## Manufacturing Career Cluster Design

### Manufacturing Pathway – CIP Code 48.0000

**Approved Pathway:**
1. Includes minimum of three secondary-level credits.
2. Includes a work-based element.
4. Supporting documentation include Articulation Agreement(s) and a Program of Study.
5. Technical-level and Application-level courses receive .5 state-weighted funding in an approved CTE pathway.

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**Production Strand**
- Manufacturing Processes | 13002 | 1 credit
- Advanced Production Blueprint Reading | 39108 | .5 credit
- Drafting/CAD | 21107 | 1 credit
- Production Welding Processes I (Ag Welding) | 39207 (18404) | 1 credit
- Machine Tool Technology | 13203 | 1 credit
- Mass Production | 13052 | 1 credit
- CAM | 13204 | 1 credit
- Skilled Mechanical Crafts | 17062 | .5 credit
- Advanced Production Blueprint Reading | 39108 | .5 credit
- Machine Tool Technology 1a | 39203 | .5 credit
- Maintenance Welding Processes | 13208 | 1 credit
- Mech. Power Transmission & Conveyor Systems | 13302 | .5 credit

**APPLICATION LEVEL**

**Production Strand**
- **Adv. Drafting/CAD** | 21150 | 1 credit
- **Mass Production II** | 39052 | 1 credit
- **Mach. Tool Tech. II** | 39204 | 1 credit
- **Research & Design for Manuf.** | 13998 | 1 credit
- **Production Welding Processes II** | 39208 (18407) | 1 credit
- **Automated Systems** | 39010 | .5 credit
- **Advanced Materials Technology** | 38010 | 1 credit
- Remodeling & Bldg. Maintenance | 17009 | .5 credit
- Sheet Metal & HVACR | 38012 | 1 credit
- Sheet Metal Technology | 13205 | .5 credit
- HVAC Technology | 17056 | .5 credit
- Plumbing Technology | 17058 | .5 credit
- Electrical & Security Systems | 17113 | .5 credit
- **Hydraulics & Pneumatics** | 39302 | .5 credit
- Work-Based Maintenance Experience | 13348 | .5 credit

*Production Strand Only  **Has a specific Pre-requisite course(s) – See Competency Profile for details.*

Approved Pathway must contain 3 credits within one strand before adding courses from other strand.
KANSAS STATE CAREER CLUSTER COMPETENCY PROFILE
MANUFACTURING PATHWAY (C.I.P. 48.0000)

STUDENT______________________________________________
Graduation Date     ________________________________________

Rating Scale:
4 - Exemplary Achievement
3 - Proficient Achievement
2 - Limited Achievement
1 - Inadequate Achievement
0 - No Exposure

COMMON CAREER TECHNICAL CORE –
CAREER READY STANDARDS (To be taught throughout the pathway)

1. Act as a responsible and contributing citizen and employee
2. Apply appropriate academic and technical skills
3. Attend to personal health and financial well-being
4. Communicate clearly, effectively and with reason
5. Consider the environmental, social and economic impacts of decisions
6. Demonstrate creativity and innovation
7. Employ valid and reliable research strategies
8. Utilize critical thinking to make sense of problems and persevere in solving them.
9. Model integrity, ethical leadership and effective management
10. Plan education and career path aligned to personal goals
11. Use technology to enhance productivity
12. Work productively in teams while using cultural/global competence

13. Evaluate the nature & scope of the Manufacturing Career Cluster and the role of manufacturing in society and in the economy
15. Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices
16. Describe career opportunities and means to achieve those opportunities in each of the Manufacturing Career Pathways
17. Describe government policies and industry standards that apply to manufacturing
18. Demonstrate workplace knowledge and skills common to manufacturing
19. Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance
20. Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment
21. Diagnose equipment problems and effectively repair manufacturing equipment

22. Implement a preventive maintenance schedule to maintain manufacturing equipment, tools and workstations
23. Implement an effective, predictive and preventive manufacturing equipment maintenance program

INTRODUCTORY COURSES

38001-INTRODUCTION TO INDUSTRIAL TECHNOLOGY (.5 Credit) An introductory level course designed to instruct students in the basic skills necessary to all occupations in the Construction, Manufacturing & Transportation areas.

