.
 - Apply advanced GTAW welding techniques, including specialized welding positions and materials.
- Thermal Cutting Processes:
 - Master manual and mechanized OxyFuel cutting techniques, including equipment setup, safety precautions, and precise cutting practices.



- Develop expertise in manual Plasma Arc Cutting, covering equipment operation, safety, and accurate contour cutting methods.
- Acquire advanced cutting skills, including precision cutting and contour cutting techniques for complex projects.
- Welding Inspection and Testing:
 - Understand industry standards for welding inspection and testing, including the acceptance criteria for weld quality.
 - Perform visual inspections of welds, assessing them for compliance with industry standards.
 - Gain familiarity with non-destructive testing (NDT) methods and their applications in weld quality assessment.
 - Interpret and apply quality control measures to ensure welding projects meet or exceed industry requirements.

Assessments

- Advanced Welding Skills Practical Assessment:
 - Objective: Evaluate students' proficiency in advanced welding techniques, including FCAW, GTAW, and thermal cutting processes.
 - Assessment: Students will perform a practical assessment that includes welding exercises using FCAW and GTAW on various materials and in different positions. They will also demonstrate their proficiency in manual and mechanized OxyFuel cutting and manual Plasma Arc Cutting. Their performance will be assessed based on weld quality, precision, and adherence to safety protocols.
 - Weld Inspection and Quality Control Test:
 - Objective: Assess students' understanding of industry standards for welding inspection and quality control measures.
 - Assessment: Students will review welding inspection scenarios and test cases, including weld defects and quality criteria. They will be required to identify defects, assess weld quality, and determine whether the weld meets or exceeds industry standards. This assessment will evaluate their ability to apply quality control measures.
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- AWS Certification Readiness Assessment (AWS SENSE):
 - Objective: Measure students' readiness for AWS SENSE Certification by evaluating their knowledge of AWS SENSE program requirements, examination components, and preparation strategies.
 - Assessment: Students will complete an assessment that includes questions related to AWS SENSE Certification requirements, examination content, and strategies for preparing for the certification exams. They will also outline their certification preparation plan, which may include AWS SENSE projects and practice exams.
- AWS Assessment (Completion of AWS SENSE Projects):
 - Objective: Ensure students meet AWS SENSE Certification standards by successfully completing designated AWS SENSE projects.
 - Assessment: Students will select AWS SENSE projects aligned with their skill level and career goals. They will plan, execute, and document these projects according to AWS guidelines and standards. The completed projects will be evaluated for quality, precision, and compliance with AWS procedures.

Course: AWS Proficiency Lab

Length: Semester

Standards

- 9.3.MN-PPD.1 Produce quality products that meet manufacturing standards and exceed customer satisfaction.
- 9.3.MN-PPD.2 Research, design and implement alternative manufacturing processes to manage production of new and/or improved products.
- 9.3.MN-PPD.3 Monitor, promote and maintain a safe and productive workplace using techniques and solutions that ensure safe production of products.
- 9.3.MN-PPD.4 Implement continuous improvement processes in order to maintain quality within



- manufacturing production.
- 9.3.MN-PPD.5 Develop procedures to create products that meet customer needs.

Essential Question(s)

- What are the key components and requirements of AWS SENSE Practical Exams, and how do they align with industry standards for welding proficiency?
- How can material selection, preparation, and precise cutting techniques impact the quality and integrity of welding projects in preparation for AWS certification?
- In what ways do Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), and Gas Tungsten Arc Welding (GTAW) procedures differ in their applications and suitability for various welding scenarios and materials?
- What are the critical aspects of quality control, visual inspection, and non-destructive testing (NDT) methods that ensure welds meet or exceed industry standards, and how can they be applied in AWS SENSE projects?
- How does the successful completion of AWS SENSE projects, including precise documentation and adherence to AWS guidelines, contribute to students' readiness for AWS certification and their ability to excel in the welding profession?

