Appendix A

WORK PROCESS SCHEDULE

AND

RELATED INSTRUCTION OUTLINE

Appendix A

WORK PROCESS SCHEDULE
Welder-Fitter

O*NET-SOC CODE: 51-4121.00 **RAPIDS CODE:** 0627

This schedule is attached to and a part of these Standards for the above identified occupation.

1. APPRENTICESHIP APPROACH

☒ Time-based ☐ Competency-based ☐ Hybrid

2. TERM OF APPRENTICESHIP

The term of the apprenticeship is 4 years with an OJL attainment of 8,000 hours, supplemented by the minimum required 645 hours of related instruction.

3. RATIO OF APPRENTICES TO JOURNEYWORKERS

The apprentice to journeyworker ratio is: 1 Apprentice(s) to 1 Journeyworker(s).
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4. PROBATIONARY PERIOD

Every applicant selected for apprenticeship will serve a probationary period of 90 days.

WORK PROCESS SCHEDULE
Welder-Fitter

O*NET-SOC CODE: 51-4121.00 **RAPIDS CODE:** 0627

Work Process Schedule	**Approximate Hours: 8,000**
A. Oxy-Fuel Welding Level 1	30
1. Set-up, adjust, and regulate tanks, hoses and torches 2. Tack, fillet, and groove weld in the flat position 3. Perform maintenance on oxy-fuel welding equipment	
B. Oxy-Fuel Cutting Level 1	240
1. Set-up, adjust, and regulate tanks, hoses and torches 2. Perform manual straight cutting 3. Perform manual bevel cutting	
C. Oxy-Fuel Brazing Level 1	30
1. Set-up, adjust, and regulate tanks, hoses and torches 2. Silver braze pipe joints 3. Perform maintenance on oxy-fuel brazing equipment	
D. Shielded Metal Arc Welding (S.M.A. W.) -Level 1	200
1. Set-up, operate, and maintain S.M.A.W. equipment 2. Identify electrode 3. Fillet weld plate in designated positions 4. Groove weld plate in designated positions 5. Weld pipe in the vertical and horizontal positions 6. Cut and gouge using carbon arc-air method	
E. Gas Tungsten Arc Welding (G.T.A.W.)-Level 2	1,500
1. Set-up, operate, and maintain G.T.A.W. equipment 2. Identify welding wire 3. Fillet weld plate in designated positions 4. Groove weld plate in designated positions 5. Weld pipe in the vertical and horizontal positions	

F. Gas Metal Arc Welding (G.M.A.W.) Semi-Automatic-Level 1 2,100

1. Set-up, operate, and maintain G.M.A.W. equipment
2. Identify electrode
3. Fillet weld plate in designated positions
4. Groove weld plate in designated positions
5. Weld pipe in the designated positions
6. SAW Sub Arc Welding

G. Tools and Equipment 1,400

1. Operate grinders, debur stock, rough removal of material
2. Use and care for hand tools: wrenches, hammers, punches, pliers, etc.
3. Use and care for measuring devices: tape measures, rules, scales, calipers, dividers, etc.
4. Use of plate beveler
5. Use of hand held plasma cutter
6. Use of needle scaler and power brush
7. Use and care for precision instruments: micrometers, verniers, fixed gages, etc.

H. Fabrication and Assembly 2,500

1. Layout stock from blueprints, sketches, and templates
2. Drill, ream, countersink, counterbore, spot face, and tap holes using portable equipment
3. Chip and grind material using hand held tools
4. Shop rigging and material handling
5. Fixture building and hydraulic porta power tool use for assembly

Total Hours 8,000

RELATED INSTRUCTION OUTLINE
Welder-Fitter

Related Instruction Training Provider: Manchester Community College

O*NET-SOC CODE: 51-4121.00 RAPIDS CODE: 51-4121.00

Related Instruction Training Outline **Approximate Hours: 645**

Course Number	Course Title	Credits Lec	Credits Lab	Total Hours
WELD101M	**Fundamentals of Welding**	**3**	**0**	**45**

This course introduces the fundamental concepts of welding with an overview of the four major processes: Shielded Metal Arc Welding (SMAW) Gas Metal Arc Welding (GMAW) Gas Tungsten Arc Welding (GTAW) and Oxyfuel Welding (OFW). Emphasis will be placed upon the safety requirements for electric and gas welding processes based upon the ANSI Z49.1 Safety in Welding, Cutting and Allied Processes. Fire prevention, confined spaces procedures, hot work procedures, material handling and general shop safety will be studied. An introduction to welder qualifications will be covered as well as joint configurations and welding terminology used in the field. Professional work traits expected in the welding field will be discussed.

