2025 – 2026

MANUFACTURING TECHNOLOGY COURSES

KENTUCKY CTE
EMPOWERED
Today's Career and Technical Education

MANUFACTURING COURSES
2025 – 2026

Table of Contents

COMPUTER-AIDED DESIGN COURSES

Advanced Dimensioning and Measurement 470924

This course presents an in-depth study of advanced industrial dimensioning principles, tolerances, fits, and ANSI (American National Standards Institute) standards. It also explores the shape and geometric characteristics of parts through geometric tolerance.

Prerequisite: Engineering Graphics 480113

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Define terms and principles used in advanced dimensioning.
2. Apply drawing practices and tolerance dimensioning on mating parts.
3. Explain and work with ANSI (American National Standards Institute) standards.
4. Demonstrate surface texture symbols and surface finish.
5. Compare conventional tolerancing with Geometric Dimensioning and Tolerancing.
6. Establish a basic understanding of Geometric Dimensioning and Tolerancing.
7. Analyze specific graphic designs and determine the proper location for dimensions.
8. Define terms and principles relating to Dimensional Metrology.
9. Demonstrate a working knowledge of basic handheld measuring instruments.
10. Measure with basic handheld measuring instruments.
11. Explain the relationship of precision measurement to manufacturing and design.
12. Demonstrate a working understanding of one-tenth of an inch and one-thousandth of an inch.

Architectural Design 480116

This course combines the elements and fundamentals of architectural design with the theory and application of presentation techniques. It deals with site selection, use of materials in design, spatial relationships, and aesthetics. Traditional and contemporary design, designers, processes, and historical milestones are explored. Board and computer techniques are used in illustrating student designs.

Prerequisites: Introduction to Architecture 480117

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Identify symbols and materials used on all drawings.
3. Draw a residential floor plan.
4. Use appropriate dimensioning techniques and architectural drawing standards.
5. Use drafting references and vendor product catalogs.
6. Draw residential elevations.
7. Draw and dimension presentation elevations.
8. Construct accompanying drawings to the floor plan, including foundation, framing, electrical, plumbing, heating, ventilation, and air conditioning.
9. Identify material representations in plan and section views.

Construction Drafting (Techniques) 480119

This lecture and lab course cover the elements for constructing standard, residential, and commercial buildings. Wood frame, solid masonry, veneer, concrete, and steel construction details are explored. Students will learn the essentials of standard construction details, which illustrate the various construction methods and will develop a portfolio for those techniques.

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Construct residential foundation plans.
3. Construct residential floor framing plans.
4. Construct residential wall framing plans.
5. Construct residential roof framing plans.
6. Construct detailed drawings of reinforced concrete.
7. Construct detailed drawings of typical wood frame sections.
8. Construct detailed drawings of concrete blocks and masonry units.
9. Draw stair plans and details.
10. Draw fireplace plans and sections.
11. Construct cross-section for a residential plan.
12. Construct section drawings of roofs and parapets.

Co-op* I (CAD) 480142

Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work. This course can be repeated.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Gain career awareness and the opportunity to test career choices.
3. Receive work experience related to career interests prior to graduation.
4. Integrate classroom studies with work experience.
5. Receive exposure to facilities and equipment unavailable in a classroom setting.
6. Increase employability potential after graduation.
7. Earn funds to help finance education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Engineering Graphics 480113

This course includes an exploration of lines and planes as they relate to orthographic projection to show the size and shape of objects. Instruction includes the application of principles and graphic elements of sectioning to show interior detail, the techniques involved in creating oblique projections, axonometric projections, and perspective drawings, and the dimensioning techniques and symbol usage common to all drafting disciplines.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the work area.
2. Construct drawings of basic sectional views.
3. Apply dimensioning techniques.
4. Construct title blocks, revision blocks, materials list, and tolerancing blocks.
5. Freehand sketch orthographic and pictorial views.
6. Construct axonometric drawings.
7. Construct oblique drawings.
8. Construct one-point perspective.
9. Construct two-point perspective.

Industrial Drafting Processes 480127

This course explores weldment design, welding symbols, welding processes and fabrication techniques, tool and die, and jig and fixture drawings. Design specifications, pattern drawings, casting, forming processes, and mechanical drawing principles in relation to the manufacturing industry, screw-thread design, and related fastening concepts as they relate to manufactured items and construction are also included.

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Identify and use welding symbols on fabrication drawings.
3. Construct welding assembly drawings.
4. Construct casting drawings.
5. Construct forging drawings.
6. Construct jig and fixture drawings.
7. Construct tool and die drawings.
8. Identify, specify, and construct drawings of fasteners.
9. Construct and dimension keyway and keyseat drawings.
10. Construct detailed, schematic and simplified thread drawings.
11. Construct spring drawings.

Introduction to 3D Printing Technology 332001

An introduction to additive rapid prototyping manufacturing (three-dimensional printing) and its applications in conjunction with computer technology, including hardware, software, three- dimensional printing technology, file management, internet, security, and computer intellectual property ethics. Presents basic use of applications, programming, systems and utility software.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Describe, using appropriate terminology, the concepts and applications of 3D (three- dimensional) printing.
2. Demonstrate a basic understanding of various 3D (three-dimensional) printing materials, chemical/mechanical properties, and necessary equipment settings to process them.
3. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
4. Utilize computer and 3D (three-dimensional) printing-related technology as a tool to manage, manipulate, use and present information both in a virtual model and general form.
5. Discuss ethical and responsible computing and 3D (three-dimensional) printing issues, such as copyright, patent, intellectual property rights, privacy, dangers of use, sustainability, security and internet safety.
6. Demonstrate awareness of the use and impact of computers and 3D (three-dimensional) printers in different areas of business, education, the home, and the global realm.
7. Effectively use computer application programs and related graphical interfaces.
8. Describe how 3D (three-dimensional) printing and computer technology globalization impacts varying cultures, commerce, materialism, and business opportunities.
9. Transfer and share files and information using physical methods, networks, email, and cloud-based data storage systems.
10. Demonstrate a basic understanding and application of computer-based or mobile 3D (three-dimensional) imaging/scanning methods and equipment.
11. Locate and access relevant information sources found on networks such as the internet and be familiar with web browsers, search sources, sources of online help, and sources of information related to the field of study.
12. Demonstrate an awareness of different types of software applications and operating systems, as well as software distribution, upgrading, and cloud computing.
13. Perform common file-management functions effectively.
14. Search, access, and transfer files to and from websites dedicated to functioning as 3D (three-dimensional) printing model file repositories.
15. Effectively generate and manipulate 3D (three-dimensional) computer models

using a variety of CAD (Computer-Aided Design) tools and techniques.
16. Demonstrate an understanding of foundational 3D (three-dimensional) printing and slicing features such as support material, rafts, brims, and skirts.
17. Skillfully create effective presentations, spreadsheets, and basic word-processing documents.
18. Demonstrate an understanding of how continual growth in innovative reasoning, technological skills, and presentation impact personal economic opportunities as well as employability.
19. Identify how to maintain computer and 3D (three-dimensional) printing equipment and solve common hardware problems.

Intermediate Computer-Aided Drafting 480112

Students will use CAD software to produce advanced two- and three-dimensional object drawings; advanced techniques of drafting, layering, and symbols associated with one or more design applications; and calculations of perimeters, areas, and mass associated with the drawings. (Project Lead the Way Component)

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in all areas at all times.
2. Demonstrate, through practice and communications, a comprehensive working knowledge of CAD drafting and the drafting symbols associated with one or more design applications.
3. Produce complex drawings through the use of CAD techniques.
4. Use CAD to calculate perimeters and areas for design features.
5. Construct three-dimensional models using various techniques.
6. Project two-dimensional orthographic and axonometric views and sections of the three-dimensional models.
7. Use advanced CAD operations.

Internship (CAD) 480145

Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the internship do not receive compensation.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1 – 3

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Gain career awareness and the opportunity to test career choices.
3. Receive work experience related to career interests prior to graduation.
4. Integrate classroom studies with work experience.
5. Receive exposure to facilities and equipment unavailable in a classroom setting.
6. Increase employability potential after graduation.

Introduction to Architecture 480117

This course provides a practical approach to architectural drafting through an introduction to board and computer-aided drafting as it relates to residential and commercial architecture, specifications, and structural systems, including wood, masonry, concrete, and steel.

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Use proper drawing setup for architectural scales.
3. Relate the design with site considerations.
4. Sketch a residential floor plan.
5. Identify floor plan symbols.
6. Identify material representations in plan and section views.
7. Apply basic dimensioning techniques.
8. Construct accompanying drawings to the floor plan such as elevations and electrical plans.

Introduction to Computer-Aided Drafting 480110

Students will use a computer graphic workstation in the application of fundamental principles and capabilities of CAD, basic drafting conventions, and operations. An in-depth study of computer-aided drafting commands, terminology, command utilization, and skill development will be provided.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Demonstrate an understanding of orthographic projection, section, auxiliary, and pictorial views as they relate to three-dimensional objects.
3. Identify the alphabet of lines and name each line's use.
4. Use architects, metric, civil, and mechanical drafter's scales.
5. Understand the use and purpose of a title block.
6. Demonstrate a basic understanding of dimensions and their uses.
7. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
8. Discuss ethical computing issues such as copyright, privacy, security, and property.
9. Use graphical user interface.
10. Use computer application programs.
11. Access information sources found on networks such as the Internet and utilize web browsers, search sources, and sources of information related to their field.
12. Demonstrate an awareness of different types of software applications.
13. Produce line entities using various coordinate techniques.
14. Construct geometric shapes in two-dimensional space.
15. Develop detailed orthographic views as required.
16. Construct cross sections of various designs with cross-hatching incorporated as desired.
17. Apply dimensions and annotations to drawings.
18. Move, copy, delete, and save drawings or portions of drawings.
19. Use CAD to manipulate drawings by means of translation, rotation, scaling, zooming, panning, and windowing.
20. Explore three-dimensional drawing techniques.

Introduction to Surveying (For CAD) 480104

Students are introduced to the elements of surveying, including measurements, distance corrections, leveling, angles, area computation, computer calculations, topographic surveying, electronic distance measuring instruments, construction surveying, GPS, and GIS.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Identify surveying methods and notations of measurements.
3. Analyze correction of error.
4. Identify surveying instruments.
5. Identify various methods of leveling.
6. Explain methods of traverse calculations and area computation.
7. Analyze computer calculations and omitted measurements.
8. Identify various types of surveys.
9. Explain Global Positioning System and Geographic Information Systems.
10. Identify volumes and horizontal and vertical curves.

Mechanical Design 480135

Students will explore the design process involved in the development of mechanical working drawings and the design principles in various manufacturing disciplines; gear drawing and design, and cam and follower drawing and design; design principles, mechanical adaptation, and their drawing practices; mechanical assemblies, machine design, power transmission, bearings, and seals in assemblies; and shop processes involved in these mechanical designs.

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Construct mechanical working drawings.
3. Construct gear drawing and design.
4. Construct cam and follower drawings.
5. Solve mechanical problems related to gears and cams.
6. Select appropriate gears from vendor catalogs.
7. Construct mechanical power transmission drawings.
8. Construct assembly drawings using bearings and seals.
9. Demonstrate knowledge of shop processes.

Parametric Modeling 480136

This course introduces Parametric Modeling and Design in CAD. The course explores the techniques associated with drafting and design using parametric modeling software. It also introduces the creation of parametric models and explores associative function and flexibility of concurrent part design.

Prerequisite: Introduction to Computer-Aided Drafting 480110 **OR** Intermediate Computer-Aided Drafting 480112

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Demonstrate an awareness of the terminology and concepts of Parametric Modeling.
3. Demonstrate basic parametric modeling procedures.
4. Demonstrate the ability to create parametric sketches.
5. Create fully constrained sketches.
6. Apply/modify geometric constraints and dimensions to capture and alter the design geometry of the part.
7. Demonstrate, through practice, the construction of simple parametric solid models.
8. Demonstrate the ability to perform feature-based modeling operations on parts.
9. Perform analyses on the model.
10. Perform simple assembly modeling.
11. Create desired working drawing layouts and dimensioned views from parametric solids.

Special Problems (CAD) 480179

This course allows the student to gain intermediate experience in their perspective fields through projects and tasks assigned by the instructor and based on applications the student may experience as a professional. It sets the foundation for more in-depth projects that will be included in the student's future portfolio and focuses on various assignments and curricula as determined by the program instructor.

This course does not count toward concentrator or completer status.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Demonstrate and practice safe work habits in the lab area.
2. Expand the portfolio of CAD drawings to enhance career opportunities.
3. Discuss occupation opportunities.

COMPUTERIZED MANUFACTURING AND MACHINING COURSES

Advanced Dimensioning and Measurement 470924

This course presents an in-depth study of advanced industrial dimensioning principles, tolerances, fits, and ANSI (American National Standards Institute) standards. It also includes the exploration of the shape and geometric characteristics of parts through geometric tolerance.

Prerequisite: Fundamentals of Machine Tools A 470913

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Define terms and principles used in advanced dimensioning.
5. Apply drawing practices and tolerance dimensioning on mating parts.
6. Explain and work with ANSI (American National Standards Institute) standards.
7. Demonstrate surface texture symbols and surface finish.
8. Compare conventional tolerance with Geometric Dimensioning and Tolerance.
9. Establish a basic understanding of Geometric Dimensioning and Tolerance.
10. Analyze specific graphic designs and determine the proper location for dimensions.
11. Define terms and principles relating to Dimensional Metrology.
12. Demonstrate a working knowledge of basic handheld measuring instruments.
13. Measure with basic hand-held measuring instruments.
14. Explain the relationship of precision measurement to manufacturing and design.
15. Demonstrate a working understanding of one-tenth of an inch and one-thousandth of an inch.

Applied Machining I 470911

This course consists of intermediate level skills using machining equipment and surface grinders. It will include the selection of grinding wheels. Applications in milling, lathe, bench work, and utilizing gauge blocks and the sine bar are covered in this course. Surface grinding and abrasives are introduced, and the properties of metals are discussed.

Prerequisites: Fundamentals of Machine Tools A 470913 **AND** Fundamentals of Machine Tools B 470914

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Machine and finish holes on the milling machine.
5. Cut and finish different types of key seats.
6. Select and use different types of milling cutters.
7. Select and perform basic grinding operations.
8. Machine holes on a vertical mill.
9. Form mill on a vertical mill.
10. Mill key seats.
11. Mill an angle on a vertical mill.
12. Demonstrate the care and safe use of machine grinders.
13. Select grinding wheels.
14. Classify metals and metal shapes.