Content

- AWS SENSE Practical Exam Overview:
 - Introduction to the AWS SENSE Practical Exams.
 - Understanding the examination criteria and requirements.
 - Overview of the projects and skills to be assessed.
- Material Selection and Preparation:
 - Selection of appropriate materials for AWS SENSE projects.
 - Material cutting techniques, including layout and precision cutting.
 - Material preparation, including beveling and edge preparation.
- Shielded Metal Arc Welding (SMAW) Proficiency:



- Practical exercises and projects involving SMAW techniques.
 - Mastery of SMAW welding positions and joint configurations.
 - Focus on safety and precision in SMAW welding.
- Gas Metal Arc Welding (GMAW) Proficiency:
 - Application of GMAW skills to AWS SENSE projects.
 - Proficiency in GMAW welding positions and joint types.
 - Safety protocols and precision in GMAW welding.
- Flux Cored Arc Welding (FCAW) Proficiency:
 - Hands-on practice and projects related to FCAW procedures.
 - Skill development in FCAW welding positions and joint preparations.
 - Emphasis on safety and precision in FCAW welding.
- Gas Tungsten Arc Welding (GTAW) Proficiency:
 - GTAW skills applied to AWS SENSE projects.
 - Proficiency in GTAW welding positions and material types.
 - Safety considerations and precision in GTAW welding.
- Quality Control and Inspection:
 - Understanding AWS standards and acceptance criteria for weld quality.
 - Visual inspection techniques for welds.
 - Non-destructive testing (NDT) methods and their application.
- AWS SENSE Project Execution:
 - Practical implementation of AWS SENSE projects.
 - Completion of required welding projects as per AWS standards.
 - Documentation and record-keeping for AWS certification.
- Safety Protocols and Best Practices:
 - Comprehensive review of safety procedures and best practices.
 - Personal protective equipment (PPE) requirements.
 - Hazard identification and mitigation in the welding environment.
- AWS Certification Preparation:
 - Strategies for preparing for AWS SENSE Certification.



- Review of AWS examination content and formats.
- Practice exams and preparation resources.

Skills

- AWS SENSE Practical Exam Overview:
 - Understand the structure and requirements of AWS SENSE Practical Exams.
 - Identify the specific skills and projects to be assessed in the exams.
 - Familiarize oneself with AWS examination criteria and expectations.
- Material Selection and Preparation:
 - Select appropriate materials for AWS SENSE projects based on project specifications.
 - Demonstrate precision in material cutting, including layout, marking, and cutting techniques.
 - Prepare materials for welding, including edge preparation, beveling, and fit-up.
- Shielded Metal Arc Welding (SMAW) Proficiency:
 - Apply SMAW welding techniques to AWS SENSE projects.
 - Master welding positions, joint configurations, and electrode selection.
 - Prioritize safety practices and execute SMAW welds with precision.
- Gas Metal Arc Welding (GMAW) Proficiency:
 - Execute GMAW welding procedures as required for AWS SENSE projects.
 - Proficiently weld in various positions and on different joint types.
 - Adhere to safety protocols and demonstrate precision in GMAW welding.
- Flux Cored Arc Welding (FCAW) Proficiency:
 - Apply FCAW skills to AWS SENSE projects, including various positions and joint preparations.
 - Demonstrate safety awareness and precision in FCAW welding.
 - Achieve proficiency in welding tasks specific to FCAW procedures.
- Gas Tungsten Arc Welding (GTAW) Proficiency:
 - Utilize GTAW techniques for AWS SENSE projects, adapting to different positions and materials.
 - Emphasize safety practices and precision in GTAW welding.
 - Exhibit proficiency in welding tasks associated with GTAW procedures.
- Quality Control and Inspection:



- Comprehend AWS standards and acceptance criteria for weld quality.
- Develop visual inspection skills for welds and identify common defects.
- Understand the basics of non-destructive testing (NDT) methods and their application in quality assessment.
- AWS SENSE Project Execution:
 - Successfully complete AWS SENSE projects according to AWS standards and guidelines.
 - Document and maintain records of project completion, including welding parameters and materials used.
 - Meet project deadlines and quality requirements specified by AWS.
- Safety Protocols and Best Practices:
 - Adhere to strict safety protocols, including the proper use of personal protective equipment (PPE).
 - Identify potential hazards in the welding environment and apply best practices for mitigation.
 - Promote a culture of safety and responsible conduct in the welding shop.
- AWS Certification Preparation:
 - Develop a comprehensive strategy for preparing for AWS SENSE Certification.
 - Review AWS examination content, formats, and expectations.
 - Engage in practice exams and utilize preparation resources effectively.

