

# MANUFACTURING CAREER CLUSTER DESIGN

## Manufacturing Pathway – CIP Code 48.0000

### INTRODUCTORY LEVEL

Introduction to Industrial Technology	38001	.5 credit
Production Blueprint Reading	21108	.5 credit
*Introduction to Welding	13207	.5 credit

### TECHNICAL LEVEL

#### 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

#### Maintenance Strand

Skilled Mechanical Crafts	17062	.5 credit
Advanced Production Blueprint Reading	39108	.5 credit
Machine Tool Technology 1a	39203	.5 credit
Maintenance Welding Processes Mech. Power Transmission & Conveyor Systems	13208	1 credit
	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

#### Maintenance Strand

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.

#### Approved Pathway:

- 1) Includes minimum of three secondary-level credits.
- 2) Includes a work-based element.
- 3) Consists of a sequence: Introductory-level, Technical-level, and Application-level courses.
- 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.

**KANSAS STATE CAREER CLUSTER COMPETENCY PROFILE**  
**MANUFACTURING PATHWAY (C.I.P. 48.0000)**

**MANUFACTURING CLUSTER**

**STUDENT** \_\_\_\_\_  
**Rating Scale:**

- 4 - Exemplary Achievement**
- 3 - Proficient Achievement**
- 2 - Limited Achievement**
- 1 - Inadequate Achievement**
- 0 - No Exposure**

Graduation Date _____ <b>I certify that the student has received training in the areas indicated.</b>
Instructor Signature _____
Instructor Signature _____
Instructor Signature _____
Instructor Signature _____

**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

**COMMON CAREER TECHNICAL CORE –  
 MANUFACTURING CLUSTER STANDARDS  
 (To be taught throughout the pathway)**

13. Evaluate the nature & scope of the Manufacturing Career Cluster and the role of manufacturing in society and in the economy
14. Analyze & summarize how manufacturing businesses improve performance
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.**

- 4 3 2 1 0
- 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)

- Explain the importance of hazard communications (HazCom) and material safety data sheets (MSDSs).
  - Respond to hazardous-materials and hazardous-waste emergency situations in accordance with regulatory requirements.
  - Follow safety procedures required for lifting heavy objects.
  - Demonstrate a working knowledge of safety education, environment, and enforcement for life and work.
  - Apply safe practices while using tools and equipment.
  - Apply safe practices for housekeeping, dress, fire, chemicals & personal protection while working in a shop.
  - Describe fire prevention and firefighting techniques.
  - Explain the purpose of OSHA and how it promotes safety on the job.
- 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.

- Demonstrate the safe use of common power tools.
  - Perform preventive maintenance on basic power tools used in the industrial trades.
- 4 3 2 1 0 5. **Blueprint Reading**
- Perform 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. **21<sup>st</sup> 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 level 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.

- 4 3 2 1 0 4. Demonstrate proficiency in setting, turning on and turning off layers.
- 4 3 2 1 0 5. Create standard drawings for templates.
- 4 3 2 1 0 6. Demonstrate the ability to load, store files, and transport files via Internet.
- 4 3 2 1 0 7. Place text on a drawing and be able to change to different font styles, sizes and angles.
- 4 3 2 1 0 8. Be proficient in the use of printer/plotter operations.
- 4 3 2 1 0 9. Demonstrate ability to place text on a drawing and change to different font styles, sizes and angles.
- 4 3 2 1 0 10. Demonstrate ability to dimension drawings on the CAD system.
- 4 3 2 1 0 11. Demonstrate proficiency in setting limits and scale on the CAD system.
- 4 3 2 1 0 12. Construct drawings using straight line, circle, and hidden line statements, etc.
- 4 3 2 1 0 13. Construct isometric and 3D drawings.
- 4 3 2 1 0 14. Set grid and snap specifications.
- 4 3 2 1 0 15. Define and use commands to modify a drawing.
- 4 3 2 1 0 16. Use symbols (from a symbol library) in a drawing.