Applied Machining II 470912

This course prepares the student for a higher level in the operation of machine tools. Applications in milling, lathe, bench work, gauge blocks, and the sine bar are covered in this course. Surface grinding and abrasives are introduced, and the properties of metals are discussed.

Prerequisite: Applied Machining I 470911

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Perform the grinding of parts with surfaces that are flat, parallel, and perpendicular.
5. Perform the machining of tapers on mills and lathes.
6. Perform plunge cutting operations.
7. Perform the knurling on the lathe.
8. Operate a surface grinder.
9. Mount, balance, and dress grinding wheels.
10. Cut tapers.
11. Chase standard threads on the lathe.
12. Chase metric threads on the lathe.

Blueprint Reading for Machinists 470921

This course provides the student with a beginning and advanced series of lectures, demonstrations, and practice exercises in the study of prints. Safety will be emphasized as an integral part of this course.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate competency in mathematical fraction and decimal problems.
5. Identify the alphabet of lines.
6. Identify multiple views.
7. Arrange multiple views.
8. Arrange two-view drawings.
9. Identify one-view drawings.
10. Arrange and identify auxiliary views.
11. Demonstrate the use of size and location dimensions.
12. Demonstrate proper dimensions of cylinders and arcs.
13. Size dimensions of holes and angles.
14. Locate dimensions for centering of holes, points, and centers.
15. Interpret the base line dimensions on drawings.
16. Calculate tolerances.
17. Identify labeling of various screw threads.
18. Calculate tapers and machined surfaces.
19. Dimension parts using shop notes.
20. Identify half, full, and removed sections.
21. Interpret ordinate and tabular dimensions.
22. Set tolerances using geometric dimensioning techniques.
23. Sketch parts with irregular shapes.
24. Sketch oblique views of various parts.
25. Sketch and dimension shop drawings.
26. Demonstrate visualizing techniques of multiple views.
27. Identify line types used in combinations.
28. Identify standards listings on working drawings.
29. List procedural machining and construction requirements from notations on working drawings.
30. List proper procedures for the construction of various machining processes.
31. Determine proper thread series and types for duty-specific assembly.
32. Specify duty-specific uses of contour notes.

33. Determine overall measurements of contoured parts.
34. Explain various terms involved in multiple sections.
35. Identify usages for chamfers and interpret sizes.
36. Define various chamfer terms.
37. Determine the sizing procedures of necks and grooves.
38. Identify various keyway and key seat standards.
39. Identify the usage of geometric symbols.
40. Define terms relating to geometric tolerance.
41. Set standards and tolerances using geometric dimensioning.
42. Set axis coordinates on numerical control prints.
43. Determine axis coordinates on ordinate and tabular prints.
44. Identify casting and forging terms.
45. Calculate bend setbacks in sheet metals and plate steels.
46. Identify parts and materials from various reference books and manuals.

CAD/CAM/CNC 470925

This course introduces the student to CAD/CAM/CNC systems, which include CAM software. The student will utilize process planning, manual programming and CAD/CAM for CNC equipment. The student will load a CNC program and set tools, work offsets and machine parts.

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Perform routine maintenance on tools, equipment, and machines.
5. Demonstrate knowledge of manual data input on CNC machines.
6. Create a roughing tool path for milling applications.
7. Enter tool offsets, cutter geometry and work offset.
8. Test and run a program.
9. Create a thread element, grooving and roughing for turning.
10. Use fixed cycles on CNC machines.
11. Use an automatic tool changer.
12. Work with sub-routines.
13. Generate code from converted CAD geometry.
14. Use the CAM system to transfer CAD geometry, RS – 232, DNC link.
15. Use process planning for CNC equipment.
16. Create drawings on CAM software.
17. Load a CNC program and set tools and work offsets.
18. Generate code using CAM software.
19. Operate CNC equipment.

Conversational Editing and Subroutines 470927

This course introduces students to performing editing routines to subroutines and to programs that contain loops. Students will also interpret error messages from the control.

Prerequisite: Introduction to Conversational Programming 470926

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Identify preventative measures.
5. Identify hazardous materials.
6. Practice safe use of CNC milling machines.
7. Use conversational programming of CNC machine tools.
8. Complete projects using the skills obtained in the classroom in work situations.
9. Write a conversational program.
10. Troubleshoot the program and correct mistakes.
11. Identify errors and correct them in programs.
12. Improve programs.
13. Write programs by hand.
14. Perform machining operations using programs written by hand.
15. Edit existing programs.
16. Edit existing blocks in programs.
17. Interpret error messages from the control.
18. Demonstrate knowledge of when to use and when not to use polar coordinates.
19. Calculate X, Y, OR Z and I, J, or K points using the Pythagorean Theorem and trigonometry.
20. Write a program containing subroutines.
21. Write a program containing loops.

Co-op*: Machine Tool 470929

Co-op provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the cooperative education program receive compensation for their work. This course can be repeated.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.
9. Earn funds to help finance education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Fundamentals of Machine Tools – A 470913

This course provides the basic principles needed for a solid foundation in machine tool technology. Areas and machines covered include shop safety, bench work, drill press, power saw, measurement, mills, and lathes.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Perform bench work processes, hacksaw, files, layout, drill, tap and other activities to meet industry standards.
5. Perform safe and functional activities on the following machines: horizontal band saw, vertical band saw, drill press, arbor press, lathes, and mills.
6. Perform tasks with cutting hand tools and non-cutting hand tools.
7. Identify and explain the handling procedure for hazardous material and the MSDS.
8. Identify safety needs and regulations in a machine shop.
9. Identify non-cutting hand tools and the proper use of them.
10. Prepare for a bench work process.
11. Hand saw with a hacksaw.
12. Bench file the work piece.
13. Dress and true grinding wheels on bench and pedestal grinders.
14. Demonstrate knowledge of power saws, parts, and applications.
15. Demonstrate the care and safe use of the power saw.
16. Cut and weld band saw blades.
17. Perform operations on the cut-off saw.
18. Perform operations on the vertical band saw.
19. Demonstrate knowledge of drill press, parts, and applications.
20. Demonstrate the care and safe use of the drill press.
21. Calculate and set the cutting speed and feed on the drill press.
22. Sharpen drills.
23. Set up a drill press and drill holes.
24. Shape and finish holes on a drill press.
25. Tap holes by hand and machine on a drill press.
26. Thread by hand with taps and dies.
27. Operate an arbor press.
28. Use chisels and punches.
29. Demonstrate knowledge of hazardous materials handling.
30. Demonstrate knowledge of hazardous materials storage.
31. Demonstrate lock-out/tag-out procedures.
32. Demonstrate use of MSDS.
33. Measure with basic hand-held measuring instruments.

Fundamentals of Machine Tools – B 470914

This course provides intermediate skill development in machine tool technology. The course builds on basic skills, especially in the calculation of safe cutting speed and feed rates for the drill press, power saw, mills, and lathes. Shop safety, bench work, and precision measurement are also emphasized.

Prerequisite: Fundamentals of Machine Tools – A 470913

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate knowledge of lathes, parts, and applications.
5. Demonstrate the care and safe use of lathes.
6. Demonstrate use and knowledge of mill parts and applications.
7. Demonstrate knowledge of cutting tools.
8. Demonstrate knowledge of cutting fluids.
9. Identify and explain the handling procedure for hazardous material and the content of MSDS.
10. Calculate set speeds and feeds on a lathe.
11. Sharpen high-speed tool bits.
12. Mount work piece on a lathe.
13. Face a work piece.
14. Perform turning operations.
15. Machine with carbide cutting tools.
16. File and polish a work piece.
17. Demonstrate knowledge of a milling machine, parts, and applications.
18. Demonstrate the care and safe use of milling machines.
19. Calculate set speeds and feeds on the milling machine.
20. Mill flat surfaces and grooves using a vertical mill.
21. Apply cutting fluid to machining operations.

Interdisciplinary Geometry and Computer-Aided Drafting (CAD) 480114

This course is designed to introduce the student to the customization of CAD software. Menu creation and programming will be applied as it relates to the CAD program.

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Utilize advanced CAD applications.
5. Develop basic programming techniques.

Internship: Machine Tool 470932

Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the internship do not receive compensation.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1 - 3

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.

Intermediate Computer-Aided Drafting 480112

This course uses CAD software to produce advanced two- and three-dimensional object drawings. Students are given the opportunity to practice advanced techniques of drafting, layering, and symbols associated with one or more design applications. Students calculate perimeters, areas, and mass associated with the drawings.

Prerequisite: Introduction to Computer-Aided Drafting 480110

Recommended Grade Level: 9 - 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate, through practice and communications, a comprehensive working knowledge of CAD drafting and the drafting symbols associated with one or more design applications.
5. Produce complex drawings through the use of CAD techniques.
6. Use CAD to calculate perimeters and areas for design features.
7. Construct three-dimensional models using various techniques.
8. Project two-dimensional orthographic and axonometric views and sections of the three- dimensional models.
9. Use advanced CAD operations.

Introduction to 3D Printing Technology 332001

An introduction to additive rapid prototyping manufacturing (three-dimensional printing) and its applications in conjunction with computer technology, including hardware, software, three- dimensional printing technology, file management, internet, security, and computer intellectual property ethics. Presents basic use of applications, programming, systems and utility software.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Describe, using appropriate terminology, the concepts and applications of 3D (three-dimensional) printing.
2. Demonstrate a basic understanding of various 3D (three-dimensional) printing materials, chemical/mechanical properties, and necessary equipment settings to process them.
3. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
4. Utilize computer and 3D (three-dimensional) printing-related technology as a tool to manage, manipulate, use and present information both in a virtual model and general form.
5. Discuss ethical and responsible computing and 3D (three-dimensional) printing issues, such as copyright, patent, intellectual property rights, privacy, dangers of use, sustainability, security and internet safety.
6. Demonstrate awareness of the use and impact of computers and 3D (three-dimensional) printers in different areas of business, education, the home, and the global realm.
7. Effectively use computer application programs and related graphical interfaces.
8. Describe how 3D (three-dimensional) printing and computer technology globalization impacts varying cultures, commerce, materialism, and business opportunities.
9. Transfer and share files and information using physical methods, networks, email, and cloud-based data storage systems.
10. Demonstrate a basic understanding and application of computer-based or mobile 3D (three-dimensional) imaging/scanning methods and equipment.
11. Locate and access relevant information sources found on networks such as the internet and be familiar with web browsers, search sources, sources of online help, and sources of information related to the field of study.
12. Demonstrate an awareness of different types of software applications and operating systems, as well as software distribution, upgrading, and cloud computing.
13. Perform common file-management functions effectively.
14. Search, access, and transfer files to and from websites dedicated to functioning as 3D (three-dimensional) printing model file repositories.
15. Effectively generate and manipulate 3D (three-dimensional) computer models using a variety of CAD (Computer-Aided Design) tools and techniques.
16. Demonstrate an understanding of foundational 3D (three-dimensional) printing and

slicing features such as support material, rafts, brims, and skirts.
17. Skillfully create effective presentations, spreadsheets, and basic word processing documents.
18. Demonstrate an understanding of how continual growth in innovative reasoning, technological skills, and presentation impact personal economic opportunities as well as employability.
19. Identify how to maintain computer and 3D (three-dimensional) printing equipment and solve common hardware problems.

Introduction to Computer-Aided Drafting 480110

This course uses a computer graphic workstation in the application of fundamental principles and capabilities of CAD, basic drafting conventions, and operations. Students participate in an in-depth study of computer-aided drafting commands, terminology, command utilization, and skill development.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate an understanding of orthographic projection, section, auxiliary, and pictorial views as they relate to three-dimensional objects.
5. Identify the alphabet of lines and name each line's use.
6. Use architects, metric, civil, and mechanical drafter's scales.
7. Understand the use and purpose of a title block.
8. Demonstrate a basic understanding of dimensions and their uses.
9. Describe, using correct computer terminology, basic computer functions, uses of computers in society and different types of software.
10. Discuss ethical computing issues, such as copyright, privacy, security, and property.
11. Use a graphical user interface.
12. Use computer application programs.
13. Access information sources found on networks such as the internet, become familiar with web browsers and search for information related to their field.
14. Demonstrate an awareness of different types of software applications.
15. Produce line entities using various coordinate techniques.
16. Construct geometric shapes in two-dimensional space.
17. Develop detailed orthographic views as required.
18. Construct cross sections of various designs, with cross-hatching incorporated as desired.
19. Apply dimensions and annotations to drawings.
20. Move, copy, delete, and save drawings or portions of drawings.
21. Use CAD to manipulate drawings by means of translation, rotation, scaling, zooming, panning, and windowing.
22. Explore 3-D drawing techniques.

Introduction to Conversational Programming 470926

This course introduces students to conversational programming guidelines, which will include program preparation, conversational input, and minor editing.

Prerequisites: Fundamentals of Machine Tools – A 470913 **AND** Fundamentals of Machine Tools – B 470914

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Identify and practice preventative measures.
5. Identify and explain the handling procedure for hazardous material.
6. Practice safe use of CNC milling machines.
7. Use conversational programming of CNC machine tools.
8. Complete projects using the skills obtained in the classroom in work situations.
9. Write a conversational program.
10. Troubleshoot the program and correct mistakes.
11. Respond to prompts.
12. Prepare a conversational program.
13. Edit existing conversational programs.
14. Perform machining operations using programs created by students.
15. Respond to prompts correctly to build a program.
16. Prepare a program in conversational language.
17. Compare conversational input to coded input.
18. Determine errors in programs and correct them.
19. Look for improvements in the process of a program.
20. Insert blocks of information into programs.
21. Delete blocks of information from programs.

Manual Programming 470915

This course introduces the student to the CNC format and the Cartesian Coordinate System. It also introduces the student to CNC codes and programming, set-up, and operation of CNC machine tools. The student will utilize process planning and manual programming for CNC equipment. The student will load a CNC program and set tools and work offsets.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Use process planning for CNC equipment.
5. Use manual programming for CNC equipment.
6. Load a CNC program and set tools and work offsets.
7. Identify the tasks that must be done to put a job into production.
8. Use proper tool path sequencing.
9. Apply the “Rule of Thumb” to determine rotary axis direction and the “Right-Hand Rule.”
10. Describe the characteristics and differences between position and reference points.
11. Calculate coordinate points using absolute Cartesian values.
12. Calculate coordinate points using incremental Cartesian values.
13. Identify basic CNC code structure.