Assessments

- AWS SENSE Project Portfolio Assessment:
 - Objective: Evaluate students' ability to plan, execute, and document AWS SENSE projects according to AWS standards and guidelines.
 - Assessment: Students will complete a portfolio of AWS SENSE projects, demonstrating proficiency in SMAW, GMAW, FCAW, and GTAW welding techniques. Each project will be assessed for weld quality, precision, adherence to safety protocols, and documentation completeness. Successful project completion is a requirement for this assessment.
 - Weld Inspection and Quality Control Examination:
 - Objective: Assess students' knowledge of industry standards for welding inspection, quality control measures, and non-destructive testing (NDT) methods.
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- Assessment: Students will take an examination that includes scenarios related to visual inspection of welds, identification of weld defects, and application of NDT methods. They will be required to demonstrate their understanding of AWS standards and quality criteria.

Course: Advanced Metal Design

Length: Semester

Standards

- 9.3.MN-PPD.1 Produce quality products that meet manufacturing standards and exceed customer satisfaction.
- 9.3.MN-PPD.2 Research, design and implement alternative manufacturing processes to manage production of new and/or improved products.
- 9.3.MN-PPD.3 Monitor, promote and maintain a safe and productive workplace using techniques and solutions that ensure safe production of products.
- 9.3.MN-PPD.4 Implement continuous improvement processes in order to maintain quality within manufacturing production.
- 9.3.MN-PPD.5 Develop procedures to create products that meet customer needs.

Essential Question(s)

- How can advanced metal cutting techniques, such as plasma and laser cutting, be effectively employed to achieve intricate and precise designs in metalwork?
- In what ways can the integration of aesthetics and functionality be optimized when shaping and forming metal for both artistic and practical purposes?
- How do emerging industry trends and sustainable practices influence the evolution of metal design, and how can these principles be applied to projects?



- What strategies and skills are necessary for successful project management and execution in complex metal design endeavors, including planning, resource allocation, and teamwork?
- How can a professional portfolio effectively showcase advanced metal design projects and convey creativity, craftsmanship, and problem-solving abilities to potential employers and peers?

Content

- Advanced Metal Cutting Techniques:
 - Precision metal cutting methods, including plasma cutting and laser cutting.
 - Intricate and curved cuts for artistic and functional designs.
 - Safety protocols for advanced cutting equipment.
- Complex Welding Procedures:
 - Advanced welding techniques such as TIG (Gas Tungsten Arc Welding) and MIG (Gas Metal Arc Welding).
 - Multi-pass welding for thicker materials.
 - Welding dissimilar metals for specialized applications.
- Creative Metal Shaping and Forming:
 - Sculptural metal shaping for artistic projects.
 - Techniques for bending, forging, and shaping metal into complex forms.
 - The integration of aesthetics and functionality in metal design.
- Design Concepts and Prototyping:
 - Ideation and conceptualization of metal design projects.
 - Creating detailed project plans and prototypes.
 - Balancing form, function, and aesthetics in design.
- Advanced Metal Finishing and Surface Treatments:
 - Surface preparation for painting, powder coating, and patina application.
 - Custom finishes, including texturing, distressing, and polishing.
 - Preservation techniques to maintain the integrity of metalwork.
- Innovative Joining Methods:
 - Exploration of modern fastening and joining techniques.



- Integration of fasteners, adhesives, and mechanical connections.
 - Secure and aesthetically pleasing joint design.
- Artistry in Metal Design:
 - Incorporating artistic elements into metalwork.
 - Expressive and decorative metal design projects.
 - Collaboration between art and metal craftsmanship.
- Fabrication Technology and Machinery:
 - Mastery of advanced metalworking tools and machinery.
 - CNC (Computer Numerical Control) machinery for precision fabrication.
 - Safe operation and maintenance of advanced equipment.
- Project Management and Execution:
 - Planning and managing complex metal design projects.
 - Project timelines, budgeting, and resource allocation.
 - Team collaboration and leadership in metal fabrication projects.
- Industry Trends and Sustainability:
 - Exploration of emerging trends and innovations in metal design.
 - Sustainable metal design practices and materials.
 - Adapting to changes and advancements in the metalworking industry.
- Portfolio Development and Presentation:
 - Building a professional portfolio showcasing advanced metal design projects.
 - Effective presentation of design concepts and project outcomes.
 - Preparing for career opportunities and further education in metal design.