**21150 – ADVANCED DRAFTING/CAD (1 Credit) An advanced, application level course designed to build on and apply the skills learned in 21107 Drafting/CAD.**

- 4 3 2 1 0 1. Demonstrate the ability to create drawings in 3D
- 4 3 2 1 0 2. Demonstrate proficiency in creating auxiliary views
- 4 3 2 1 0 3. Identify, draw, and position appropriate auxiliary views
- 4 3 2 1 0 4. Demonstrate proficiency in creating section views
- 4 3 2 1 0 5. Identify ,draw, and position appropriate section views
- 4 3 2 1 0 6. Demonstrate knowledge of user coordinate system

- 4 3 2 1 0 7. Demonstrate ability to manipulate UCS
- 4 3 2 1 0 8. Demonstrate ability to set and use advanced dimensioning functions correctly
- 4 3 2 1 0 9. Construct solid models
- 4 3 2 1 0 10. Manipulate solid models
- 4 3 2 1 0 11. Demonstrate the ability to create drawings in 3D

**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.**

- 4 3 2 1 0 1. Perform Bench work and Layout Operations
- 4 3 2 1 0 2. Demonstrate Precision Measuring
- 4 3 2 1 0 3. Perform Layout Operations
- 4 3 2 1 0 4. Operate Drilling Machines
- 4 3 2 1 0 5. Operate Manual Lathes
- 4 3 2 1 0 6. Operate Manual Milling Machines
- 4 3 2 1 0 7. Operate Grinding tools and Equipment
- 4 3 2 1 0 8. Interpret Blueprint Drawing
- 4 3 2 1 0 9. Use Metric and English standards of Measurement
- 4 3 2 1 0 10. Demonstrate the Use of Hand tools.
- 4 3 2 1 0 11. Cut threads with taps and dies
- 4 3 2 1 0 12. Identify Tap Drill sizes
- 4 3 2 1 0 13. Calculate Feeds and Speeds for machining
- 4 3 2 1 0 14. Demonstrate Work Process Planning
- 4 3 2 1 0 15. Demonstrate applied math skills in Geometry and Algebra
- 4 3 2 1 0 16. Introduce the use of specialty measuring tools
- 4 3 2 1 0 17. Establish Material preparation including saws
- 4 3 2 1 0 18. Operate Boring Equipment
- 4 3 2 1 0 19. Determine applications of Materials

- 4 3 2 1 0 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.**

- 4 3 2 1 0 1. Apply the post process treatment of materials
- 4 3 2 1 0 2. Perform Advance concepts in milling
- 4 3 2 1 0 3. Perform Advance concepts in turning
- 4 3 2 1 0 4. Demonstrate CNC Lathe Fundamentals
- 4 3 2 1 0 5. Demonstrate CNC Milling Fundamentals
- 4 3 2 1 0 6. Operate Precision Measurement tools and equipment
- 4 3 2 1 0 7. Demonstrate Inspection and Quality control
- 4 3 2 1 0 8. Interpret Blueprint Drawings and Sketches
- 4 3 2 1 0 9. Determine Work Process planning
- 4 3 2 1 0 10. Demonstrate use of advanced Math Skills related to machining
- 4 3 2 1 0 11. Apply the use of CAM in machining processes
- 4 3 2 1 0 12. Perform Measurements on a surface plate

**13204- CAM (COMPUTER AIDED MACHINING (1 Credit) A comprehensive, technical level course designed to instruct students in the knowledge and skills needed to perform computer aided machining tasks.**

- 4 3 2 1 0 1. Interpret and read blueprints to generate code
- 4 3 2 1 0 2. Manipulate Mechanical Drawings using CAM
- 4 3 2 1 0 3. Use Cartesian coordinate system in generating Code
- 4 3 2 1 0 4. Create 2-D Multi-View drawings
- 4 3 2 1 0 5. Generate Pictorial Drawings
- 4 3 2 1 0 6. Create BOM (Bill of Material)
- 4 3 2 1 0 7. Demonstrate communication with machine tools

- 4 3 2 1 0 8. Import Solid models into CAM
- 4 3 2 1 0 9. Create a 2-D from a 3-D model.
- 4 3 2 1 0 10. Demonstrate Knowledge of Machining Fundamentals
- 4 3 2 1 0 11. Establish Plan of Procedure
- 4 3 2 1 0 12. Establish Plan of Procedure
- 4 3 2 1 0 13. Knowledge of various industry specific software
- 4 3 2 1 0 14. Demonstrate editing CNC Code with CAM
- 4 3 2 1 0 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).**

- 4 3 2 1 0 1. Identify materials and processes incorporated in mass production
- 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. Apply math skills to manage distance, spacing, angle measurements, and placement for project development
- 4 3 2 1 0 4. Perform steps to interpret, transfer and layout procedures for projects
- 4 3 2 1 0 5. Estimate production costs based on product needs assessment
- 4 3 2 1 0 6. Safely use and maintain basic hand and power tools
- 4 3 2 1 0 7. Demonstrate skills required to safely use power equipment
- 4 3 2 1 0 8. Explore and/or implement computer automations into mass production
- 4 3 2 1 0 9. Analyze and solve problems using skills related to methods in production of a product