Mechanical Blueprint Reading 470922

This course provides the student with an advanced series of lectures, demonstrations, and practice exercises in the study of prints involving decimal and metric math, combination of lines, multi-view drawings, assembly drawings, fasteners, machining and construction processes, datum coordinates, numerical control prints, sheet metal prints, welding, casting and forging prints. Safety will be emphasized.

Prerequisite: Blueprint Reading for Machinists 470921

Recommended Grade Level: 11 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate visualizing techniques of multiple views.
5. Identify line types used in combinations.
6. Identify standards listings on working drawings.
7. List procedural machining and construction requirements from notations on working drawings.
8. List proper procedures for the construction of various machining processes.
9. Determine proper thread series and types for duty-specific assembly.
10. Specify duty-specific uses of contour notes.
11. Determine overall measurements of contoured parts.
12. Explain various terms involved in multiple sections.
13. Identify usages for chamfers and interpret sizes.
14. Define various chamfer terms.
15. Determine the sizing procedures of necks and grooves.
16. Identify various keyway and key seat standards.
17. Identify the usage of geometric symbols.
18. Define terms relating to geometric tolerance.
19. Set standards and tolerances using geometric dimensioning.
20. Set axis coordinates on numerical control prints.
21. Determine axis coordinates on ordinate and tabular prints.
22. Identify casting and forging terms.
23. Calculate bend setbacks in sheet metals and plate steels.
24. Identify parts and materials from various reference books and manuals.

Metrology/Control Charts 470928

This course provides the basic principles of using precision measurement instruments and their application to inspection and quality control.

Recommended Grade Level: 10 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate and practice the correct use of gauging equipment.
5. Demonstrate the use of gauging equipment in part inspection.
6. Demonstrate knowledge of common control chart information.
7. Use gauging equipment to supply control charts with chart information.
8. Discuss Coordinate Measuring Machine.
9. Demonstrate and practice the correct use of an optical comparator.
10. Demonstrate knowledge, skills and abilities of applied statistics as outlined in the NIMS Framework for Machining Skills.
11. Identify parts and materials from various reference books and manuals.

Special Problems (CMM) 470979

This is a course designed for the student who has demonstrated specific needs. This course does not count toward concentrator or completer status.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Complete selected tasks/problems as determined by the instructor.

INDUSTRIAL MAINTENANCE TECHNOLOGY COURSES

Advanced Hydraulic Systems 470316

This course covers the design, repair, and troubleshooting of hydraulic systems.

Prerequisite: Fluid Power 470321

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in machining.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe the properties of hydraulic fluid.
5. Describe how an accumulator performs in a circuit.
6. Install and operate an accumulator into a circuit.
7. Install and operate a pilot-operated check valve.
8. Install and operate a pressure-compensated flow control valve.
9. Install and operate a pilot-operated directional control valve.
10. Install and operate a pressure port check valve.
11. Install and operate a cam-operated valve.
12. Hook up and operate unloading circuits.
13. Install and operate by remote a pilot-operated pressure control valve.
14. Describe transducers.
15. Describe electrohydraulic servo valve characteristics.
16. Operate an electrohydraulic servo valve.
17. Install and align a hydraulic pump.
18. Repair a hydraulic cylinder.
19. Choose a hydraulic cylinder for a specific application.
20. Interpret hydraulic schematics.
21. Troubleshoot a hydraulic circuit.
22. Design a hydraulic circuit.
23. Repair valves.

Advanced Pneumatic Systems 470326

This course covers the design, repair and troubleshooting of pneumatic systems.

Prerequisite: Fluid Power 470321

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Repair a pneumatic cylinder.
5. Choose a pneumatic cylinder for a specific application.
6. Interpret pneumatic schematics.
7. Construct basic air logic circuits.
8. Identify symbols and devices used in air logic circuits.
9. Install and operate a check valve.
10. Install and operate a four-way pilot-operated directional control valve (DCV).
11. Install and operate a push-button DCV.
12. Install and operate a cam-operated DCV.
13. Design a pneumatic system.
14. Disassemble an air compressor.
15. Repair valves.
16. Troubleshoot a pneumatic system.
17. Test pneumatic components for proper operation.

Applied Machining I (for Industrial Maint.) 470360

This course consists of intermediate level skills using machining equipment and surface grinders. It includes the selection of grinding wheels. Applications in milling, lathe, bench work, and utilizing gauge blocks and the sine bar are covered in this course. Surface grinding and abrasives are introduced, and the properties of metals are discussed.

Prerequisites: Fundamentals of Machine Tools – A (For Maintenance) 470313 **AND** Fundamentals of Machine Tools – B (For Maintenance) 470314

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Machine and finish holes on the vertical and horizontal mills.
5. Cut and finish different types of key seats.
6. Select and use different types of milling cutters.
7. Select and perform basic grinding operations.
8. Machine holes on a vertical mill.
9. Form mill on a vertical mill.
10. Mill key seats.
11. Mill an angle on a vertical mill.
12. Cut and finish holes on vertical and horizontal mills.
13. Demonstrate the care and safe use of machine grinders.
14. Select grinding wheels.
15. Classify metals and metal shapes.

Basic Blueprint Reading 499920

This course presents basic applied math, lines, multi-view drawings, symbols, various schematics and diagrams, dimensioning techniques, sectional views, auxiliary views, threads and fasteners, and sketching typical to all shop drawings. Safety will be emphasized as an integral part of the course.

Recommended Grade Level: 9 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Review math concepts (fractions and decimals).
5. Identify the alphabet of lines.
6. Identify multiple views.
7. Arrange multiple views.
8. Arrange two-view drawings.
9. Identify one-view drawings.
10. Arrange and identify auxiliary views.
11. Demonstrate and use the size and location dimensions.
12. Demonstrate proper dimensions of cylinders and arcs.
13. Size dimensions of holes and angles.
14. Locate dimensions for centering of holes, points, and centers.
15. Interpret the base line dimensions on drawings.
16. Identify half, full, and removed sections.
17. Identify electrical schematic and diagram symbols.
18. Identify welding symbols and equipment.
19. Interpret ordinate and tabular dimensions.
20. Set tolerances using geometric dimensioning techniques.
21. Sketch parts with irregular shapes.
22. Sketch oblique views of various parts.
23. Sketch and dimension shop drawings.
24. Dimension parts using shop notes.
25. Calculate tolerances.
26. Identify labeling of various screw threads.
27. Calculate tapers and machined surfaces.
28. Interpret connections and flow of various electrical, hydraulic, and pneumatic schematics and diagrams.

Basic Troubleshooting 499925

This course explores the science of troubleshooting and the importance of proper maintenance procedures; how to work well with others, aids in communication and trade responsibilities; examines actual troubleshooting techniques, aids in troubleshooting and how to use schematics and symbols; focuses on specific maintenance tasks such as solving mechanical and electrical problems, breakdown maintenance, and the how's and whys of planned maintenance.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Explain the reason efficient troubleshooting is important in a production plant.
5. List the steps in troubleshooting a machine/system.
6. Demonstrate good communication skills when dealing with plant personnel.
7. List the questions that should be asked when a machine/system fails.
8. List the signs of a machine in need of service.
9. List the information that should be recorded in a machine equipment record.
10. Identify calibration standards.
11. Identify different troubleshooting test equipment.
12. Use schematics when troubleshooting.
13. Identify differences in schematics when troubleshooting.
14. Use a troubleshooting chart.
15. Identify bearing wear problems.
16. Identify pump failure problems and solutions.
17. Identify types of hosing.
18. Identify current voltage characteristics of wire.
19. Apply all safety rules when working with electrical equipment.
20. Identify a pictorial diagram, blocking diagram, and schematic diagram.
21. Demonstrate how to troubleshoot an electrical problem.
22. List preventive maintenance procedures.

Blueprint Reading for Machinists 470921

This course provides the student with a beginning and advanced series of lectures, demonstrations, and practice exercises in the study of prints. Safety will be emphasized as an integral part of this course.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate competency in mathematical fraction and decimal problems.
5. Identify the alphabet of lines.
6. Identify multiple views.
7. Arrange multiple views.
8. Arrange two-view drawings.
9. Identify one-view drawings.
10. Arrange and identify auxiliary views.
11. Demonstrate the use of size and location dimensions.
12. Demonstrate proper dimensions of cylinders and arcs.
13. Size dimensions of holes and angles.
14. Locate dimensions for centering of holes, points, and centers.
15. Interpret the base line dimensions on drawings.
16. Calculate tolerances.
17. Identify labeling of various screw threads.
18. Calculate tapers and machined surfaces.
19. Dimension parts using shop notes.
20. Identify half, full, and removed sections.
21. Interpret ordinate and tabular dimensions.
22. Set tolerances using geometric dimensioning techniques.
23. Sketch parts with irregular shapes.
24. Sketch oblique views of various parts.
25. Sketch and dimension shop drawings.
26. Demonstrate visualizing techniques of multiple views.
27. Identify line types used in combinations.
28. Identify standards listings on working drawings.
29. List procedural machining and construction requirements from notations on working drawings.
30. List proper procedures for the construction of various machining processes.
31. Determine proper thread series and types for duty-specific assembly.
32. Specify duty-specific uses of contour notes.
33. Determine overall measurements of contoured parts.
34. Explain various terms involved in multiple sections.

35. Identify usages for chamfers and interpret sizes.
36. Define various chamfer terms.
37. Determine the sizing procedures of necks and grooves.
38. Identify various keyway and key seat standards.
39. Identify the usage of geometric symbols.
40. Define terms relating to geometric tolerancing.
41. Set standards and tolerances using geometric dimensioning.
42. Set axis coordinates on numerical control prints.
43. Determine axis coordinates on ordinate and tabular prints.
44. Identify casting and forging terms.
45. Calculate bend setbacks in sheet metals and plate steels.
46. Identify parts and materials from various reference books and manuals.

Cooling and Dehumidification (for Industrial Maint.) 470361

This course explores the science of troubleshooting and the importance of proper maintenance procedures; how to work well with others, communication and trade responsibilities; actual troubleshooting techniques and how to use schematics and symbols; specific maintenance tasks such as solving mechanical and electrical problems and breakdown maintenance; and the how's and whys of planned maintenance.

Prerequisite: Refrigeration Fundamentals (For Maintenance) 470349

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe air conditioning.
5. List the benefits of "conditioned" air.
6. Describe some of today's current issues regarding air conditioning—industry concerns and future ramifications.
7. Describe the difference between split systems and package systems.
8. Describe the sequence of the basic refrigeration cycle and operation of the air conditioning system.
9. Use and read various tools and instrumentation needed for checking, testing, and operating air conditioning systems.
10. Define the types of condensers: air-cooled, water-cooled, and evaporative.
11. Adjust the air flow for proper temperature difference.
12. Describe the maintenance of a condenser and a cooling tower.
13. Analyze air conditioning systems and appropriately diagnose electrical and/or mechanical problems.
14. Demonstrate good customer relations in a classroom simulation.
15. Explain the importance of manufacturers' installation and operation requirements.
16. Determine equipment electrical requirements.
17. Verify equipment air flow and distribution requirements.
18. Check operation of all electrical components, including control components.
19. Demonstrate the use of tools and test equipment.
20. Check system operation while following all safety procedures.
21. Follow local codes and ordinances during installation and repair.
22. Read and demonstrate an understanding of electrical wiring diagrams.
23. Develop a systematic way to diagnose system problems and demonstrate them in class.
24. Determine the cause of failure in a system.
25. Identify and describe possible causes of failure and how to eliminate them.
26. Demonstrate the use of tools and test equipment while following safety practices.

27. Verify system operation.
28. Write a service report.
29. Identify types of control systems: electromechanical, pneumatic, electronic, and programmable.
30. Identify control system components.
31. Describe the sequences of operation in all types of control systems.
32. Construct a schematic diagram using all components necessary to safely operate an air conditioner.
33. Program a programmable thermostat for heating, cooling, and heat pump operation, including set up and set back.
34. Plot and chart psychrometric terms.
35. Describe the operation of electronic air cleaners.
36. Measure pressure drop with a magnetic gauge.

Co-op* I (Ind Maint) 470305

Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work. This course can be repeated.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Electrical Components (Ind. Maint.) 470358

This course defines the electrical components of an air conditioning system. Different types of line voltages, wiring diagrams, and solid-state devices are included. Safety is emphasized.

Prerequisites: HVAC Electricity (Ind Maint) 470365 **OR** Industrial Maintenance Electrical Principles 470322 **AND** Industrial Maintenance Electrical Motor Controls 470348

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Measure voltage with digital and analog voltmeters.
5. Measure AC current with a clamp-on ammeter.
6. Measure resistance with an ohmmeter.
7. Check winding insulation with a megohmmeter.
8. Check voltage with a voltage test.
9. Use a continuity tester to determine whether an open circuit exists.
10. Use a capacitance meter to measure the capacitance of both run and start capacitors.
11. Define watts, ohms, volts, and amps.
12. Define and compare single and multi-phase voltage and current.
13. Demonstrate proper use of ohmmeter, ammeter, and voltmeter.
14. Calculate electrical circuit loads.
15. Use appropriate meters to check fuses and breakers.
16. Use the appropriate meter to determine wattage, resistance, voltage, and amperage.
17. Interpret tables and charts from the National Electrical Code (NEC).
18. Figure wire sizes and voltage drop.
19. Draw and identify power transformer types.
20. Use electrical meters appropriately to test and identify voltages and phases.
21. Size and test fuses and breakers and safely replace them.
22. Use NEC tables to size EMT.
23. Define relays, sequencers, contractors, capacitors, defrost timers, crankcase heaters, water valves, damper actuators, thermostats, controllers, rheostats, zone valves, and solenoids.
24. Explain the operation and application of split-phase motors, three-phase motors, variable speed motors, shaded pole motors, and permanent split capacitor motors.
25. Demonstrate proper use of testing equipment for motors.
26. Interpret detailed instructions for wiring circuits.
27. Draw electrical circuits in accordance with standard wiring procedures.
28. Wire actual electrical circuits from wiring diagrams.
29. Demonstrate the use of basic electrical meters by wiring and testing actual circuits.

30. Explain the use of various electrical components in HVACR.
31. Interpret schematic wiring diagrams into a sequence of operations for HVACR equipment.
32. Analyze the electrical performance of each component and control.
33. Rewire an HVACR unit using a schematic diagram.
34. Develop an approved routine for electrical troubleshooting.
35. Use electrical test instruments appropriately to test and correct the performance of electrical systems.