Skills

- Advanced Metal Cutting Techniques:
 - Master precision metal cutting methods, including plasma and laser cutting, for intricate designs.
 - Safely operate advanced metal cutting equipment, adhering to safety protocols.
 - Apply advanced cutting techniques to create complex shapes and forms in metal projects.
- Complex Welding Procedures:



- Proficiently execute advanced welding techniques, such as TIG and MIG, for various applications.
 - Demonstrate expertise in multi-pass welding to join thicker materials effectively.
 - Successfully weld dissimilar metals, meeting specific project requirements.
- Creative Metal Shaping and Forming:
 - Develop skills in sculptural metal shaping, bending, forging, and forming for artistic and functional designs.
 - Integrate aesthetics and functionality to create complex metal shapes.
 - Produce metalwork that showcases creativity and craftsmanship.
- Design Concepts and Prototyping:
 - Ideate and conceptualize metal design projects, translating ideas into detailed plans.
 - Create accurate prototypes to test and refine design concepts.
 - Balance form, function, and aesthetics in design projects, considering both artistic and practical aspects.
- Advanced Metal Finishing and Surface Treatments:
 - Prepare metal surfaces for various finishing techniques, including painting, powder coating, and patina application.
 - Achieve custom finishes through texturing, distressing, and polishing, enhancing the final appearance of projects.
 - Implement preservation techniques to ensure the longevity of metalwork.
- Innovative Joining Methods:
 - Explore and apply modern fastening and joining techniques to ensure the structural integrity of metal projects.
 - Design and implement secure and aesthetically pleasing joints for diverse applications.
 - Safely integrate fasteners, adhesives, and mechanical connections as required.
- Artistry in Metal Design:
 - Incorporate artistic elements into metal design projects, demonstrating creativity and expressive craftsmanship.
 - Create decorative and sculptural metal pieces that convey artistic expression and aesthetic appeal.
 - Collaborate with artistic vision to merge art and metal craftsmanship in design projects.



- Fabrication Technology and Machinery:
 - Master advanced metalworking tools and machinery, including CNC equipment, for precision fabrication.
 - Safely operate and maintain advanced machinery to meet project requirements.
 - Utilize advanced technology to streamline and enhance metal design and fabrication processes.
- Project Management and Execution:
 - Plan and manage complex metal design projects, including setting timelines and budgeting resources.
 - Lead and collaborate effectively within a team for successful project completion.
 - Demonstrate project leadership skills and problem-solving abilities in metal fabrication endeavors.
- Industry Trends and Sustainability:
 - Stay informed about emerging trends and innovations in the field of metal design.
 - Implement sustainable metal design practices, including eco-friendly materials and processes.
 - Adapt to changes and advancements in the metalworking industry to remain competitive.
- Portfolio Development and Presentation:
 - Create a professional portfolio showcasing advanced metal design projects, highlighting craftsmanship and creativity.
 - Effectively present design concepts and project outcomes to peers and potential employers.
 - Prepare for career opportunities and further education by curating a compelling portfolio.

Assessments

- Complex Metal Design Project: Students will select and execute a complex metal design project that integrates multiple advanced techniques covered in the course, such as precision cutting, creative shaping, and innovative joining methods. They will be evaluated based on the quality of craftsmanship, attention to detail, creativity, and the successful application of advanced skills.
 - Portfolio Presentation: Each student will prepare a professional portfolio showcasing their completed projects from the course. They will present their portfolio to the class, highlighting their design concepts, processes, and the incorporation of aesthetics and functionality in their work. Evaluation will focus on the clarity of presentation, the ability to communicate design intent, and the quality of documentation.
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Resources

→ Course Resources

- ◆ Welding: Principles and Applications, Larry Jeffus, ISBN: 9780357864494