1. Basic Safety
   - Identify causes of accidents and the impact of accident costs.
   - Follow safe behavior procedures on and around ladders, scaffolds and stairs.
   - Follow safe behavior procedures around electrical hazards.
   - Demonstrate the use, care and inspection of appropriate personal protective equipment (PPE)
4 3 2 1 0  2. Industrial Math
- Add, subtract, multiply, and divide whole numbers, fractions, decimals and percentages.
- Use a standard ruler, a metric ruler, and a measuring tape to measure.
- Demonstrate conversion skills for decimals and fractions.
- Recognize and perform calculations using metric units of length, weight, volume and temperature.

4 3 2 1 0  3. Hand Tools
- Recognize and identify some of the basic hand tools and their proper uses in industrial trades.
- Demonstrate the safe use of common hand tools.

4 3 2 1 0  4. Power Tools
- Recognize and identify some of the basic power tools and their proper uses in the industrial trades.

4 3 2 1 0  5. Blueprint Reading
- Demonstrate the safe use of common power tools.
- Perform preventive maintenance on basic power tools used in the industrial trades.
- Demonstrate the drafting principles needed to draw the basic geometric shapes.
- Develop a pictorial sketch of an object.
- Develop a multi-view drawing.
- Identify basic symbols used in blueprints.
- Identify various types of blueprint views used in Architecture, Construction, Manufacturing and Engineering.

4 3 2 1 0  6. Communication Skills
- Interpret information and follow instructions presented in both verbal and written form.
- Communicate effectively in on-the-job situations using verbal and written skills in various delivery modes (face-to-face, paper, electronic).
- Create and complete various written documents used in industrial trades.
- Demonstrate knowledge and use of computer systems and word processing software in effective communication.

4 3 2 1 0  7. Employability Skills
- Create and utilize employment documents including a resume and portfolio.
- Demonstrate job seeking and interview skills.
- Understand and respond to performance reviews.

4 3 2 1 0  8. 21st Century/Foundation Skills
- Demonstrate critical thinking skills and the ability to solve problems using those skills.
- Define effective relationship skills.
- Demonstrate a working knowledge of workplace issues such as sexual harassment, stress, and substance abuse.
- Demonstrate the ability to achieve common goals through team work

4 3 2 1 0  8. Materials Handling
- Verify that health, safety, environmental and government regulations are met.
- Recognize hazards and follow safety procedures required for materials handling.
- Demonstrate ability to load and unload materials properly and safely.

21108- PRODUCTION BLUEPRINT READING (.5 Credit) An introductory level course to provide students with the knowledge and ability to interpret the lines, symbols, and conventions of blueprints from a variety of industrial applications.

4 3 2 1 0  1. Identify symbols associated with blueprints
4 3 2 1 0  2. Interpret work from multiview drawings
4 3 2 1 0  3. Interpret size and location of features
4 3 2 1 0  4. Visualizing shapes and objects in multiple views
4 3 2 1 0  5. Ability to convert fractions and decimals proficiently
4 3 2 1 0  6. Interpret inch and metric drawings
4 3 2 1 0  7. Demonstrate legend and note reading skills
4 3 2 1 0  8. Interpret basic geometric dimensioning and tolerancing terminology
4 3 2 1 0  9. Identify different views utilized in blueprint reading
4 3 2 1 0  10. Identify orthographic projection such as lines and symbols for electrical, piping, mechanical, architectural, welding, and machining prints
13207- INTRODUCTION TO WELDING (.5 Credit) (Production Strand Only) An introductory course designed to instruct students in basic welding skills.

4 3 2 1 0  1. Identify safe practices and safety and health issues and procedures
4 3 2 1 0  2. Demonstrate proper use of personal protective equipment and safe work habits
4 3 2 1 0  3. Demonstrate safe set up of welding equipment
4 3 2 1 0  4. Recognize joint design and welding terminology
4 3 2 1 0  5. Identify and describe welding symbols
4 3 2 1 0  6. Manually operate an oxyfuel torch to cut carbon steel structural materials of varying thicknesses
4 3 2 1 0  7. Identify/select Arc welding electrodes used for welding
4 3 2 1 0  8. Describe metallurgy and identify metals
4 3 2 1 0  9. Weld joints in the F and H positions using a fast freeze electrode
4 3 2 1 0  10. Weld joints in the F and H positions using a low hydrogen electrode
4 3 2 1 0  11. Weld joints in the F and H positions using GMAW carbon steel
4 3 2 1 0  12. Weld joints in the F and H positions using GTAW carbon steel

PRODUCTION STRAND

13002- MANUFACTURING PROCESSES (1 Credit) A comprehensive, technical level course to instruct students in the knowledge and skills common to all manufacturing occupations. (Designed to be taught prior to the occupationally specific courses in drafting, machining, metals, cabinetmaking and welding.)