Fluid Power 470321

This course is a study of fluid power theory, component identification and application, schematic reading, and basic calculations related to pneumatic and hydraulic systems and their operations.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Design simple hydraulic and pneumatic systems.
5. Draw hydraulic and pneumatic circuits.
6. Install a pneumatic pressure regulator.
7. Check and replace the pneumatic pressure regulator.
8. Install pressure relief valve.
9. Check and replace the pressure relief valve.
10. Install a non-rotating cylinder.
11. Install hydraulic and pneumatic motors.
12. Install pressure booster (intensifier).
13. Install a pressure-reducing valve.
14. Install a rotating cylinder.
15. Replace 2-way, 3-way, and 4-way valves (solenoid-operated valves).
16. Replace an accumulator.
17. Adjust the pressure on hydraulic systems.
18. Change filters in hydraulic systems.
19. Change hydraulic fluid.
20. Install hydraulic pressure regulator.
21. Check and replace the hydraulic pressure regulator.
22. Install hydraulic sequence valve.
23. Check and replace the hydraulic sequence valve.
24. Install counter-balance valve.
25. Install flow control or speed control valve.
26. Install hydraulic pump.
27. Replace the hydraulic cylinder.

Fundamentals of Machine Tools – A (For Maintenance) 470313

This course provides the basic principles needed for a solid foundation in machine tool technology. Areas and machines covered include shop safety, bench work, drill press, power saw, measurement, mills, and lathes.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate and practice safe work habits in the lab area as outlined in the NIMS Framework for Machining Skills.
5. Perform bench work processes, hacksaw, files, layout, drill, tap and other activities to meet industry standards.
6. Perform safe and functional activities on the following machines: horizontal band saw, vertical band saw, drill press, arbor press, lathes, and mills.
7. Perform tasks with cutting hand tools and non-cutting hand tools.
8. Identify and explain the handling procedure for hazardous material and the content of MSDS (Material Safety Data Sheet).
9. Identify safety needs and regulations in a machine shop.
10. Identify non-cutting hand tools and the proper use of them.
11. Prepare for a bench work process.
12. Hand saw with a hacksaw.
13. Bench file the workpiece.
14. Dress and true grinding wheels on bench and pedestal grinders.
15. Demonstrate knowledge of power saws, parts, and applications.
16. Demonstrate the care and safe use of the power saw.
17. Cut and weld band saw blades.
18. Perform operations on the cut-off saw.
19. Perform operations on the vertical band saw.
20. Demonstrate knowledge of drill press, parts, and applications.
21. Demonstrate the care and safe use of the drill press.
22. Calculate and set the cutting speed and feed on the drill press.
23. Sharpen drills.
24. Set up a drill press and drill holes.
25. Shape and finish holes on a drill press.
26. Tap holes by hand and machine on a drill press.
27. Thread by hand with taps and dies.
28. Operate an arbor press.
29. Use chisels and punches.
30. Demonstrate knowledge of hazardous materials handling.
31. Demonstrate knowledge of hazardous materials storage.

32. Demonstrate lock-out/tag-out procedures.
33. Demonstrate use of MSDS (Material Safety Data Sheet).
34. Measure with basic hand-held measuring instruments.

Fundamentals of Machine Tools – B (For Maintenance) 470314

This course provides the basic principles needed for a solid foundation in machine tool technology. Areas and machines covered include shop safety, bench work, drill press, power saw, measurement, mills, and lathes.

Prerequisite: Fundamentals of Machine Tools – A (For Maintenance) 470313

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Demonstrate and practice safe work habits in the lab area.
5. Demonstrate knowledge of lathes, parts, and applications.
6. Demonstrate the care and safe use of lathes.
7. Demonstrate use and knowledge of mill parts and applications.
8. Demonstrate knowledge of cutting tools.
9. Demonstrate knowledge of cutting fluids.
10. Identify and explain the handling procedure for hazardous material and the content of MSDS (Material Safety Data Sheet).
11. Calculate and set speeds and feeds on a lathe.
12. Sharpen high-speed tool bits.
13. Mount workpiece on a lathe.
14. Face a workpiece.
15. Perform turning operations.
16. Machine with carbide cutting tools.
17. File and polish a workpiece.
18. Demonstrate knowledge of a milling machine, parts, and applications.
19. Demonstrate the care and safe use of milling machines.
20. Calculate and set speeds and feeds on the milling machine.
21. Mill flat surfaces and grooves using a vertical mill.
22. Apply cutting fluid to machining operations.

Gas Metal Arc Welding and Lab 470367

This course covers the identification, inspection, and maintenance of GMAW machines; identification, selection and storage of GMAW electrodes; principles of GMAW; and the effects of variables on the GMAW process. Theory and applications of related processes such as FCAW, SMAW and metallurgy are also included. Students learn the practical application and manipulative skills of Gas Metal Arc Welding and the proper safety situations needed in this process. Both ferrous and non-ferrous metals will be covered, as well as various joint designs on plates in all positions.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Apply the technical math required for employment opportunities in welding.
5. Use lab equipment and tools.
6. Apply principles of GMAW to weld metals to include FCAW and SMAW.
7. Apply knowledge of the effects of variables of GMAW to weld plate and pipe.
8. Apply knowledge of basic metallurgy to control chemical, physical, and mechanical properties of alloy steels.
9. Identify and select filler materials for GMAW processes.
10. Weld fillet welds in all positions using various transfer modes on steel, stainless steel, and aluminum.

Heating and Humidification (for Industrial Maint.) 470363

This course explains heating systems from simple fossil fuel furnaces through more complex systems. This course will also concentrate on the line and control voltage circuitry pertaining to these systems. ARI (Air-Conditioning and Refrigeration Institute) Controls: Subtopics A-C; Heating Systems: Subtopics A-C; System Installation and Start-Up: Subtopics A and B; System Servicing and Troubleshooting: Subtopic C; Tools and Equipment: Subtopic D. This course is designed to develop the practical skills of troubleshooting, checking, adjusting, and installing heating units currently in use.

Prerequisite: HVAC Electricity (Ind Maint) 470365

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Adjust valves.
5. Check coil resistance of a valve coil.
6. Test gas valve operation.
7. Check the voltage at gas valve operator.
8. Check pressure at inlet vs. outlet of gas valve.
9. Perform a regular conversion on a gas valve from natural gas to LP or reverse: low, line voltage, redundant, two-stage, and modulating.
10. Explain the operation of a solenoid valve.
11. Explain direct vs. servo regulation.
12. Identify limited, non-adjustable and adjustable regulators.
13. Determine application of gas valves.
14. Differentiate between pilot proving devices.
15. Explain the operation of flame rod, mercury flame switch, bimetal, and millivolt flame sensors.
16. Test and change a thermocouple flame sensor.
17. Test spark ignition modules.
18. Perform safety lockout procedures for burners.
19. Measure resistance of a cad cell during operation.
20. Explain the operation of an oil delay valve.
21. Identify and install residential heating and cooling thermostats.
22. Test a fan/limit control to identify a set point of control.
23. Wire a complete heating system—line and low voltage.
24. Identify controls for heating and cooling.
25. Wire a humidistat into electrical circuit.
26. Wire control circuit for electronic air cleaner.
27. Test and adjust the fuel system of furnace.

28. Check the ignition system.
29. De-rate or change over a gas burner.
30. Adjust burner system to recommended efficiency.
31. Check for proper temperature rise across the furnace.
32. Test all safety controls.
33. Set proper air distribution in house.
34. Remove, install, and adjust blower motor and/or belt.
35. Clean the pilot assembly.
36. Adjust the regulator.
37. Observe proper draft conditions.
38. Oil motor(s) and bearings.
39. Check and adjust the heat anticipator.
40. Check circulator for alignment and lubrication.
41. Set aquastat.
42. Check water-regulating valve operator.
43. Inspect/change zone valve operator.
44. Remove air from water system.
45. Wire a multi-zone/multi-pump hydronic system.
46. Identify types of hydronic piping systems.
47. Test boiler efficiency and clean if necessary.
48. Oil motor(s).
49. Check and adjust the heat anticipator.
50. Perform pressure checks on the fuel system.
51. Perform pressure checks on the venting system.
52. Measure temperature difference across heating and cooling equipment.
53. Adjust individual register outlets to properly balance system.
54. Describe the reasons for codes.
55. Discuss three model codes: boca, standard, and uniform.
56. Identify the codes and standards for the applicable area, locality, or state.
57. Discuss the relationship between codes and manufacturers' installation instructions.
58. Identify standards not covered by codes: ARI (Air-Conditioning and Refrigeration Institute), ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers), and SMACNA (Sheet Metal and Air Conditioning Contractors National Association).
59. Demonstrate good customer relations in a classroom situation.
60. Explain the importance of manufacturers' installation and operation requirements.
61. Determine equipment electrical requirements.
62. Verify equipment air flow and distribution requirements.
63. Check operation of all electrical control components.
64. Check operation of gas train components and measurements.
65. Demonstrate use of tools and instruments.
66. Check oil burner components and measurements.
67. Check ignition systems while following all safety principles.
68. Evaluate fuel supply systems.
69. Test for proper combustion.
70. Check electrical components for operation and wiring connections.
71. Check for correct heating input and adjust to manufacturers' specifications.

72. Read and demonstrate an understanding of electrical wiring diagrams.
73. Use tools and test equipment appropriately while following safety practices.
74. Demonstrate an understanding of combustion theory.
75. Determine air requirements.
76. Develop a systematic way to diagnose system problems and demonstrate them in class.
77. Determine cause of failure in a heating system.
78. Identify and describe all possible causes of failure and how to eliminate causes.
79. Verify system operation.
80. Write a service report.
81. Measure chimney draft with a draft gauge.
82. Perform an efficiency test on an oil-gas burner: smoke test, CO2 test, and 02 test.
83. Determine the efficiency of an oil pump using a vacuum gauge and a pressure gauge.
84. Determine the relative humidity using a sling psychrometer.
85. Measure gas pressure with a U-tube manometer.

HVAC Electricity (Ind Maint) 470365

This course introduces students to the basic physics of electricity. Students apply Ohm's Law, measure resistance, voltage, ohms, watts and amps; construct various types of electrical circuits, select wire and fuse sizes; and learn to troubleshoot an electric motor and motor controls.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Measure ohms with an ohmmeter.
5. Measure voltage with a voltmeter.
6. Measure amps with an ammeter.
7. Measure watts with a wattmeter.
8. Solve electrical circuit problems using Ohm's Law.
9. Draw and interpret electrical symbols.
10. Construct series circuits.
11. Construct parallel circuits.
12. Construct series-parallel circuits.
13. Connect, operate, and identify the types of single-phase motors.
14. Measure the resistance of windings in a split-phase motor and identify the start/run windings.
15. Test capacitors.
16. Select wire and fuse sizes.
17. Test transformers.
18. Locate faults in electrical circuits.
19. Identify types of 3-phase power supplies.
20. Troubleshoot magnetic motor starters and coils.

Industrial Maintenance Electrical Motor Controls 470348

This course addresses the diversity of electrical motor control devices and applications used in industry today with safety and electrical lockouts included.

Prerequisite: Industrial Maintenance Electrical Principles 470322

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Connect control relay systems.
5. Connect a dynamic braking circuit for AC motors.
6. Test magnetic starters.
7. Connect overload relays into starting control circuits.
8. Connect reduced voltage starters.
9. Connect time delay relays.
10. Connect motor for automatic controls.
11. Connect automatic reduced voltage starter for DC motor control.
12. Connect limit switches.
13. Connect motor control circuits for plug-ins.
14. Connect point starters for DC motors.
15. Connect push button stations.
16. Connect selector switches.
17. Connect sensing devices (non-electric).
18. Connect magnetic starters.

Industrial Maintenance Electrical Principles 470322

This course introduces the theory of electricity and magnetism and the relationship of voltage, current, resistance, and power in electrical circuits. The course is designed to develop an understanding of alternating and direct current fundamentals. Students will apply formulas to analyze the operation of AC and DC circuits.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Review and apply OSHA Standards and the National Electrical Code.
5. Care for, maintain, identify and use basic hand tools.
6. Solder/de-solder electrical connections.
7. Set up and operate power supplies.
8. Compute, measure, and identify the conductance and resistance of conductors and insulators.
9. Measure properties of a circuit using VOM and DMM meters.
10. Solve electrical circuit problems using Ohm's Law.
11. Analyze, construct and troubleshoot parallel circuits.
12. Analyze, construct and troubleshoot series circuits.
13. Analyze, construct and troubleshoot series-parallel circuits.
14. Determine the physical and electrical characteristics of capacitors and inductors.
15. Analyze basic motors, generator theory and operation.
16. Write technical reports.
17. Use an oscilloscope to verify the properties of an AC signal.
18. Determine physical and electrical characteristics of transformers and test procedures.
19. Compute and measure power in AC circuits.
20. Apply and demonstrate the Edison system and the three-phase system.
21. Analyze and identify circuit protection.
22. Connect various transformer configurations.
23. Wire two- and three-way switches.
24. Wire single phase circuit.
25. Identify, install, and label circuit breakers, fuses and other overload protection in distribution panels.
26. Identify appropriate wiring sizes and amperage ratings.
27. Identify and install appropriate wiring techniques.
28. Install conductors in various forms of conduit raceways.

Industrial Maintenance of PLCs 470330

This course includes the theory of Programmable Logic Controllers to include installation, programming, interfacing, and troubleshooting PLCs.

Prerequisite: Industrial Maintenance Electrical Motor Controls 470348

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe the basic operation of programmable controllers.
5. Apply language functions and symbols used in PLC.
6. Translate relay logic to PLC logic.
7. Fabricate I/O configurations using serial and parallel.
8. Design simple programmable controller applications.
9. Program PLCs.
10. Install PLCs to replace relay systems.
11. Install PLCs to operate fluid power systems.
12. Plan a shutdown procedure for PLC-managed equipment.
13. Troubleshoot hardware faults using PLCs.
14. Identify PLC hardware.
15. Program the use of timers, counters, and sequencers in PLC applications.
16. Develop basic PLC wiring diagrams and ladder logic programs.
17. Troubleshoot PLC applications.

Internship: Ind Maint 470308

The internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the internship do not receive compensation.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1 – 3

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.

Introduction to 3D Printing Technology 332001

An introduction to additive rapid prototyping manufacturing (three-dimensional printing) and its applications in conjunction with computer technology, including hardware, software, three-dimensional printing technology, file management, internet, security, and computer intellectual property ethics. Presents basic use of applications, programming, systems and utility software.