Upon successful completion of this course, students will be able to:

1. Explain the theoretical principles of SMAW, GMAW, GTAW and OFW welding processes.
2. Demonstrate an understanding of electrical safety requirements.
3. Demonstrate an understanding of fuel gas safety requirements.
4. Explain fire prevention techniques.
5. Demonstrate an understanding of hot work procedures and confined space procedures.
6. Explain shop safety requirements and material handling techniques.
7. Use welding terminology to communicate effectively in the field.

WELD111M	**Gas and Arc Welding Lab**	**0**	**10**	**60**

At the successful completion of this course, each student will be able to: (1) safely utilize oxy-fuel cutting equipment to cut shapes and prepare material for welding; (2) safely utilize oxy-fuel welding equipment to weld various mild steel joints in the four welding positions; (3) safely utilize arc welding equipment to weld various mild steel joints in the four welding positions; (4) safely use oxy-fuel equipment for braze welding, brazing, soldering and fusion welding of the most widely used types of metals.

Upon successful completion of this course, students will be able to:

1. Safely set up gas welding equipment and make welds in all positions on mild steel.

2. Safely set up shielded metal arc welding equipment and make welds in all positions on mild steel.

3. Safely set up oxygen fuel cutting equipment to cut shapes and prepare material for welding.

4. Safely set up arc cutting equipment to cut shapes and prepare material for welding.

WELD112M	**Gas and Arc Welding Theory**	**3**	**0**	**45**

This course will allow students to explore how metals are produced; the advantages of different steel making processes; chemical, physical and mechanical properties of common metals; the operating principles of gas and arc welding and cutting equipment; how electrodes are made and their uses, differences and numbering system; and basic joints and processes. Gas and arc welding processes are identified, and methods to control them are also explained.

Upon successful completion of this course, students will be able to:

1. Explain how metals are produced and the advantages of different steelmaking processes.

2. Explain the different chemical, physical, and mechanical properties of the common metals.

3. Explain the operating principles of gas and arc welding cutting equipment.

4. State how electrodes are made, their uses, their numbering system, and the proper storage of them.

5. Identify distortion from gas and arc welding processes and explain methods to

control it before, during and after welding.

6. Explain the advantages and disadvantages of different gases used in gas and arc welding.

7. Understand the personnel protection and safety rules of the gas and arc welding processes.

WELD113M	**Technical Blueprint Reading**	**0**	**3**	**15**

Introduces the basic concepts and practices of technical drawing and blueprint reading. Covers the proper use of: drawing equipment; line work and lettering; construction and interpretation of multi-view orthographic drawings; sectional views and auxiliary views. Other topics of discussion include dimensioning and tolerances; sketching and structural steel shapes. Emphasis will be placed on using the drawing skills learned to maintain a high quality of workmanship in the field.

Upon successful completion of this course, students will be able to:

1. Demonstrate the proper use of drafting equipment.
2. Produce multi-view drawings.
3. Produce drawings with sectional views.
4. Produce drawings with auxiliary views.
5. Interpret blueprints and dimensioning systems.
6. Produce pictorial drawings, isometric and oblique.

WELD121M	**MIG and TIG Welding Laboratory**	**0**	**10**	**60**

Instructs students in the safe, hands-on use of the GTAW, GMAW, FCAW, SAW and PAW processes as they are used in industry. The GTAW process will be used to weld mild steel, stainless steel, aluminum, copper alloys and titanium. The GMAW process will be used to weld mild steel, stainless steel and aluminum. Resistance welding, plastic welding and thermal spray equipment may also be used.

Upon successful completion of this course, students will be able to:

1. Safely setup GTAW equipment and perform welds in all positions on mild steel, aluminum, stainless steel and titanium.

2. Safely setup and operate GMAW equipment and perform welds in all positions on mild steel, stainless steel and aluminum.

3. Recognize the difference between the GMAW metal transfer modes.

4. Safely setup and perform FCAW in all positions on mild steel and stainless steel.

5. Safely setup and operate SAW equipment to automatically weld in the flat position.

6. Troubleshoot defective welds and distinguish between operator error and equipment malfunction.

7. Document weld parameters and write repeatable weld procedures.

WELD122M	**MIG and TIG Welding Theory**	**3**	**0**	**45**

Covers the theory behind the gas-shielded arc welding processes, GMAW and GTAW. Principles of operation, filler materials and gas selection are discussed in great detail, as well as modern welding processes, including: Submerged Arc Welding, Plasma Arc Welding; Solid State Welding; Resistance Welding; Electroslag Welding; Stud Welding; the high energy beam processes; Thermal Spraying and more.