4 3 2 1 0  1. Identify materials and processes incorporated in the manufacturing industry.

4 3 2 1 0  2. Utilize technical drawings/blueprints, work orders, and other ways of conveying product specifications.
4 3 2 1 0  3. Demonstrate proper safety procedures for manufacturing processes and material handling.
4 3 2 1 0  4. Safely use and maintain basic hand and power tools.
4 3 2 1 0  5. Demonstrate and develop skills for bonding, casting, combining, conditioning, forming, and separating processes.
4 3 2 1 0  6. Explore and/or implement computer automations into manufacturing processes.
4 3 2 1 0  7. Analyze and solve problems using skills related to methods in production of a product.
4 3 2 1 0  8. Integrate team and mass production processes into manufacturing.
4 3 2 1 0  9. Incorporate LEAN manufacturing concepts: _ visual management, _ value stream mapping, _ 5S, _ kanban systems, _ lean metrics, _ shop layout.
4 3 2 1 0 10. Research future technologies affecting manufacturing with regards to going green, recycling supplies, alternative resources.
4 3 2 1 0 11. Demonstrate soldering abilities
4 3 2 1 0 12. Demonstrate a basic understanding of metallurgy

39108- ADVANCED PRODUCTION BLUEPRINT READING (.5 Credit) A technical level course designed to develop advanced technical communication skills used to interpret manufacturing production drawings as related to manufacturing occupations including blueprints, schematics, and other trade prints.

4 3 2 1 0  1. Identify and interpret symbols specific to manufacturing production and a variety of technical fields, such as mechanical, electrical, plumbing and pipefitting, power distribution, process and instrumentation, architectural, and process flow diagrams.
4 3 2 1 0  2. Interpret work from multiview drawings and computer models used in manufacturing applications to include engineering, architectural, and schematic representations.
4 3 2 1 0  3. Determine processes and procedures for diagnostic applications or job completion.
4 3 2 1 0  4. Demonstrate proficiency reading technical information including dimensioning techniques.
4 3 2 1 0  5. Visualize shapes and objects in multiple views to interpret various drawings used in manufacturing, commercial, and industrial manufacturing which may include electrical, schematics, plumbing, piping ISO’s, piping and instrumentation diagrams, architectural and civil.
4 3 2 1 0  6. Develop a work order from production blueprint to create a product from a multiview drawing.

21107 – DRAFTING/CAD (1 Credit) (Pre-requisite course for Advanced Drafting/CAD 21150) A comprehensive, technical level course designed to instruct students in the use of CAD design and software.

4 3 2 1 0  1. Identify and demonstrate the use of CAD commands and system peripherals.
4 3 2 1 0  2. Demonstrate the ability to dimension drawings on the CAD system.
4 3 2 1 0  3. Demonstrate proficiency in setting limits and scale on the CAD system.
43210 4. Demonstrate proficiency in setting, turning on and turning off layers.
43210 5. Create standard drawings for templates.
43210 6. Demonstrate the ability to load, store files, and transport files via Internet.
43210 7. Place text on a drawing and be able to change to different font styles, sizes and angles.
43210 8. Be proficient in the use of printer/plotter operations.
43210 9. Demonstrate ability to place text on a drawing and change to different font styles, sizes and angles.
43210 10. Demonstrate the ability to dimension drawings on the CAD system.
43210 11. Demonstrate proficiency in setting limits and scale on the CAD system.
43210 12. Construct drawings using straight line, circle, and hidden line statements, etc.
43210 13. Construct isometric and 3D drawings.
43210 15. Define and use commands to modify a drawing.
43210 16. Use symbols (from a symbol library) in a drawing.