Recommended Grade Level: 9

Recommended Credit: 1

Students will:

1. Describe, using appropriate terminology, the concepts and applications of 3D (three-dimensional) printing.
2. Demonstrate a basic understanding of various 3D (three-dimensional) printing materials, chemical/mechanical properties, and necessary equipment settings to process them.
3. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
4. Utilize computer and 3D (three-dimensional) printing-related technology as a tool to manage, manipulate, use and present information both in a virtual model and general form.
5. Discuss ethical and responsible computing and 3D (three-dimensional) printing issues, such as copyright, patent, intellectual property rights, privacy, dangers of use, sustainability, security and internet safety.
6. Demonstrate awareness of the use and impact of computers and 3D (three-dimensional) printers in different areas of business, education, the home, and the global realm.
7. Effectively use computer application programs and related graphical interfaces.
8. Describe how 3D (three-dimensional) printing and computer technology globalization impacts varying cultures, commerce, materialism, and business opportunities.
9. Transfer and share files and information using physical methods, networks, email, and cloud-based data storage systems.
10. Demonstrate a basic understanding and application of computer-based or mobile 3D (three-dimensional) imaging/scanning methods and equipment.
11. Locate and access relevant information sources found on networks such as the internet and be familiar with web browsers, search sources, sources of online help, and sources of information related to the field of study.
12. Demonstrate an awareness of different types of software applications and operating systems, as well as software distribution, upgrading, and cloud computing.
13. Perform common file-management functions effectively.
14. Search, access, and transfer files to and from websites dedicated to functioning as 3D (three-dimensional) printing model file repositories.
15. Effectively generate and manipulate 3D (three-dimensional) computer models using a variety of CAD (Computer-Aided Design) tools and techniques.

16. Demonstrate an understanding of foundational 3D (three-dimensional) printing and slicing features such as support material, rafts, brims, and skirts.
17. Skillfully create effective presentations, spreadsheets, and basic word processing documents.
18. Demonstrate an understanding of how continual growth in innovative reasoning, technological skills, and presentation impact personal economic opportunities as well as employability.
19. Identify how to maintain computer and 3D (three-dimensional) printing equipment and solve common hardware problems.

Maintaining Industrial Equipment 470318

This course is designed to introduce the student to maintenance techniques and procedures used to maintain industrial equipment.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe the care and safe use of maintenance tools, equipment and components, such as lock-out/tag-out, rigging, and electrical safety.
5. Describe lubrication techniques used on machines and components.
6. Identify various types of bearings and seals.
7. Explain the replacement procedure for bearings and seals.
8. Explain the alignment of couplings using straight edge and feeler gauge, dial indicator methods, and laser.
9. Explain the mounting and operation of centrifugal pumps and motors.
10. Explain the mounting and operation of speed reduction/speed increase assemblies.
11. Explain the mounting and operation of clutch and brake assemblies.
12. Identify common belts, such as V-Belt and timing.
13. Explain the tension and alignment of various belts.
14. Identify common types of chains, such as roller and silent.
15. Explain the tensioning and alignment of various chains.
16. Explain the alignment of sprockets and sheaves.
17. Explain the installation and adjustment variable of pitch sheaves.
18. Explain the common types of gears, such as spur and helical.
19. Describe the maintenance of open and closed gearing.
20. Explain the diametral pitch and gear meshing.
21. Explain vibration analysis in troubleshooting.
22. Identify various fasteners, keys, keyways, and bolts.
23. Explain set-up, lighting and using oxyfuel cutting equipment.
24. Perform lubrication techniques on machines and components.
25. Replace bearings and seals.
26. Align couplings using straight edge and feeler gauge, dial indicator methods, and laser.
27. Mount and operate centrifugal pumps and motors.
28. Mount and operate speed reduction/speed increase assemblies.
29. Mount and operate clutch and brake assemblies.
30. Adjust tension and alignment of various belts.
31. Adjust tension and alignment of various chains.
32. Align sprockets and sheaves.
33. Install and adjust pitch sheaves.

34. Maintain open and closed gearing.
35. Use vibration analysis in troubleshooting.
36. Perform straight line, piercing, and beveling with oxyfuel-cutting equipment.

Refrigeration Fundamentals (For Maintenance) 470349

The student is introduced to the fundamentals of refrigeration, refrigeration terms, and the basic refrigeration cycle. Proper use of tools, test equipment, and materials is stressed. Environmental issues, including refrigerant handling, are discussed. Refrigerant piping and methods used to join them are taught. General and specific safety are emphasized.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Explain the history of refrigeration.
5. Compare the benefits of a closed vs. open system.
6. Identify and explain the operation of the four major components.
7. Identify the high and low sides of the system.
8. Define matter and heat.
9. Distinguish between the three states of matter.
10. Explain the direction and rate of heat flow.
11. Describe the three methods of heat transfer.
12. Identify the reference points of temperature: boiling point, freezing point, critical temperature, and absolute zero.
13. Explain the difference between heat and temperature.
14. Explain the differences between latent and sensible heat.
15. Explain the relationship between pressures and fluids at different temperatures.
16. Calculate absolute and gauge pressures.
17. Measure absolute and gauge pressures.
18. Explain how fluids react in a closed vs. open system.
19. Compare temperature with pressure (P/T Chart).
20. Explain why fluids flow.
21. Define the properties of refrigerants.
22. Explain the uses of different refrigerants.
23. Identify color coding of refrigerant cylinders.
24. Explain classifications of refrigerants.
25. List proper transfer and storage of refrigerants.
26. Explain the four parts of the refrigeration cycle.
27. Draw a refrigeration system on a Pressure-Enthalpy (PH) chart.
28. Explain the benefits of superheat and subcooling.
29. Identify the effects of improper refrigerant in a system.
30. Identify basic tools and accessories: various screwdrivers, nutdrivers, socket wrenches, Allen (hex) wrenches, open- and box-end wrenches, and flare wrenches.
31. Identify power tools: general-purpose drill, power screwdriver, hammer drill,

reciprocating saw, and screw-gun.
32. Identify fasteners: bolts, screws, masonry anchors, various electrical connectors, conduit, pipe and cable clamps, and nails.
33. Identify pipe and tubing tools: pipe cutters, reamers and threaders, tubing cutters and reamers, benders, flaring tools, swaging tools, and pipe vises.
34. Describe lubrication methods utilizing grease guns, oilers, and sprays.
35. Measure pressures with the refrigeration gauge manifold.
36. Evacuate systems with a two-stage vacuum pump.
37. Measure vacuums with a thermistor vacuum gauge.
38. Measure temperatures with various thermometers.
39. Charge a system with an electronic charging scale.
40. Check for leaks with electronic leak detector dye and electrosonic.
41. Identify types of pipe and tubing used in refrigeration work.
42. Identify various types of fittings.
43. Describe methods of insulating pipe and tubing.
44. Identify soldering and brazing alloys used in HVACR.
45. Explain applications of soldering and brazing alloys.
46. Flare, swag, and bend copper tubing.
47. Identify types of torches.
48. Solder and braze copper tubing.
49. Cut and thread iron pipe.
50. Describe heat sink methods.
51. Describe heat exchange techniques.
52. Explain saturation temperature.
53. Determine the METD (Mean Effective Temperature Difference).
54. Check for and repair refrigerant leaks.
55. Measure temperatures with bimetal and glass stem thermometers.
56. Describe the applications of vibration eliminators.
57. Identify types of evaporators: bare tube, finned, plate, unit coolers, and chillers.
58. Explain the operation performance of a condenser.
59. Charge system with refrigerant on the liquid side as well as the suction side.
60. Test and adjust all operating and safety controls.
61. Replace filter driers.
62. Inspect electrical circuits for defective connections.
63. Repair defective connections.
64. Interpret wiring diagram.
65. Clean drain line.
66. Check all electrical components for voltage and current.
67. Check and/or change compressor oil.
68. Clean condenser coil surface—air-cooled and water-cooled.
69. Perform all aspects of preventive maintenance.

Robotics and Automation (For Maintenance) 470351

This course provides an introduction to the theory of robots, including terminology, components, and basic programming. It provides a theory of servo and non-servo robots. Topics include robot types, controllers, manipulators, basic robotic programming, and fluid power systems. It also provides a basic theory of flexible and computer-integrated manufacturing and control systems.

Prerequisite: Industrial Maintenance Electrical Motor Controls 470348

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Explain the set-up, repair, and maintenance of automatic machines.
5. Explain the set-up, repair, and maintenance of processing equipment.
6. Explain the set-up, repair, and maintenance of robots that work together as part of a total automated manufacturing system.
7. Develop cost/benefit analysis for automation.
8. Develop case studies for improving production, efficiency, and profitability.
9. Analyze, summarize, and interpret major factors in automation, including operator training, teamwork, resistance, and organized labor.
10. Analyze and develop safety strategies for automated systems.
11. Develop online and offline robot programs.
12. Describe components in the integrated manufacturing environment.
13. Demonstrate knowledge of robot terminology.
14. Read and understand technical manuals.
15. Explain how to perform preventive maintenance.
16. Identify and describe the functions of vision systems.
17. Describe open-loop and closed-loop control.
18. Demonstrate knowledge of servo and non-servo systems.
19. Demonstrate knowledge of robot classifications.
20. Define computer-integrated manufacturing (CIM) systems.
21. Develop a safety strategy for automated work cells to include risk assessment and risk reduction.
22. Demonstrate leadership skills.

Shielded Metal Arc Welding and Lab (For Maintenance) 470354

This course presents students with the identification, inspection, and maintenance of SMAW electrodes, principles of SMAW, and effects of variables on the SMAW process to weld plate and pipe, and metallurgy.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Identify, select, and store SMAW electrodes.
5. Apply principles of the SMAW process to cut and weld metals.
6. Apply the knowledge of the effects of variables on the SMAW process to weld plates and pipes.
7. Apply the knowledge of basic metallurgy to control the chemical, physical, and mechanical properties of carbon steel.
8. Use shop equipment and tools.

Shop Management 470301

This course introduces the basic principles of safe and efficient shop management. Inventory control, fiscal management, and customer relations are emphasized.

Recommended Grade Level: 10 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Maintain tools and equipment.
5. Develop customer relations skills.
6. Prepare work orders.
7. Maintain inventory.
8. Maintain service records.
9. Supervise personnel.
10. Prepare parts requisition.
11. Provide fiscal management.
12. Complete an incident report.

Special Topics - Industrial Maintenance Technology 470336

Special Topics is designed to enhance a student's understanding of problem-solving in industrial situations. It expands on the task lists that have already been taught to the student in previous industrial maintenance courses.

This course does not count toward concentrator or completer status.

Prerequisite: Consent of Instructor

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Complete selected tasks/problems as determined by the instructor.

Welding for Maintenance 470328

This course will provide basic instruction needed for students to weld using SMAW, MIG, TIG and Oxy-Fuel.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in maintenance.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe the selection, care, and storage of oxyfuel-cutting equipment.
5. Explain the identification, selection, and storage of SMAW electrodes.
6. Apply principles of the SMAW process to cutting welding metals.
7. Describe the setup and use of SMAW welders.
8. Explain the application of basic metallurgy principles to control the chemical, physical, and mechanical properties of carbon steel.
9. Explain the proper use of shop equipment and tools.
10. Explain the setup and use of MIG welders.
11. Explain the setup and use of TIG welders.

METAL FABRICATION COURSES

Co-op* I (Metal Fab) 480803

Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work. This course can be repeated.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Gain career awareness and the opportunity to test career choices.
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.
6. Earn funds to help finance education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Co-op* II (Metal Fab) 480804

Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 2

Students will:

1. Gain career awareness and the opportunity to test career choices.
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.
6. Earn funds to help finance education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Co-op* III (Metal Fab) 480805

Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 3

Students will:

1. Gain career awareness and the opportunity to test career choices.
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.
6. Earn funds to help finance education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Internship: Metal Fab 480806

Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the internship do not receive compensation.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1 – 3

Students will:

1. Gain career awareness and the opportunity to test career choices.
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.

Introduction to 3D Printing Technology 332001

An introduction to additive rapid prototyping manufacturing (three-dimensional printing) and its applications in conjunction with computer technology, including hardware, software, three-dimensional printing technology, file management, internet, security, and computer intellectual property ethics. Presents basic use of applications, programming, systems and utility software.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Describe, using appropriate terminology, the concepts and applications of 3D (three-dimensional) printing.
2. Demonstrate a basic understanding of various 3D (three-dimensional) printing materials, chemical/mechanical properties, and necessary equipment settings to process them.
3. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
4. Utilize computer and 3D (three-dimensional) printing-related technology as a tool to manage, manipulate, use and present information both in a virtual model and general form.
5. Discuss ethical and responsible computing and 3D (three-dimensional) printing issues, such as copyright, patent, intellectual property rights, privacy, dangers of use, sustainability, security and internet safety.
6. Demonstrate awareness of the use and impact of computers and 3D (three-dimensional) printers in different areas of business, education, the home, and the global realm.
7. Effectively use computer application programs and related graphical interfaces.
8. Describe how 3D (three-dimensional) printing and computer technology globalization impacts varying cultures, commerce, materialism, and business opportunities.
9. Transfer and share files and information using physical methods, networks, email, and cloud-based data storage systems.
10. Demonstrate a basic understanding and application of computer-based or mobile 3D (three-dimensional) imaging/scanning methods and equipment.
11. Locate and access relevant information sources found on networks such as the internet and be familiar with web browsers, search sources, sources of online help, and sources of information related to the field of study.
12. Demonstrate an awareness of different types of software applications and operating systems, as well as software distribution, upgrading, and cloud computing.
13. Perform common file-management functions effectively.
14. Search, access, and transfer files to and from websites dedicated to functioning as 3D (three-dimensional) printing model file repositories.
15. Effectively generate and manipulate 3D (three-dimensional) computer models using a variety of CAD (Computer-Aided Design) tools and techniques.
16. Demonstrate an understanding of foundational 3D (three-dimensional) printing and

slicing features such as support material, rafts, brims, and skirts.
17. Skillfully create effective presentations, spreadsheets, and basic word processing documents.
18. Demonstrate an understanding of how continual growth in innovative reasoning, technological skills, and presentation impact personal economic opportunities as well as employability.
19. Identify how to maintain computer and 3D (three-dimensional) printing equipment and solve common hardware problems.