- 4 3 2 1 0 10. Integrate mass production processes into design as related to traditional methods of manufacturing and constructing products
- 4 3 2 1 0 11. Select and perform best practices for joining, assembling, and finishing projects
- 4 3 2 1 0 12. Incorporate LEAN manufacturing concepts pertaining to mass production \_ visual management, \_ value stream mapping, \_ 5S, \_ kanban systems, \_ lean metrics, \_ shop layout
- 4 3 2 1 0 13. Explain the role of business and market in the free enterprise system
- 4 3 2 1 0 14. Research future technologies affecting mass production and teaming concepts related to going green, recycling supplies, alternative resources

**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).**

- 4 3 2 1 0 1. Identify and select materials used in developing production processes.
- 4 3 2 1 0 2. Use technical drawings, blueprints, work orders, and product specifications in product development.
- 4 3 2 1 0 3. Apply math skills to manage distance, spacing, angle measurements, and placement for project development
- 4 3 2 1 0 4. Perform steps to interpret, transfer and layout production methods for projects
- 4 3 2 1 0 5. Safely use and maintain basic hand and power tools
- 4 3 2 1 0 6. Demonstrate skills required to safely use specialized equipment
- 4 3 2 1 0 7. Incorporate traditional methods of fabrication and design with advanced

- technologies to create plans, and construct products
- 4 3 2 1 0 8. Analyze and solve problems using skills related to methods in fabrication of a product
- 4 3 2 1 0 9. Develop project bill of material, cost estimates and plan of procedure for products.
- 4 3 2 1 0 10. Select and perform best practices for joining, assembling, and finishing products.
- 4 3 2 1 0 11. Incorporate LEAN manufacturing concepts pertaining to product fabrication and design. \_ visual management, \_ value stream mapping, \_ 5S, \_ kanban systems, \_ lean metrics, \_ shop layout
- 4 3 2 1 0 12. Research future technologies affecting mass production and design.

**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)**

- 4 3 2 1 0 1. Work with a client to develop a client-driven product
- 4 3 2 1 0 2. Produce a working model (graphic or physical) using advanced software and/or equipment
- 4 3 2 1 0 3. Demonstrate ability to apply shading and rendering techniques to 3d surfaces and solid models
- 4 3 2 1 0 4. Demonstrate ability to access and utilize industry resources
- 4 3 2 1 0 5. 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 6. Apply principles of dimensioning/ tolerances, fasteners/hardware, and power transmission
- 4 3 2 1 0 7. Apply basic principles of form and function to enhance project acceptance and quality
- 4 3 2 1 0 8. Utilize effective management techniques to organize work flow
- 4 3 2 1 0 9. Conduct product evaluations and critique their effectiveness
- 4 3 2 1 0 10. Research new technologies to meet future client needs
- 4 3 2 1 0 11. Demonstrate abilities in design/planning, visual communication & problem solving in the manufacturing industry
- 4 3 2 1 0 12. Integrate alternative manufacturing methods and materials in current production process drawings
- 4 3 2 1 0 13. Demonstrate an awareness of current manufacturing standards & Methodologies
- 4 3 2 1 0 14. Demonstrate ability to incorporate industry specific codes as given for a selected project
- 4 3 2 1 0 15. Demonstrate ability to set and work within defined budget
- 4 3 2 1 0 16. Research & use information for product development
- 4 3 2 1 0 17. Manipulate materials and processes to meet client needs
- 4 3 2 1 0 18. Demonstrate ability to manage and set project goals and timelines

**39207- PRODUCTION WELDING PROCESSES I (1 Credit) (Pre-requisite for Production Welding Processes II and Automated Systems) A technical level course designed to instruct students in the knowledge and skills needed to perform welding procedures.**

- 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. Identify and describe welding theory related to standard processes
- 4 3 2 1 0 5. Make welds using the oxyfuel process
- 4 3 2 1 0 6. Braze weld carbon steel
- 4 3 2 1 0 7. Describe the flame cutting process
- 4 3 2 1 0 8. Strike the Arc/weld a pad of beads
- 4 3 2 1 0 9. Describe nondestructive testing methods and demonstrate their use
- 4 3 2 1 0 10. Describe destructive testing methods and demonstrate their use
- 4 3 2 1 0 11. Identify physical and chemical properties of metals and how they impact a metals' weldability
- 4 3 2 1 0 12. Draw welding symbols to illustrate a welded joint
- 4 3 2 1 0 13. Weld joints in the F and H positions using a fast fill electrode
- 4 3 2 1 0 14. Weld joints in the F and H positions using multi-pass technique GMAW
- 4 3 2 1 0 15. Weld joints in the F and H positions using multi-pass technique GTAW
- 4 3 2 1 0 16. Weld joints in the F and H positions using multi-pass technique SMAW