13203 - MACHINE TOOL TECHNOLOGY I (1 Credit) (Pre-requisite for Machine Tool Technology II) A comprehensive, technical level course designed to provide students with experience in the basic theories, equipment and skills needed to perform machining skills.
43210 1. Perform Bench work and Layout Operations
43210 2. Demonstrate Precision Measuring Operations
43210 3. Perform Layout Operations
43210 4. Operate Drilling Machines
43210 5. Operate Manual Lathes
43210 6. Operate Manual Milling Machines
43210 7. Operate Grinding tools and Equipment
43210 8. Interpret Blueprint Drawing
43210 9. Use Metric and English standards of Measurement
43210 10. Demonstrate the Use of Hand tools.
43210 11. Cut threads with taps and dies
43210 12. Identify Tap Drill sizes
43210 13. Calculate Feeds and Speeds for machining
43210 15. Demonstrate applied math skills in Geometry and Algebra
43210 16. Introduce the use of specialty measuring tools
43210 17. Establish Material preparation including saws
43210 18. Operate Boring Equipment
43210 19. Determine applications of Materials
43210 20. Demonstrate the use of machine shop formulas

39204 - MACHINE TOOL TECHNOLOGY II (1 Credit) An application level course designed to provide students with advanced machining skills and further opportunities to apply those skills.
43210 1. Apply the post process treatment of materials
43210 2. Perform Advance concepts in milling
43210 3. Perform Advance concepts in turning
43210 4. Demonstrate CNC Lathe Fundamentals
43210 5. Demonstrate CNC Milling Fundamentals
43210 6. Operate Precision Measurement tools and equipment
43210 7. Demonstrate Inspection and Quality control
43210 8. Interpret Blueprint Drawings and Sketches
43210 9. Determine Work Process planning
43210 10. Demonstrate use of advanced Math Skills related to machining
43210 11. Apply the use of CAM in machining processes
43210 12. Perform Measurements on a surface plate

21150 – ADVANCED DRAFTING/CAD (1 Credit) An advanced, application level course designed to build on and apply the skills learned in 21107 Drafting/CAD.
43210 1. Demonstrate the ability to create drawings in 3D
43210 2. Demonstrate proficiency in creating auxiliary views
43210 3. Identify, draw, and position appropriate auxiliary views
43210 4. Demonstrate proficiency in creating section views
43210 5. Identify, draw, and position appropriate section views
43210 6. Demonstrate knowledge of user coordinate system

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3210 8. Import Solid models into CAM
3210 9. Create a 2-D from a 3-D model.
3210 10. Demonstrate Knowledge of Machining Fundamentals

3210 11. Establish Plan of Procedure
3210 12. Establish Plan of Procedure
3210 13. Knowledge of various industry specific software
3210 14. Demonstrate editing CNC Code with CAM
3210 15. Program Multiple Axis code

13052- MASS PRODUCTION (1 Credit) (Pre-requisite for Mass Production II and Automated Systems) A comprehensive, technical level course designed to instruct students in the knowledge and skills required for fabricating products using a variety of materials (wood, plastic, metal, composites).
3210 1. Identify materials and processes incorporated in mass production
3210 2. Utilize technical drawings/blueprints, work orders, and other ways of conveying product specifications
3210 3. Apply math skills to manage distance, spacing, angle measurements, and placement for project development
3210 4. Perform steps to interpret, transfer and layout procedures for projects
3210 5. Estimate production costs based on product needs assessment
3210 6. Safely use and maintain basic hand and power tools
3210 7. Demonstrate skills required to safely use power equipment
3210 8. Explore and/or implement computer automations into mass production
3210 9. Analyze and solve problems using skills related to methods in production of a product

39052- MASS PRODUCTION II (1 Credit)
An application level course which builds on skills learned in 13052 Mass Production and is designed to instruct students in advanced knowledge and skills required for fabricating products using a variety of materials (wood, plastic, metal, composites).
3210 1. Identify and select materials used in developing production processes.
3210 2. Use technical drawings, blueprints, work orders, and product specifications in product development.
3210 3. Apply math skills to manage distance, spacing, angle measurements, and placement for project development.
3210 4. Perform steps to interpret, transfer and layout production methods for projects
3210 5. Safely use and maintain basic hand and power tools
3210 6. Demonstrate skills required to safely use specialized equipment
3210 7. Incorporate traditional methods of fabrication and design with advanced technologies to create plans, and construct products
3210 8. Analyze and solve problems using skills related to methods in fabrication of a product
3210 9. Develop project bill of material, cost estimates and plan of procedure for products.
3210 10. Select and perform best practices for joining, assembling, and finishing products.
3210 11. Incorporate LEAN manufacturing concepts pertaining to product fabrication and design.
3210 12. Research future technologies affecting mass production and teaming concepts related to going green, recycling supplies, alternative resources