Metal Trade Information and Metals 480816

A series of lectures and demonstrations of hand tools, the use of machinery in the shop, and various types of metal and their uses in the metal trade will be discussed.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Apply work site and lab safety procedures.
2. Apply personal safety rules and procedures.
3. Apply fire prevention rules and procedures.
4. Demonstrate hazardous communication procedures.
5. Describe and demonstrate universal precaution procedures.
6. Identify common sheet metal fabrication hand tools.
7. Demonstrate proper use of common sheet metal fabrication hand tools.
8. Obtain First Aid certification.
9. Obtain CPR certification.
10. Use and care for tools and equipment.
11. Select appropriate sheet metal gauges.
12. Select specified types of sheet metals.

Parallel Line Layout 480813

This course introduces the parallel line method of developing the pattern for an object. In addition, this course presents basic applied math, lines, multi-view drawings, symbols, various schematics and diagrams, dimensioning techniques, sectional views, auxiliary views, and sketching typical of sheet metal drawings. Safety will be emphasized as an integral part of the course.

Prerequisite: Metal Trade Information and Metals 480816

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Identify the purposes for parallel line layout.
2. Identify parts fabricated with parallel line layout methods.
3. Use the parallel line method to lay out sheet metal patterns.
4. Identify hand tools required for parallel line layout development.
5. Measure sheet metal to determine the available space for assembly pattern.
6. Select the appropriate sheet metal gauge.
7. Form sheet metal assemblies with bench stakes and mallets.
8. Introduction and math review (fractions and decimals).
9. Identify line types used in combinations.
10. Identify multiple views.
11. Arrange multiple views.
12. Demonstrate visualizing techniques of multiple views.
13. Identify one-view drawing.
14. Arrange and identify auxiliary views.
15. Demonstrate the use of size and location dimensions.
16. Identify standard listings on working drawings.
17. Size dimensions of holes and angles.
18. Locate dimensions for centering of holes, points, and centers.
19. Identify half, full, and removed sections.
20. Identify usages for chamfers and interpret sizes.
21. Sketch oblique views of various parts.
22. Sketch and dimension shop drawings.

Radial Line Development 480814

Radial line development uses many of the procedures of parallel line development and triangulation. The student will learn to develop patterns from any centered, round or square taper using the radial line method.

Prerequisite: Parallel Line Layout 480813

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Apply safety rules and procedures.
2. Use and care for tools and equipment.
3. Interpret building trades blueprints.
4. Measure sheet metal to determine the available space for assembly pattern.
5. Use the radial line method to lay out sheet metal patterns.
6. Select sheet metal gauges for patterns.
7. Cut sheet metal with aviation snips.
8. Cut sheet metal with straight snips.
9. Fabricate residential and commercial heating and air conditioning ductwork.

Sheet Metal I – A 480817

This course introduces the student to interpreting drawings of plans for a duct system and learning how to fabricate the ducts.

Prerequisite: Parallel Line Layout 480813

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Measure sheet metal to determine available space for assembly patterns.
2. Use the radial line method to lay out sheet metal patterns.
3. Use the triangular method to lay out sheet metal patterns.
4. Use the parallel line method to lay out sheet metal patterns.
5. Select sheet metal gauges for patterns.
6. Select types of sheet metals.
7. Cut sheet metal layouts with aviation snips.
8. Cut sheet metal layouts with bulldog snips.
9. Cut sheet metal layouts with circular snips.
10. Cut sheet metal layouts with combination snips.
11. Cut sheet metal layouts with double-cut snips.
12. Cut sheet metal layouts with straight snips.
13. Store tools.
14. Cut sheet metal with hand notchers.
15. Cut sheet metal with combination notchers.
16. Cut sheet metal with squaring shears.
17. Cut sheet metal with universal metal cutters.
18. Bend sheet metal with hand seamers.
19. Form sheet metal assemblies with blow horn stakes and mallets.
20. Form sheet metal assemblies with conductor stakes and mallets.
21. Form sheet metal assemblies with common squares and mallets.
22. Form sheet metal assemblies with creasing stakes and mallets.
23. Form sheet metal with the slip-roll to create a cylindrical shape.
24. Form single and double hems on sheet metal layouts with brake.
25. Turn the edges of sheet metal elbow assemblies with an elbow edging machine.
26. Form sheet metal assemblies with hollow mandrel stakes and mallets.
27. Form sheet metal assemblies with mandrel stakes and mallets.
28. Form sheet metal assemblies with needle case stakes and mallets.
29. Fabricate residential and commercial heating and air conditioning ductwork.
30. Cut sheet metal layouts with do-all saws.
31. Cut sheet metal layouts with hacksaws.

Sheet Metal I – B 480818

This course provides advanced training in designing and interpreting plans for a duct system and advanced fabrication of duct systems and precision sheet metal concepts.

Prerequisite: Sheet Metal I – A 480817

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Measure sheet metal to determine available space for assembly patterns.
2. Use the radial line method to lay out sheet metal patterns.
3. Use the triangular method to lay out sheet metal patterns.
4. Use the parallel line method to lay out sheet metal patterns.
5. Select sheet metal gauges for patterns.
6. Select types of sheet metals.
7. Cut sheet metal layouts with aviation snips.
8. Cut sheet metal layouts with bulldog snips.
9. Cut sheet metal layouts with circular snips.
10. Cut sheet metal layouts with combination snips.
11. Cut sheet metal layouts with double-cut snips.
12. Cut sheet metal layouts with straight snips.
13. Store tools.
14. Make advanced sheet metal cuts with hand notchers.
15. Make advanced sheet metal cuts with combination notchers.
16. Make advanced sheet metal cuts with squaring shears.
17. Make advanced sheet metal cuts with universal metal cutters.
18. Make advanced sheet metal bends with hand seamers.
19. Form sheet metal assemblies with blow horn stakes and mallets.
20. Form sheet metal assemblies with conductor stakes and mallets.
21. Form sheet metal assemblies with common squares and mallets.
22. Form sheet metal assemblies with creasing stakes and mallets.
23. Form sheet metal with the slip-roll to create a cylindrical shape.
24. Form single and double hems on sheet metal layouts with brake.
25. Make advanced sheet metal turned edges or elbow assemblies with an elbow edging machine.
26. Form advanced sheet metal assemblies with hollow mandrel stakes and mallets.
27. Form advanced sheet metal assemblies with mandrel stakes and mallets.
28. Form advanced sheet metal assemblies with needle case stakes and mallets.
29. Fabricate advanced residential and commercial heating and air conditioning ductwork.
30. Glue insulation to the exterior and interior surfaces.
31. Install heating, ventilation, and air conditioning ducts.
32. Cut advanced sheet metal layouts with do-all saws.
33. Cut advanced sheet metal layouts with hacksaws.
34. Cut advanced sheet metal layouts with hawk-billed snips.

35. Identify capacities for the English Wheel.
36. Shape sheet metal parts with the English Wheel.
37. Smooth sheet metal parts with the English Wheel.
38. Shape sheet metal parts with the Shot Bag and Mallet.

Sheet Metal II – A 480819

This course provides a series of lectures to improve skills in pattern development and the fabrication of more difficult fittings.

Prerequisite: Sheet Metal I – B 480818

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Apply safety rules and procedures.
2. Use and care for tools and equipment.
3. Interpret building trade blueprints.
4. Draw sheet metal assemblies.
5. Use the radial line method to lay out sheet metal patterns.
6. Use the triangular method to lay out sheet metal patterns.
7. Use the parallel line method to lay out sheet metal patterns.
8. Select sheet metal gauges for patterns.
9. Cut sheet metal with aviation snips.
10. Cut sheet metal with straight snips.
11. Cut sheet metal with squaring shears.
12. Turn the edges of sheet metal elbow assemblies with an elbow-turning machine.
13. Fabricate residential and commercial heating and air conditioning ductwork.
14. Install heating, ventilation, and air conditioning ducts.
15. Install machine guards and assemblies.
16. Use signed numbers.
17. Apply algebraic symbols and terms.
18. Solve simple equations.
19. Solve problems in work-related situations and distinguish between direct and indirect relationships.
20. Perform and apply surface measurement calculations.
21. Use exponents and radicals.

Sheet Metal II – B 480820

This course provides a series of advanced lectures to improve skills in advanced pattern development and fabrication of complicated fittings.

Prerequisite: Sheet Metal II – A 480819

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Apply safety rules and procedures.
2. Use and care for tools and equipment.
3. Interpret building trade blueprints.
4. Draw advanced sheet metal assemblies.
5. Use the radial line method to lay out advanced sheet metal patterns.
6. Use the triangular method to lay out advanced sheet metal patterns.
7. Use the parallel line method to lay out advanced sheet metal patterns.
8. Select sheet metal gauges for patterns.
9. Cut sheet metal with aviation snips.
10. Cut sheet metal with straight snips.
11. Cut sheet metal with squaring shears.
12. Turn complicated edges of sheet metal elbow assemblies with an elbow-turning machine.
13. Fabricate complicated residential and commercial heating and air conditioning ductwork.
14. Install heating, ventilation, and air conditioning ducts.
15. Install machine guards and assemblies.
16. Cut sheet metal parts on the power shear.
17. Use mechanical and computerized shear gauges.
18. Cut sheet metal products on the band saw.
19. Use die applications on the power brake.
20. Perform alignment and die setting of the power brake.
21. Be introduced to MIG welding.
22. Use CNC Controlled Punch Press.
23. Program CNC Controlled Punch Press.

Special Projects I (Metal Fab) 480879

This is a course designed for the student who has demonstrated specific special needs. This course does not count toward concentrator or completer status.

Prerequisite: Radial Line Development 480814

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Apply work site and lab safety procedures.
2. Describe and apply the problem-solving processes independently or in teams to sheet metal fabrication projects.

WELDING TECHNOLOGY COURSES

Basic Blueprint Reading 499920

This course presents basic applied math, lines, multi-view drawings, symbols, various schematics and diagrams, dimensioning techniques, sectional views, auxiliary views, threads and fasteners, and sketching typical to all shop drawings. Safety will be emphasized as an integral part of the course.

Recommended Grade Level: 9 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Review math concepts (fractions and decimals).
5. Identify the alphabet of lines.
6. Identify multiple views.
7. Arrange multiple views.
8. Arrange two-view drawings.
9. Identify one-view drawings.
10. Arrange and identify auxiliary views.
11. Demonstrate and use the size and location dimensions.
12. Demonstrate proper dimensions of cylinders and arcs.
13. Size dimensions of holes and angles.
14. Locate dimensions for centering of holes, points, and centers.
15. Interpret the baseline dimensions on drawings.
16. Identify half, full, and removed sections.
17. Identify electrical schematic and diagram symbols.
18. Identify welding symbols and equipment.
19. Interpret ordinate and tabular dimensions.
20. Set tolerances using geometric dimensioning techniques.
21. Sketch parts with irregular shapes.
22. Sketch oblique views of various parts.
23. Sketch and dimension shop drawings.
24. Dimension parts using shop notes.
25. Calculate tolerances.
26. Identify labeling of various screw threads.
27. Calculate tapers and machined surfaces.
28. Interpret connections and flow of various electrical, hydraulic, and pneumatic schematics and diagrams.

Basic Welding and Lab 480524

Students are introduced to welding, cutting processes, and related equipment. Basic setup, operation, and related safety are applied.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Set up and operate various welding and cutting equipment.

Blueprint Reading for Welding 480505

This course provides a study of occupationally specific prints for welders. Advanced study of multi-view drawings, assembly drawings, datum dimensions, numerical control drawings, sheet metal prints, castings and forgings, instrumentation and control charts, diagrams, working drawings, geometric dimensioning, tolerance, and use of reference materials and books are included. Occupational specifics, including welding drawings, symbols, joint types, grooves, pipe welding symbols, testing symbols, and specification interpretations, are stressed.

Prerequisite: Consent of Instructor

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Interpret lines.
5. Interpret views to include AWS and ISO symbols when needed.
6. Interpret conventional and datum line dimensions.
7. Interpret and apply tolerances.
8. Interpret section lines.
9. Interpret sectioning.
10. Interpret and apply American Welding Society welding symbols.
11. Interpret and apply International Standard welding symbols.
12. Draw shop sketches.
13. Interpret various types of prints, including fabrication, repair, structural steel, and piping prints.
14. Read and interpret blueprints.
15. Complete projects from prints.
16. Practice controlling distortion.
17. Practice repairing distortion.

Co-op* I (Welding) 480541

Co-op provides supervised on-the-job work experience related to educational objectives. Students participating in the Cooperative Education program receive compensation for their work. This course can be repeated.

Prerequisite: Consent of Instructor

Recommended Grade Level: 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.
9. Earn funds to help finance education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Cutting Processes and Lab 480501

Students will obtain a working knowledge of various cutting processes used by the welding industry. Skills will include but are not limited to safety, theory of operation, setup and operating techniques, troubleshooting, making minor equipment repairs, terms and definitions, identification, evaluation, and repair and prevention of discontinuities of cut surfaces. Also included are oxyfuel cutting, plasma arc cutting, exothermic cutting, air carbon arc cutting, shielded metal arc cutting, and mechanical cutting processes.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Practice cutting processes safety procedures.
5. Discuss the welding theories of operation.
6. Discuss setup and operating techniques.
7. Apply principles of troubleshooting and making minor equipment repairs.
8. Identify, evaluate, repair, and prevent reoccurrence of discontinuities of cut surfaces.

Gas Metal Arc Welding and Lab 480522

This course covers the identification, inspection, and maintenance of GMAW machines; identification, selection and storage of GMAW electrodes; principles of GMAW; and the effects of variables on the GMAW process. Theory and applications of related processes such as FCAW, SMAW, and metallurgy are also included. Students learn the practical application and manipulative skills of Gas Metal Arc Welding and the proper safety situations needed in this process. Both ferrous and non-ferrous metals will be covered, as well as various joint designs on plates in all positions.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with integrity, responsibility, quality, discipline and teamwork.
4. Use lab equipment and tools.
5. Apply principles of GMAW to weld metals, including FCAW and SMAW.
6. Apply knowledge of the effects of variables of GMAW to weld plate and pipe.
7. Apply knowledge of basic metallurgy to control chemical, physical, and mechanical properties of alloy steels.
8. Identify and select filler materials for GMAW processes.
9. Weld fillet welds in all positions using various transfer modes on steel, stainless steel, and aluminum.