Upon successful completion of this course, students will be able to:

1. Explain the principles of operation for each process studied.
2. Determine the best process for a given job.
3. Determine the proper electrodes, filler materials and shielding gases to use for given jobs.
4. Recommend alternate processes for a given job.

WELD186M	**Blueprint Reading for Welders**	**3**	**0**	**45**

Introduces: print reading, covering the different types of lines, dimensions and notes used to make sketches and prints; the various types of views and their relationship to each other; the welding symbols; and inspection and testing symbols for all welding processes. Students will develop a practical understanding of the blueprint reading knowledge required by the welding industry for employment.

Upon successful completion of the course, students will be able to:

1. Demonstrate technical understanding of the information contained on blueprints.
2. Identify welding requirements according to welding symbol information.
3. Use the information contained on blueprints to communicate set-up and welding instructions from the designer to the welder and fitter.
4. Compose a bill of materials from a blueprint.

WELD125M	**Manufacturing and Repair Technology**	**0**	**3**	**15**

Introduces the safety and fundamental use of machine tools in both manufacturing and repair environments. Processes covered include turning, milling, drilling, broaching, grinding and precision measurement. In laboratory sessions, students will apply the techniques studied by using machine tools to manufacture welding fixtures and dimensionally restore parts which were repaired by welding.

Upon successful completion of the course, students will be able to:

1. Recognize and identify the major machine tools used for repair or manufacturing.
2. Effectively communicate with machine shop professionals.
3. Safely set up and operate lathes to perform turning, boring and drilling operations.
4. Safely set up and operate vertical milling machines to perform milling and drilling operations.
5. Safely use the pedestal grinder to sharpen lathe cutting tools and drills.
6. Safely set up and operate the surface grinder to prepare weld macro specimens.
7. Safely set up and operate vertical and horizontal bandsaws.
8. Use machine tools to repair worn parts restored by welding.

9. Explain and describe the safety requirements for the operation of the basic machine tools including: the Lathe, Milling Machine, Pedestal Grinder, Belt Sander, Vertical and Horizontal Bandsaws.

10. Use precision measuring tools for product inspection and manufacturing.

11. Safely set up and operate belt sanders and pedestal grinders.

CAD113M	**Applied CAD for Industry**	**1**	**3**	**30**

An introduction to the basic concepts and practices of producing drawings by computer- aided drafting using AutoCAD® software. Covers setting up for electronic drawing, drawing accurately, controlling the graphic display, basic drawing techniques, graphic entities and an introduction to editing.

Upon successful completion of the course, students will be able to:

1. Use a CAD system to produce 2 Dimensional drawings.
2. Use a diskette or other storage device to store CAD-produced drawings.
3. Retrieve drawings for revision and plotting.
4. Extract information from drawings.
5. Dimension drawings appropriately.

WELD211M	**Structural Code Welding Lab**	**0**	**10**	**60**

Covers the hands-on practice of Shielded Metal Arc Welding as applied to the American Welding Society Structural Steel Code D1.1. Students perform welder qualification tests in all positions and subject the test coupons to the required forms of mechanical testing. The role of the Welding Inspector is also covered, as well as the documentation required for both welder and weld-procedure qualification. Students gain experience in the inspection role to become familiar with weld defects and discontinuities.

Upon successful completion of the course, students will be able to:

1. State the various A. W. S. D1.1 Structural Steel Code requirements.
2. Qualify to A.W.S. requirements for groove weld plate qualification in both limited and unlimited thickness with SMAW, FCAW & GMAW processes.
3. Recognize weld defects and discontinuities using PT, MT and visual inspection.
4. Properly document weld procedure and welder qualification tests.

WELD212M	**Code Welding Theory**	**3**	**0**	**45**

This course will cover proper industrial quality-control procedures with respect to welder qualification, welding procedure qualifications, materials control and quality assurance organization. These concepts will then be utilized in discussion of three major welding codes and specifications: A.W.S., D1.1, ASM.E., boiler and pressure vessel code and A.P.I. 1104, which covers cross country pipelines. The principles and practices of common forms of non-destructive testing will be covered with emphasis placed upon weld defects and discontinuities. Several methods of safely performing leak testing will be covered. Weldability of the steels and non-ferrous metals will also be discussed, as well as the weldability of dissimilar metals.