13998- RESEARCH AND DESIGN FOR MANUFACTURING (1 Credit) Advanced level application course that incorporates experienced-based learning including IHT or Internships supported by classroom attendance and discussion, within their area of interest/study. (Must be preceded by at least one credit of technical level courses)
3210 1. Work with a client to develop a client-driven product
3210 2. Produce a working model (graphic or physical) using advanced software and/or equipment
3210 3. Demonstrate ability to apply shading and rendering techniques to 3d surfaces and solid models
3210 4. Demonstrate ability to access and utilize industry resources
3210 5. Use appropriate grammar and word usage in the creation and implementation of a formal graphic presentation using current standards and technology
43210 6. Apply principles of dimensioning/ tolerances, fasteners/hardware, and power transmission

43210 7. Apply basic principles of form and function to enhance project acceptance and quality

43210 8. Utilize effective management techniques to organize work flow

43210 9. Conduct product evaluations and critique their effectiveness

43210 10. Research new technologies to meet future client needs

43210 11. Demonstrate abilities in design/planning, visual communication & problem solving in the manufacturing industry

43210 12. Integrate alternative manufacturing methods and materials in current production process drawings

43210 13. Demonstrate an awareness of current manufacturing standards & Methodologies

43210 14. Demonstrate ability to incorporate industry specific codes as given for a selected project

43210 15. Demonstrate ability to set and work within defined budget

43210 16. Research & use information for product development

43210 17. Manipulate materials and processes to meet client needs

43210 18. Demonstrate ability to manage and set project goals and timelines

43210 2. Demonstrate proper use of personal protective equipment and safe work habits

43210 3. Demonstrate safe set up of welding equipment

43210 4. Identify and describe welding theory related to standard processes

43210 5. Make welds using the oxyfuel process

43210 6. Braze weld carbon steel

43210 7. Describe the flame cutting process

43210 8. Strike the Arc/weld a pad of beads

43210 9. Describe nondestructive testing methods and demonstrate their use

43210 10. Describe destructive testing methods and demonstrate their use

43210 11. Identify physical and chemical properties of metals and how they impact a metals’ weldability

43210 12. Draw welding symbols to illustrate a welded joint

43210 13. Weld joints in the F and H positions using a fast fill electrode

43210 14. Weld joints in the F and H positions using multi-pass technique GMAW

43210 15. Weld joints in the F and H positions using multi-pass technique GTAW

43210 16. Weld joints in the F and H positions using multi-pass technique SMAW

43210 4. Calculate weld sizes from prints, drawings, and measure welds produced in the lab

43210 5. Measure weld defects

43210 6. Weld joints in the V position using SMAW on a variety of materials

43210 7. Weld joints in the V position using GTAW on a variety of materials

43210 8. Weld joints in the OH position using SMAW on a variety of materials

43210 9. Weld joints in the OH position using GMAW on a variety of materials

43210 10. Weld joints in the F, H, and V position using FCAW

43210 11. Plasma cut and gouge materials in shapes, bevels, and straight lines

39010 – AUTOMATED SYSTEMS (.5 credit)
An advanced application level course that builds on skills learned in either Production Welding Processes or Mass Production in the area of robotics.

43210 1. Set up a robotic cell and program a movement path.

43210 2. Program a part on a robotic cell.

43210 3. Run a programmed part and edit the program to include a fixture movement.

43210 4. Program a new job and edit the job.

43210 5. Create a robot program using a weave instruction format.

43210 6. Create a new program on an assembled part, set up, and run the part.

39208 – PRODUCTION WELDING II (1 Credit)
An advanced, application level courses that builds on skills learned in 39207 Production Welding Processes I and provides opportunities for applying welding skills.

43210 1. Solve complex written problems in fabrication

43210 2. Measure materials and solve fabrication problems using welding specific measuring tools

43210 3. Calculate the material required from a bill of materials

38010 – ADVANCED MATERIALS TECHNOLOGY (1 Credit)
A progressive application level course furthering the study of CNC equipment, materials, and the processes involved with fabricating goods with these technologies (i.e. composite panel products, veneering, etc.).

43210 1. Research and apply composite
43210 2. Research and apply overlay/veneer materials fabrication (for woods based courses).