Additional content is optional for all pathways but **must** be taught for students in Welding TRACK CIP 48.0508.99

1. Interpret and apply tolerances.
2. Interpret and apply American Welding Society welding symbols.
3. Draw shop sketches.
4. Read and interpret blueprints.
5. Interpret lines.
6. Interpret views to include AWS (ISO symbols optional).
7. Interpret conventional and datum line dimensions.
8. Interpret and apply tolerances.
9. Interpret sectioning and section lines.
10. Apply principles of oxy-fuel systems to cut, weld, braze, and braze-weld with oxy-fuel.
11. Apply principles of controlling distortion.
12. Set up components of oxy-fuel equipment and set up procedures.
13. Apply oxyfuel-cutting applications and procedures.
14. Apply oxy-fuel welding applications and procedures.
15. Apply brazing and braze welding principles and applications.

Gas Tungsten Arc Welding and Lab 480525

This course covers identification, inspection, and maintenance of GTAW machines; identification, selection and storage of GTAW electrodes; principles of GTAW; effects of variables on the GTAW process; and metallurgy. This course also teaches the theory and application of Plasma Arc Cutting.

Recommended Grade Level: 10 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Use lab equipment and tools.
5. Apply principles of GTAW to weld metals.
6. Set up GTAW systems.
7. Apply knowledge of the effects of variables to weld plates and pipes.
8. Apply knowledge of basic metallurgy to control chemical, physical, and mechanical characteristics of non-ferrous metals.
9. Identify and select GTAW electrodes.
10. Identify and select GTAW fill rods.
11. Clean metals with solvent or cleaning fluids.
12. Set up and operate plasma arc-cutting equipment.

Gas Tungsten Arc Welding Pipe Lab A 480538

Students learn the method of operation and application of the Gas Tungsten Arc Welding system for welding both ferrous and non-ferrous pipes in 2G and 5G positions.

Prerequisite: GTAW Groove Lab 480530 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on Integrity, responsibility, quality, discipline and teamwork.
4. Weld pipe (GTAW).

GMAW Aluminum Lab 480534

Students learn to weld aluminum using the GMAW process. Fillet and groove welds are made in all positions on both plate and pipe. Short-circuiting and spray transfers are used where appropriate.

Prerequisite: Gas Metal Arc Welding and Lab 480522 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Weld fillet and groove welds on an aluminum plate in all positions using GMAW-S.
5. Weld fillet and groove welds on an aluminum plate in all positions using spray transfer GMAW.
6. Weld fillet and groove welds on aluminum pipe in all positions.

GMAW Groove Lab 480533

Students learn the method of operation and application of the Gas Metal Arc Welding process for welding groove welds in both ferrous and non-ferrous plates in all positions using both short circuiting and spray transfer where appropriate.

Prerequisite: Gas Metal Arc Welding and Lab 480522 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Weld groove welds on ferrous and non-ferrous plates in all positions with short-circuiting and spray transfer where appropriate.

GMAW Pipe Lab A 480540

This course acquaints the student with the operation and application of the Gas Metal Arc System for welding pipe in 2G and 5G positions.

Prerequisite: GMAW Groove Lab 480533 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Weld pipe in 2G and 5G (GMAW).

GTAW Groove Lab 480530

Students learn the method of operation and application of the Gas Tungsten Arc Welding process for welding groove welds in both ferrous and non-ferrous plates in all positions.

Prerequisite: Gas Tungsten Arc Welding and Lab 480525 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Weld groove welds in ferrous and non-ferrous plates in all positions.

Internship (Welding) 480544

The internship provides supervised on-the-job work experience related to the student's education objectives. Students participating in the practicum do not receive compensation.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1 – 3

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests prior to graduation.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential after graduation.

Introduction to 3D Printing Technology 332001

An introduction to additive rapid prototyping manufacturing (three-dimensional printing) and its applications in conjunction with computer technology, including hardware, software, three-dimensional printing technology, file management, internet, security, and computer intellectual property ethics. Presents basic use of applications, programming, systems and utility software.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Describe, using appropriate terminology, the concepts and applications of 3D (three-dimensional) printing.
2. Demonstrate a basic understanding of various 3D (three-dimensional) printing materials, chemical/mechanical properties, and necessary equipment settings to process them.
3. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
4. Utilize computer and 3D (three-dimensional) printing-related technology as a tool to manage, manipulate, use and present information both in a virtual model and general form.
5. Discuss ethical and responsible computing and 3D (three-dimensional) printing issues, such as copyright, patent, intellectual property rights, privacy, dangers of use, sustainability, security and internet safety.
6. Demonstrate awareness of the use and impact of computers and 3D (three-dimensional) printers in different areas of business, education, the home, and the global realm.
7. Effectively use computer application programs and related graphical interfaces.
8. Describe how 3D (three-dimensional) printing and computer technology globalization impacts varying cultures, commerce, materialism, and business opportunities.
9. Transfer and share files and information using physical methods, networks, email, and cloud-based data storage systems.
10. Demonstrate a basic understanding and application of computer-based or mobile 3D (three-dimensional) imaging/scanning methods and equipment.
11. Locate and access relevant information sources found on networks such as the internet and be familiar with web browsers, search sources, sources of online help, and sources of information related to the field of study.
12. Demonstrate an awareness of different types of software applications and operating systems, as well as software distribution, upgrading, and cloud computing.
13. Perform common file-management functions effectively.
14. Search, access, and transfer files to and from websites dedicated to functioning as 3D (three-dimensional) printing model file repositories.
15. Effectively generate and manipulate 3D (three-dimensional) computer models using a variety of CAD (Computer-Aided Design) tools and techniques.

16. Demonstrate an understanding of foundational 3D (three-dimensional) printing and slicing features such as support material, rafts, brims, and skirts.
17. Skillfully create effective presentations, spreadsheets, and basic word processing documents.
18. Demonstrate an understanding of how continual growth in innovative reasoning, technological skills, and presentation impact personal economic opportunities as well as employability.
19. Identify how to maintain computer and 3D (three-dimensional) printing equipment and solve common hardware problems.

Oxy-Fuel Systems and Lab 480523

This course provides a working knowledge of oxy-fuel identification, setup, inspection, and maintenance; consumable identification, selection and care; principles of operation; and effects of variables for manual and mechanized oxy-fuel cutting, welding, brazing principles and practice, and metallurgy. Shop safety and equipment use are also covered.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 - 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Practice oxy-fuel welding safety procedures.
5. Use shop equipment and tools.
6. Apply principles of oxy-fuel systems to cut, weld, braze, and braze-weld with oxy-fuel.
7. Apply principles of controlling distortion.
8. Set up components of oxy-fuel equipment and set up procedures.
9. Apply oxyfuel-cutting applications and procedures.
10. Apply oxy-fuel welding applications and procedures.
11. Apply brazing and braze welding principles and applications.

Shielded Metal Arc Welding (SMAW) and Lab 480521

Students learn the identification, inspection, and maintenance of SMAW electrodes, the principles of SMAW, the effects of variables on the SMAW process to weld plate and pipe, and metallurgy.

Recommended Grade Level: 9 – 12

Recommended Credit: .5 – 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with integrity, responsibility, quality, discipline and teamwork.
4. Identify, select, and store SMAW electrodes.
5. Apply principles of the SMAW process to cut and weld metals.
6. Apply the knowledge of the effects of variables on the SMAW process to weld plates and pipes.
7. Apply the knowledge of basic metallurgy to control the chemical, physical, and mechanical properties of carbon steel.
8. Use shop equipment and tools.

Additional content is optional for all pathways but **must** be taught for students in Welding TRACK CIP 48.0508.99

1. Interpret and apply tolerances.
2. Interpret and apply American Welding Society welding symbols.
3. Draw shop sketches.
4. Read and interpret blueprints.
5. Interpret lines.
6. Interpret views to include AWS (ISO symbols optional).
7. Interpret conventional and datum line dimensions.
8. Interpret and apply tolerances.
9. Interpret sectioning and section lines.
10. Apply principles of oxy-fuel systems to cut, weld, braze, and braze-weld with oxy-fuel.
11. Apply principles of controlling distortion.
12. Set up components of oxy-fuel equipment and set up procedures.
13. Apply oxyfuel-cutting applications and procedures.
14. Apply oxy-fuel welding applications and procedures.
15. Apply brazing and braze welding principles and applications.

Shielded Metal Arc Welding Pipe Lab A 480536

Students will learn the required manipulative skills to arc weld pipes using mild steel electrodes in the 2G and 5G positions, including proper pipe preparations, electrodes, safety precautions, and welding sequences. Fillet welds on pipe joints are also included in 2F, 2FR, 4F, and 5F positions.

Prerequisite: SMAW Open Groove Lab 480535

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Use lab equipment and tools.
5. Apply principles of SMAW.

Shielded Metal Arc Welding Pipe Lab B 480537

Students will learn the required manipulative skills to arc weld pipes using mild steel electrodes in the 6G position, including proper pipe preparations, electrodes, safety precautions, and welding sequences.

Prerequisite: SMAW Open Groove Lab 480535

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Weld pipe (SMAW).

SMAW Groove Welds with Backing Lab 480528

Students will acquire the manipulative skills to do groove welds in all positions with backing.

Prerequisite: Shielded Metal Arc Welding (SMAW) and Lab 480521 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Weld SMAW groove welds in all positions.

SMAW Open Groove Lab 480535

This course offers the student the opportunity to advance skills in the practical aspects of vee-butt plate welding using SMAW.

Prerequisite: Shielded Metal Arc Welding (SMAW) and Lab 480521 **OR** Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Apply principles of SMAW to welding.
5. Perform skills in vee-butt plate welding.

Special Problems (Welding) 480595

This is a course designed for the student who has demonstrated specific needs. This course does not count toward concentrator or completer status.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Complete selected tasks/problems as determined by the instructor.

Welding Certification 480507

Students will gain a working knowledge of certification encountered in welding. The student will start with developing a WPS, qualify the WPS, and qualified personnel. Documents used in welding certification are developed and used.

This course does not count toward concentrator or completer status.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities in welding.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Apply destructive and non-destructive testing methods.
5. Apply knowledge of procedure qualification.
6. Apply knowledge of performance qualification.
7. Apply knowledge of welding codes.
8. Apply knowledge of welding standards.
9. Apply knowledge of welding specifications.

WOOD MANUFACTURING COURSES

Advanced Wood Processing 480733

This course is an experience for advanced wood processing technicians involving the integration of computer-aided design and world-class manufacturing of wood products.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Identify the basic parts of a CNC machining center.
5. Describe the career opportunities and job titles in CNC.
6. Identify the tasks that must be done to put a job into production.
7. Describe the tasks in the CNC process.
8. Identify standard and auxiliary axes on routers and boring machines using the “Right Hand Rule.”
9. Describe the characteristics of and differences between position and reference points.
10. Calculate coordinate points using absolute Cartesian values.
11. Calculate coordinate points using incremental Cartesian values.
12. Locate and select coordinate values for reference points.
13. Identify data storage media in CNC.
14. Identify the components of a CNC system.
15. List the special features of CNC.
16. Select the tooling for a CNC job.
17. Select and use appropriate holding tools.
18. Perform routine maintenance.
19. Load code into the control of CNC machining center.
20. Align and coordinate the machine and tools.
21. Enter tool offsets and cutter geometry.
22. Test and run a program.
23. Write an operator setup document.
24. Select speeds and feeds for the type of tool and material to be machined.
25. Plan an efficient and safe program with good sequencing.
26. Identify proprietary differences in “G” and “M” codes.
27. Use the basic coded words in the program.

Cabinet Making Technology 480731

This course is an overview of the cabinet and store fixture industries. Emphasis will be placed on the design and construction of face frames as well as frameless (32mm) systems. Students will plan and build a vanity, kitchen cabinet, or shop project that utilizes contemporary casework techniques.

Prerequisites: Technical Drawing and Blueprint Reading 480719 **AND** Wood Product Manufacturing 480740

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Produce working drawings for a typical set of kitchen cabinets, both manually and with the aid of computer software.
5. Produce a cutting list needed to build a set of cabinets.
6. Demonstrate an understanding of both face and frame and 32mm systems of cabinet construction.
7. Identify standardized cabinet dimensions.
8. Differentiate between custom cabinetry and modular/mass-produced cabinetry.
9. Compare the cost of manufacturing components (doors and drawers) vs. outsourcing.
10. Identify trade associations for the cabinet and store fixture industries and review standards and certification programs.
11. Manufacture a countertop using high-pressure decorative laminate.
12. Fabricate a typical cabinetry project.
13. Install a typical base and wall cabinet.
14. Solve first-degree algebra equations.
15. Apply algebraic knowledge to solve verbal problems and formulas.
16. Solve simple plan and solid geometry problems.
17. Prepare a surface/product for the finishing process.
18. Identify the factors associated with the finish quality of a wood product.
19. Differentiate between paints, varnish, lacquer, shellac, polyurethane, conversion varnish, and water-based products.
20. Demonstrate contemporary application techniques for both oil-based and water-based products.
21. Explain the theory and operation of various coating technologies.
22. Disassemble, re-assemble, and adjust a conventional spray gun.
23. Develop a finishing schedule for a variety of finishing materials applied to a variety of substrates.
24. Describe EPA and OSHA regulations as they pertain to the finishing industry.
25. Evaluate and specify drying equipment, fluid handling equipment, and exhaust/filtering systems.
26. Perform standardized tests on finished surfaces to determine durability.

CAD for Wood Technology 480725

This course is designed for the fundamental principles and capabilities of CAD, basic drafting conventions and operations that are relative to the Wood Manufacturing Industry.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Produce line entities using various coordinate techniques.
5. Construct geometric shapes in two-dimensional space.
6. Develop detailed orthographic views as required.
7. Construct cross sections of various designs, with cross-hatching incorporated as desired.
8. Apply dimensions and annotations to drawings.
9. Move, copy, delete, and save drawings or portions of drawings.
10. Explore 3-D drawing techniques.

Co-op* I (Wood) 480741

Co-op provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work. This course can be repeated.

Prerequisite: Consent of Instructor

Recommended Grade Level: 11 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential.
9. Earn funds to help with education expenses.

* Co-op can only be taken after the first four credits are earned, OR along with another course in the pathway, OR if the student is enrolled in an approved pre-apprenticeship program.

Furniture Technology 480721

Furniture design principles, structural consideration, joinery, fasteners, veneering, and the use of specialized machines for complex operations are the focus of this course. Students will plan and build a piece of furniture that includes at least one drawer, a door and some veneering.