Upon successful completion of the course, students will be able to:

1. State the various A. W. S. D1.1 Structural Steel Code requirements.
2. Qualify to A.W.S. requirements for groove weld plate qualification in both limited and unlimited thickness with SMAW, FCAW & GMAW processes.
3. Recognize weld defects and discontinuities using PT, MT and visual inspection.
4. Properly document weld procedure and welder qualification tests.

WELD213M	**Metallurgy**	**2**	**2**	**45**

This course is an introduction to the science of Metallurgy and its application to the welding of various metals. The course includes theoretical studies, as well as laboratory exercises. The concepts covered will include: identification of metals; grain structures; heat treatment processes; quench mediums and effects of mass on quenching; composition of ferrous and non-ferrous alloys; microscopic examination of metals; hardness, spark and tensile testing; and the effects of carbon and alloy content on heat-treatments and welding.

Upon successful completion of the course, students will be able to:

1. Identify metal structures.
2. Perform basic heat treatments to steel and aluminum.
3. Explain the composition of ferrous and non-ferrous alloys.
4. Explain the effects of carbon and alloy content on hardening & weldability.
5. Perform spark testing on steel to determine approximate carbon content.
6. Perform hardness and tensile testing.

7. Calculate tensile test results.
8. Understand the reasons for impact testing.
9. Perform microscopic examination of steels.
10. Prepare weld samples for macroscopic examination
11. Explain the effects that welding has on heat treatment

WELD220M	**Fabrication Techniques and Estimating**	**2**	**2**	**45**

This course deals with problems encountered when welding different types of steel and non-ferrous metals in a production shop; the use of arc motion and work motion equipment and robotics in the modern welding factory; the importance of welding procedures and the use of fixtures; and the estimating of typical welding costs (materials, cutting, welding, consumables and overhead) used to price out a job.

Upon successful completion of the course, students will be able to:

1. Detect, analyze and resolve problems encountered in the welding fabrication of products and structures.
2. Use fixtures and work holding devices to control distortion in weldments and increase productivity.
3. Demonstrate proper preparation of various structural connections and calculations of bend allowances.
4. Use arc and work motion devices to produce commercial quality welds.
5. Estimate costs for welding and cutting various metal fabrications.
6. Use robotic equipment to produce commercial quality welds.
7. Write weld procedures for automated welding and cutting.

MATH111M	**Numerical Geometry**	**3**	**0**	**45**

This is an applied course in Euclidean geometry stressing calculator manipulation and problem solving. The topics include linear, area, and solid measures involving US and SI units, solutions of linear equations, proportional relationships, congruent and similar figures, properties of polygons, circles, and ellipses.

Upon successful completion of the course, students will be able to:

1. Use the calculator to convert quantities into scientific notation, solve percentage problems, and perform arithmetic operations including signed numbers.

2. Use rounding, approximation, and dimensions (units) to identify the reasonableness of each solution.

3. Solve problems applying the fundamentals of general mathematics: whole numbers, common fractions, decimal fractions, ratio and proportion, percent, and signed numbers.

4. Solve fundamental problems using algebraic operations, simple and complex equations, the Pythagorean theorem, and the quadratic formula.

5. Solve numerical problems involving the surfaces, angles, and volumes of regular geometric figures using the fundamentals of Euclidian geometry.

6. Apply appropriate precision, accuracy, and tolerance measures in both customary measurement units (US) and metric units (SI) to all numerical solutions.

MATH135M	**Numerical Algebra & Trigonometry**	**3**	**0**	**45**

Provides students with the basic algebra and trigonometry manipulatives to compute solutions in their curricula. Algebra topics offered are signed numbers, polynomial operations, solutions of linear equations involving numerical and literal terms, word problems and formula manipulation. Trigonometric topics and trigonometric ratios as applied to right triangles and computation of measures in oblique triangles, using the Law of Sines and the Law of Cosines.

Upon successful completion of the course, students will be able to:

1. Evaluate and simplify algebraic expressions, including those with square roots, rational numbers, and exponents.

2. Solve/Graph linear equations that have one or two variables.

3. Solve/Graph inequalities that have one variable.

4. Perform operations using addition, subtraction, multiplication, and division on polynomials.

5. Factor numbers, trinomials, and special two-term polynomials (difference of two squares and sum/difference of two cubes).

6. Solve quadratic equation by factoring or by using the quadratic formula.

7. Solve right triangles using the basic trigonometry functions.

8. Solve oblique triangles using the laws of sines and cosines.

9. Solve applied problems using basic geometry properties and similar triangles.

10. Manipulate various types of algebraic formulas.

Total Minimum Hours	**645**