43210 3. Research and apply appropriate tooling methods for chosen materials.

43210 4. Research and apply appropriate methods of assembly for materials and applications (adhesives, welds, etc.).

43210 5. Research and apply appropriate finishes and proper finish procedure of chosen materials.

43210 6. Design and engineer a product using CAD and/or CAM software systems.

43210 7. Understand and demonstrate operations of advanced technology systems.

43210 8. Demonstrate effective techniques to manage and organize production flow.

43210 9. Research and understand related career fields and postsecondary training opportunities.

43210 10. Implement and manage a safety program for procedures and hazardous materials.

MAINTENANCE STRAND

17062 – SKILLED MECHANICAL CRAFTS (.5 Credit)
A technical level course designed to instruct students in the basic skills necessary for occupations in skilled mechanical crafts.

43210 1. Utilize technology resources to investigate training, education and careers available in the mechanical trades fields of construction.

43210 2. Perform the drafting and sketching techniques needed to draw basic geometric shapes.

43210 3. Develop a pictorial sketch of an object.


43210 5. Develop a flat-view of an object as it would be seen before assembly.

43210 6. Develop a materials list for the construction of a project.

43210 7. Recognize and identify basic blueprint terms, components and symbols.

43210 8. Demonstrate the ability to read a ruler and calculate square feet and cubic feet.

39203- MACHINE TOOL TECHNOLOGY Ia (.5 Credit) A comprehensive, technical level course designed to provide students with the basic theories, equipment usage and skills needed to perform machining tasks for manufacturing applications.

39108- ADVANCED PRODUCTION BLUEPRINT READING (.5 Credit) A technical level course designed to develop advanced technical communication skills used to interpret manufacturing production drawings as related to manufacturing occupations including blueprints, schematics, and other trade prints.

43210 1. Identify and interpret symbols specific to manufacturing production and a variety of technical fields, such as mechanical, electrical, plumbing and pipefitting, power distribution, process and instrumentation, architectural, and process flow diagrams.

43210 2. Interpret work flows from production/working drawings and computer models used in manufacturing applications to include engineering, architectural, and schematic representations.

43210 3. Determine processes and procedures for diagnostic applications and job completion.

43210 4. Demonstrate proficiency reading technical information including dimensioning techniques.

43210 5. Visualize shapes and objects in multiple views to interpret various production/working drawings used in manufacturing, commercial, and industrial manufacturing which may include electrical, schematics, plumbing, piping ISO’s, piping and instrumentation diagrams, architectural and civil.

43210 6. Develop a work order from production/working drawings.

39203- MACHINE TOOL TECHNOLOGY Ia (.5 Credit) A comprehensive, technical level course designed to provide students with the basic theories, equipment usage and skills needed to perform machining tasks for manufacturing applications.

43210 1. Perform bench work and layout operations.

43210 2. Demonstrate precision measuring.

43210 3. Perform layout operations.

43210 4. Operate Drilling Machines.


43210 7. Operate grinding tools and equipment.

43210 8. Interpret blueprint drawings.

43210 9. Use Metric & English standards of measurement.

43210 10. Demonstrate the use of hand tools.

43210 11. Cut threads with taps and dies.

43210 12. Identify tap drill sizes.

13208- MAINTENANCE WELDING PROCESSES (1 Credit) A technical level course designed to provide students with the knowledge and skills to perform maintenance welding.
procedures including braze and torch welding and common pipe joint welding.

13302- MECHANICAL POWER TRANSMISSION AND CONVEYOR SYSTEMS
(.5 credit) A technical level course designed to provide students with knowledge and skills needed to adjust, maintain, and repair parts of machinery and equipment. Includes hydraulics, pneumatics, gears, belt & chain drives, motors and bearings.

17009- REMODEL & BUILDING MAINTENANCE (.5 Credit)
An application level course designed to provide students with knowledge & skills needed to perform remodeling & maintenance procedures for wall, floor, window, door, electrical, HVAC, and plumbing applications.

13302- MECHANICAL POWER TRANSMISSION AND CONVEYOR SYSTEMS
(.5 credit) A technical level course designed to provide students with knowledge and skills needed to adjust, maintain, and repair parts of machinery and equipment. Includes hydraulics, pneumatics, gears, belt & chain drives, motors and bearings.