Prerequisites: Technical Drawing and Blueprint Reading 480719 **AND** Wood Product Manufacturing 480740

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Analyze a piece of furniture for “good design” qualities.
5. Interpret working drawings and visualize the construction techniques.
6. Design a furniture project that allows for expansion and contraction of the wood using solid wood, plywood, veneer, or frame and panel construction techniques.
7. Identify, evaluate and specify traditional and contemporary construction techniques.
8. Calculate machine rates, set-up times, yields, and other production control elements.
9. Set up and operate industrial woodworking equipment to perform common operations.
10. Evaluate a given production problem, formulate a plan of action and execute the plan to a satisfactory conclusion.
11. Develop skills related to the efficient operation of a rough mill, machine room, and assembly area.
12. Fabricate a piece of furniture that lends itself to specified production techniques.
13. Identify equipment capabilities and determine the sequencing of operations.
14. Solve first-degree algebra equations.
15. Apply algebraic knowledge to solve verbal problems and formulas.
16. Solve simple plane and solid geometry problems.
17. Prepare a surface/product for the finishing process.
18. Identify the factors associated with the finish quality of a wood product.
19. Differentiate between paints, varnish, lacquer, shellac, polyurethane, conversion varnish, and water-based products.
20. Demonstrate contemporary application techniques for both oil-based and water-based products.
21. Explain the theory and operation of various coating technologies.
22. Disassemble, re-assemble, and adjust a conventional spray gun.
23. Develop a finishing schedule for a variety of finishing materials applied to a variety of substrates.
24. Describe EPA and OSHA regulations as they pertain to the finishing industry.
25. Evaluate and specify drying equipment, fluid handling equipment, and exhaust/filtering systems.
26. Perform standardized tests on finished surfaces to determine durability.

Internship (Wood) 480744

Internship provides supervised on-the-job experience related to the student's educational objectives. Students participating in an internship do not receive compensation.

Prerequisite: Consent of Instructor

Recommended Grade Level: 10 – 12

Recommended Credit: 1 – 3

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Gain career awareness and the opportunity to test career choices.
5. Receive work experience related to career interests.
6. Integrate classroom studies with work experience.
7. Receive exposure to facilities and equipment unavailable in a classroom setting.
8. Increase employability potential.

Introduction to 3D Printing Technology 332001

An introduction to additive rapid prototyping manufacturing (three-dimensional printing) and its applications in conjunction with computer technology, including hardware, software, three-dimensional printing technology, file management, internet, security, and computer intellectual property ethics. Presents basic use of applications, programming, systems and utility software.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Describe, using appropriate terminology, the concepts and applications of 3D (three-dimensional) printing.
2. Demonstrate a basic understanding of various 3D (three-dimensional) printing materials, chemical/mechanical properties, and necessary equipment settings to process them.
3. Describe, using correct computer terminology, basic computer functions, uses of computers in society, and different types of software.
4. Utilize computer and 3D (three-dimensional) printing-related technology as a tool to manage, manipulate, use and present information both in a virtual model and general form.
5. Discuss ethical and responsible computing and 3D (three-dimensional) printing issues, such as copyright, patent, intellectual property rights, privacy, dangers of use, sustainability, security and internet safety.
6. Demonstrate awareness of the use and impact of computers and 3D (three-dimensional) printers in different areas of business, education, the home, and the global realm.
7. Effectively use computer application programs and related graphical interfaces.
8. Describe how 3D (three-dimensional) printing and computer technology globalization impacts varying cultures, commerce, materialism, and business opportunities.
9. Transfer and share files and information using physical methods, networks, email, and cloud-based data storage systems.
10. Demonstrate a basic understanding and application of computer-based or mobile 3D (three-dimensional) imaging/scanning methods and equipment.
11. Locate and access relevant information sources found on networks such as the internet and be familiar with web browsers, search sources, sources of online help, and sources of information related to the field of study.
12. Demonstrate an awareness of different types of software applications and operating systems, as well as software distribution, upgrading, and cloud computing.
13. Perform common file-management functions effectively.
14. Search, access, and transfer files to and from websites dedicated to functioning as 3D (three-dimensional) printing model file repositories.
15. Effectively generate and manipulate 3D (three-dimensional) computer models using a variety of CAD (Computer-Aided Design) tools and techniques.
16. Demonstrate an understanding of foundational 3D (three-dimensional) printing and

slicing features such as support material, rafts, brims, and skirts.
17. Skillfully create effective presentations, spreadsheets, and basic word processing documents.
18. Demonstrate an understanding of how continual growth in innovative reasoning, technological skills, and presentation impact personal economic opportunities as well as employability.
19. Identify how to maintain computer and 3D (three-dimensional) printing equipment and solve common hardware problems.

Introduction to Computer-Aided Drafting 480110

This course uses a computer graphic workstation in the application of fundamental principles and capabilities of CAD, basic drafting conventions, and operations. An in-depth study of computer-aided drafting commands, terminology, command utilization, and skill development will be included.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Describe, using correct computer terminology, basic computer functions, uses of computers in society and different types of software.
5. Discuss ethical computing issues, such as copyright, privacy, security, and property.
6. Use graphical user interface.
7. Use computer application programs.
8. Access information sources found on networks such as the internet and gain experience with web browsers, search sources, and sources of information related to their field.
9. Demonstrate an awareness of different types of software applications.
10. Produce line entities using various coordinate techniques.
11. Construct geometric shapes in two-dimensional space.
12. Develop detailed orthographic views as required.
13. Construct cross sections of various designs, with cross-hatching incorporated as desired.
14. Apply dimensions and annotations to drawings.
15. Move, copy, delete, and save drawings or portions of drawings.
16. Use CAD to manipulate drawings by means of translation, rotation, scaling, zooming, panning, and windowing.
17. Explore 3-D drawing techniques.

Introduction to Panel Processing 480711

This course provides an overview of the terminology, materials, processing equipment and related software utilized by panel processing manufacturers of residential and commercial casework. Emphasis will be placed on the design and fabrication of frameless cabinetry with the use of panel saws, edge banders, CNC boring equipment, and case clamps.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Identify commercial and residential applications for panel materials.
5. Explain industry trends and panel processing equipment capabilities and techniques.
6. Identify, evaluate, and specify joinery and assembly techniques.
7. Operate various types of software for designing, cutting, and optimization for efficient use of panel goods.
8. Specify the quality and quantity of materials required to fabricate frameless casework.
9. Properly layout component panels utilizing the 32mm system.
10. Set up and operate common panel processing equipment including a panel saw, edge bander, boring machine, and case clamp in a cellular manufacturing environment.
11. Generate basic machine codes and programs for running machine centers.
12. Fabricate a typical frameless piece of casework.
13. Develop and perform routine preventive maintenance on the panel saw edge bander, boring machine, and the case clamp.
14. Develop an understanding of the different tooling requirements while working on various panel products.
15. Apply work site and lab safety procedures.
16. Apply personal safety rules and procedures.
17. Apply fire prevention rules and procedures.
18. Apply first aid procedures.
19. Explain how to obtain first aid certification.
20. Demonstrate hazardous communication procedures.
21. Describe and demonstrate universal precaution procedures.
22. Solve first-degree algebra equations.
23. Apply algebraic knowledge to solve verbal problems and formulas.
24. Solve simple plane and solid geometry problems.

Lumber Grading and Drying 480716

This course prepares an individual to master the National Hardwood Lumber Association's rules for grading hardwoods and to apply those rules in a production setting. Students will identify species and use a deductive process to grade the lumber and assign it a monetary value. Students will also be introduced to hardwood lumber drying systems. Conventional dry kilns, dehumidification, vacuum, and solar kilns are illustrated. Current theories on drying lumber to minimize defects and increase quality are demonstrated. Computer controls are explained.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Use First Aid and perform CPR.
5. Describe basic lumber economics.
6. Identify woods by physical characteristics.
7. Describe career opportunities in the wood industry.
8. List the job titles in the wood industry.
9. Calculate the unit of "board feet."
10. Define cutting, clear-faced cutting, and sound cutting.
11. Calculate the percentage of clear wood in the clear face-cutting grades.
12. Identify requirements for the standard grade of "Firsts and Seconds."
13. Identify requirements for the standard grade of "FASIF."
14. Identify requirements for the standard grade of "#1 Common."
15. Identify requirements for the standard grade of "#2A Common."
16. Identify requirements for the standard grade of "#2B Common."
17. Identify requirements for the standard grade of "#3A Common."
18. Identify requirements for the standard grade of "#3B Common."
19. Identify requirements for the standard grade of "Selects."
20. Measure using a lumber rule.
21. Apply grading practices.
22. Apply safety techniques when operating a dry kiln.
23. Identify the basic components of a lumber dry kiln.
24. Identify types of dry kilns.
25. Apply sample selection techniques in preparation for loading.
26. Calculate the moisture content of samples/sections.
27. Calculate the oven-dried weight of samples.
28. Calculate the moisture of a sample.
29. Construct a drying schedule for a particular species and thickness.
30. Apply a drying schedule in a lab kiln for species and thickness.
31. Discuss the economics of equality versus time considerations when drying lumber.
32. Apply accelerated drying schedules.
33. Maintain drying records and charts.

Millwork Technology 480717

The design of molding for doors, door frames, windows, stairs, and mantels is the focus of this course. Emphasis will be placed on construction principles, joinery, and fasteners for millwork assemblies. Students will build one or more millwork items.

Prerequisites: Technical Drawing and Blueprint Reading 480719 **AND** Wood Product Manufacturing 480740

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Interpret architectural prints and shop drawings.
5. Define the three levels utilized in the Architectural Woodworking Institute's Quality Standards.
6. Conduct field measurements of projects in process to verify dimensions.
7. Identify typical stock and custom millwork projects and products.
8. Select a profile, design a template, grind the knives, install the tooling, set up the molder, run the stock, and troubleshoot the machine.
9. Calculate feed rates needed to meet AWI specifications for millwork.
10. Fabricate one or more millwork products to a specified quality level.
11. Recognize the common sizes, types, and construction techniques used to manufacture doors, windows, and stair parts.
12. Prepare a finishing sample that reflects AWI premium grade specifications.
13. Prepare a take-off and an estimate from a set of architectural plans.
14. Sharpen cutters on an abrasive wheel or stone.

Special Problems (Wood) 480795

This course allows students to gain intermediate experience in their perspective fields through projects and tasks assigned by the instructor, and based on applications, the student may one day experience as a professional. It sets the foundation for more in-depth projects that will be included in the student's future portfolio. It focuses on various assignments and curricula as determined by the program instructor.

This course does not count toward concentrator or completer status.

Recommended Grade Level: 10 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Expand their portfolio of CAD drawings to enhance career opportunities.
5. Discuss occupation opportunities.

Technical Drawing and Blueprint Reading 480719

This course focuses on the fundamentals of multi-view and pictorial drafting techniques; and reading and interpreting architectural, furniture, and cabinet drawings. Students will apply blueprint reading skills by preparing materials and cutting lists for an actual job.

Recommended Grade Level: 10 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Develop freehand sketching techniques used to convey object size and shape.
5. Use and care for drafting equipment and supplies properly.
6. Layout and draw orthographic, sectional, isometric, oblique, and perspective drawings.
7. Read and interpret specifications from architectural plans and detailed drawings.
8. Practice industry standards for dimensioning and notation.
9. Master basic geometric construction concepts and techniques.
10. Utilize the design process to develop a solution to a problem.
11. Prepare a bill of materials for a typical wood product by performing a materials take-off from an architectural drawing.
12. Create drawings needed for route sheets, subassembly, and final assembly sheets.

Wood Finishing 480720

This course is an overview of contemporary spray-finishing materials and processes for millwork assemblies. Students will learn to set up and troubleshoot a variety of common finishing systems while experimenting with finishing materials and supplies.

Recommended Grade Level: 10 – 12

Recommended Credit: .5

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Prepare a surface/product for the finishing process.
5. Identify the factors associated with the finish quality of a wood product.
6. Differentiate between paints, varnish, lacquer, shellac, polyurethane, conversion varnish, and water-based products.
7. Demonstrate contemporary application techniques for both oil-based and water-based products.
8. Explain the theory and operation of various coating technologies.
9. Disassemble, re-assemble, and adjust a conventional spray gun.
10. Develop a finishing schedule for a variety of finishing materials applied to a variety of substrates.
11. Describe EPA and OSHA regulations as they pertain to the finishing industry.
12. Evaluate and specify drying equipment, fluid handling equipment, and exhaust/filtering systems.
13. Perform standardized tests on finished surfaces to determine durability.
14. Apply work site and lab safety procedures.
15. Apply personal safety rules and procedures.
16. Apply fire prevention rules and procedures.
17. Apply first aid procedures.
18. Explain how to obtain first aid certification.
19. Demonstrate hazardous communication procedures.
20. Describe and demonstrate universal precaution procedures.

Wood Product Manufacturing 480740

Fundamentals of wood processing and an overview of the secondary wood processing industry are covered in this course. The nature of wood, material selection, terminology, safe setup, and operation of common woodworking equipment will be discussed. Students will fabricate a wood product while being introduced to custom woodworking techniques, as well as mass production concepts related to product engineering.

Recommended Grade Level: 9 – 12

Recommended Credit: 1

Students will:

1. Practice and perform safe shop procedures at all times.
2. Apply the technical math required for employment opportunities.
3. Perform all duties with emphasis on integrity, responsibility, quality, discipline and teamwork.
4. Discuss the characteristics of wood as a building material.
5. Specify and order lumber, veneer, plywood, particleboard, fiberboard, laminates, composite materials, hardware, and related materials and supplies.
6. Identify common species of hardwoods and softwoods.
7. Observe all safety rules and regulations when using hand tools, portable electric tools, and stationary machines.
8. Practice safe setup and operation of woodworking equipment.
9. Master basic jig and fixture design and development concepts.
10. Develop common production planning materials, route sheets, subassembly sheets and final assembly sheets.
11. Evaluate and specify appropriate joinery when assembling two or more components.
12. Describe the properties of common thermosetting and thermoplastic adhesives and the most appropriate application techniques for each.
13. Select and utilize common abrasive materials for surface preparation of the wood.
14. Apply work site and lab safety procedures.
15. Apply personal safety rules and procedures.
16. Apply fire prevention rules and procedures.
17. Apply first aid procedures.
18. Explain how to obtain first aid certification.
19. Demonstrate hazardous communications procedures.
20. Describe and demonstrate universal precaution procedures.
21. Set up and solve ratios and proportions.
22. Convert between various units of measure.
23. Solve problems involving significant digits, accuracy, and precision of measurements.
24. Perform mathematical operations with standard and metric measurement systems.