17009- REMODEL & BUILDING MAINTENANCE (.5 Credit)
An application level course designed to provide students with knowledge & skills needed to perform remodeling & maintenance procedures for wall, floor, window, door, electrical, HVAC, and plumbing applications.
equipment, and skills needed to perform sheet metal techniques, and to install and maintain HVAC and refrigeration systems.

432101. Safely utilize and maintain tools common to the sheet metal trade.
432102. Demonstrate blueprint reading skills including the interpretation of plans, elevations, schedules, and details.
432103. Identify the three basic types of layout: parallel line, radial line, and triangulation.
432104. Layout and fabricate a basic joint of ductwork, including seams and transverse joints.
432105. Utilize a tape measure to obtain correct measurements for a ductwork detail.
432106. Describe types and thicknesses of sheet metal fittings.
432107. Layout and fabricate basic sheet metal fittings.
432108. Describe the different seams commonly used for ductwork and explain the advantages of each.

(Divide competencies here to change from Sheet Metal to HVACR concentration)

432109. Safely utilize and maintain tools common to the mechanical trades industry.
432110. Describe the refrigeration/cooling and heating process.
432111. Describe various types of heating and cooling systems, including the pros, cons and applications of each.
432112. Demonstrate basic electrical knowledge of how electrical circuits operate.
432113. Correctly use a multi-meter to identify voltage, continuity, and ohms.
432114. Install basic programmable heat/cool thermostat.
432115. Describe thermostat wire and identify what each color should be used for.

432106. Correctly measure, cut, and join piping/tubing.
432107. Explain different types of refrigerant and their applications.
432108. Connect and read manifold gauges for troubleshooting.
432109. Recover, vacuum, and refill refrigerant.
432110. Troubleshoot and repair problems with HVAC/Refrigeration systems.
432111. Research future trends in “green technology” for the HVAC industry.
432112. Demonstrate ability to maintain appropriate maintenance documentation.

13205 – SHEET METAL TECHNOLOGY (.5 Credit)
An application level course designed to provide students with exposure to and training in the theories, equipment and skills needed to perform sheet metal techniques.
432101. Safely utilize and maintain tools common to the sheet metal trade.
432102. Demonstrate blueprint reading skills including the interpretation of plans, elevations, schedules, and details.
432103. Identify the three basic types of layout: parallel line, radial line, and triangulation.
432104. Layout and fabricate a basic joint of ductwork, including seams and transverse joints.
432105. Utilize a tape measure to obtain correct measurements for a ductwork detail.
432106. Describe types and thicknesses of sheet metal fittings.
432107. Layout and fabricate basic sheet metal fittings.
432108. Describe the different seams commonly used for ductwork and explain the advantages of each.

17056 – HVAC TECHNOLOGY (.5 Credit)
An application level course designed to provide students with exposure to and training in the theories, equipment and skills needed to install and maintain HVAC systems.
432101. Safely utilize and maintain tools common to the mechanical trades industry.
432102. Describe the heating and cooling process.
432103. Demonstrate the use of a duct calculator and the formulas used to calculate heat loads.
432104. Apply layout to HVAC projects.
432105. Describe various types of heating and cooling systems, including the pros, cons and applications of each.
432106. Demonstrate basic electrical knowledge of how electrical circuits work and how they are used within the industry.
432107. Install basic and programmable heat/cool thermostats.
432108. Describe thermostat wire and identify what each color should be used for.
432109. Research future trends in “green technology” for the HVAC industry.
432110. Troubleshoot and repair problems with HVAC systems.
432111. Correctly measure, cut and join piping/tubing.
432112. Demonstrate proper soldering techniques.
432113. Demonstrate ability to maintain appropriate maintenance documentation.

17058 – PLUMBING TECHNOLOGY (.5 Credit)
An application level course designed to provide students with training in the theories, equipment and skills needed to install, troubleshoot and maintain plumbing systems.
432101. Demonstrate proper use of basic hand and power tools used in the plumbing trade.

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2. Correctly measure, cut and join plastic, carbon steel and/or stainless steel piping/tubing.
3. Identify and install the most common types of sinks and toilets.
4. Identify and describe the functions of the major components of a water distribution system.
5. Identify and install pipe hangers and supports.
6. Identify the types of schedules and drawings used within the plumbing trade.
7. Demonstrate proper soldering techniques.
8. Identify different types of plumbing systems and their components.
9. Demonstrate proper safety procedures within the plumbing trade.
10. Troubleshoot and repair water supply, water heater, and water drainage problems.

17113- ELECTRICAL & SECURITY SYSTEMS (.5 Credit)
An application level course designed to provide students with the knowledge and skills needed to install, troubleshoot and maintain electrical and security systems.
1. Cut, ream, thread and bend conduit.
2. Compute branch circuit loads and explain installation requirements.
3. Demonstrate the procedure for safely using a clamp-on ammeter and a voltage tester.
4. Demonstrate procedures for installing raceways and boxes.
5. Demonstrate ability to correctly pull wire through conduit.
6. Select and install appropriate service entrance equipment according to codes.
7. Demonstrate the ability to properly ground electrical circuits according to codes.
8. Install breakers, plugs and switches.
9. Explain basic characteristics of series and parallel circuits.
10. Recognize and install various types of lighting fixtures.
11. Describe characteristics and functions of various fire alarm systems.
12. Describe characteristics and functions of various security and burglar alarm systems.
13. Describe the uses, characteristics and theory of low voltage systems.
14. Demonstrate knowledge of the uses and installation process for Closed Circuit TV.
15. Describe the components of and uses for electric lock hardware.
16. Demonstrate safe use of electric hand and power tools.
17. Understand and interact with LAN systems as a part of an overall security installation.
18. Demonstrate ability to install a lightning protection system.
19. Troubleshoot and repair problems in lighting fixtures, including ballast replacement.

39302- HYDRAULICS & PNEUMATICS (.5 credit) (Recommend students to take 13302 Mechanical Power Transmission & Conveyor Systems prior to this course)
An application level course designed to provide students with advanced knowledge and skills in operating, maintaining and troubleshooting hydraulic & pneumatic systems.
1. Compare & contrast the principles of hydraulics & pneumatics.
2. Demonstrate a working knowledge of hydraulics & pneumatics terminology.
3. Identify basic hydraulic and pneumatic symbols.
4. Read and understand Schematic Diagrams
5. Design and construct basic hydraulic and pneumatic circuits
6. Demonstrate proper use of pneumatic and hydraulic-operated tools
7. Explain the operation of air compressors and vacuum pumps
8. Perform diagnostic procedures on hydraulic and pneumatic systems
9. Compare & contrast the use of synthetic and petroleum-based lubricants in hydraulic systems
10. Create a comprehensive maintenance schedule for hydraulic & pneumatic systems
11. Identify components in a fluid power/pneumatic circuit

13348- WORK-BASED MAINTENANCE EXPERIENCE (.5 Credit)
Senior level application course that incorporates experienced-based learning including OJT, or Internships supported by classroom attendance and discussion, within their area of interest/study. (Must be preceded by at least one credit of additional application level courses)
1. Work with a client to develop a client-driven product or perform maintenance tasks.
2. Demonstrate ability to access and utilize industry resources.
3. Use appropriate grammar and word usage in the creation and implementation of a formal graphic presentation using current standards and technology.
4 3 2 1 0 4. Utilize effective time management techniques to organize work flow
4 3 2 1 0 5. Research new technologies to meet future client needs
4 3 2 1 0 6. Demonstrate abilities in problem solving in manufacturing maintenance.
4 3 2 1 0 7. Demonstrate an awareness of current maintenance standards & methodologies
4 3 2 1 0 8. Demonstrate ability to incorporate industry specific codes in maintenance operations.
4 3 2 1 0 9. Demonstrate ability to set and work within defined budget
4 3 2 1 0 10. Manipulate materials and processes to meet client needs
4 3 2 1 0 11. Demonstrate ability to manage and set project goals and timelines
4 3 2 1 0 12. Utilize job seeking skills including resume writing and interviewing skills.
4 3 2 1 0 13. Apply maintenance skills to work situations.

OCCUPATIONAL PROFILE RATING SCALE RUBRIC

Rating Scale (Occupational Profile)

4 - Exemplary Achievement: Student possesses outstanding knowledge, skills or professional attitude. Works Independently.
3 - Proficient Achievement: Student demonstrates good knowledge, skills or professional attitude. Requires limited supervision.
2 - Limited Achievement: Student demonstrates fragmented knowledge, skills or professional attitude. Requires close supervision.
1 - Inadequate Achievement: Student lacks knowledge, skills or professional attitude.
0 - No Instruction / Training: Student has not received instruction or training in this area.