**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.**

- 4 3 2 1 0 1. Solve complex written problems in fabrication
- 4 3 2 1 0 2. Measure materials and solve fabrication problems using welding specific measuring tools
- 4 3 2 1 0 3. Calculate the material required from a bill of materials

- 4 3 2 1 0 4. Calculate weld sizes from prints, drawings, and measure welds produced in the lab
- 4 3 2 1 0 5. Measure weld defects
- 4 3 2 1 0 6. Weld joints in the V position using SMAW on a variety of materials
- 4 3 2 1 0 7. Weld joints in the V position using GTAW on a variety of materials
- 4 3 2 1 0 8. Weld joints in the OH position using SMAW on a variety of materials
- 4 3 2 1 0 9. Weld joints in the OH position using GMAW on a variety of materials
- 4 3 2 1 0 10. Weld joints in the F, H, and V position using FCAW
- 4 3 2 1 0 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.

- 4 3 2 1 0 1. Set up a robotic cell and program a movement path.
- 4 3 2 1 0 2. Program a part on a robotic cell.
- 4 3 2 1 0 3. Run a programmed part and edit the program to include a fixture movement.
- 4 3 2 1 0 4. Program a new job and edit the job.
- 4 3 2 1 0 5. Create a robot program using a weave instruction format.
- 4 3 2 1 0 6. Create a new program on an assembled part, set up, and run the part.

**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.).

- 4 3 2 1 0 1. Research and apply composite

- materials fabrication.
- 4 3 2 1 0 2. Research and apply overlay/veneer materials fabrication (for woods based courses).
- 4 3 2 1 0 3. Research and apply appropriate tooling methods for chosen materials.
- 4 3 2 1 0 4. Research and apply appropriate methods of assembly for materials and applications (adhesives, welds, etc.).
- 4 3 2 1 0 5. Research and apply appropriate finishes and proper finish procedure of chosen materials.
- 4 3 2 1 0 6. Design and engineer a product using CAD and/or CAM software systems.
- 4 3 2 1 0 7. Understand and demonstrate operations of advanced technology systems.
- 4 3 2 1 0 8. Demonstrate effective techniques to manage and organize production flow.
- 4 3 2 1 0 9. Research and understand related career fields and postsecondary training opportunities.
- 4 3 2 1 0 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.

- 4 3 2 1 0 1. Utilize technology resources to investigate training, education and careers available in the mechanical trades fields of construction.
- 4 3 2 1 0 2. Perform the drafting and sketching principles needed to draw basic geometric shapes.
- 4 3 2 1 0 3. Develop a pictorial sketch of an object.
- 4 3 2 1 0 4. Develop a multi-view drawing.
- 4 3 2 1 0 5. Develop a flat-view of an object as it would be seen before assembly.
- 4 3 2 1 0 6. Develop a materials list for the construction of a project.
- 4 3 2 1 0 7. Recognize and identify basic blueprint terms, components and symbols.
- 4 3 2 1 0 8. Demonstrate the ability to read a ruler and calculate square feet and cubic feet.

### 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 flows from production/working 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 and 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 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.
- 4 3 2 1 0 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 maintenance applications.

- 4 3 2 1 0 1. Perform bench work and layout operations
- 4 3 2 1 0 2. Demonstrate precision measuring
- 4 3 2 1 0 3. Perform layout operations
- 4 3 2 1 0 4. Operate Drilling Machines
- 4 3 2 1 0 5. Operate Manual Lathes
- 4 3 2 1 0 6. Operate Manual Milling Machines
- 4 3 2 1 0 7. Operate grinding tools and equipment
- 4 3 2 1 0 8. Interpret blueprint drawings
- 4 3 2 1 0 9. Use Metric & English standards of measurement
- 4 3 2 1 0 10. Demonstrate the use of hand tools
- 4 3 2 1 0 11. Cut threads with taps and dies
- 4 3 2 1 0 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.**

- 4 3 2 1 0 1. Identify safe practices and safety and health issues and procedures
- 4 3 2 1 0 2. Describe metallurgy and identify metals
- 4 3 2 1 0 3. Demonstrate proper use of personal protective equipment and safe work habits
- 4 3 2 1 0 4. Make welds using the oxyfuel process
- 4 3 2 1 0 5. Braze weld carbon steel
- 4 3 2 1 0 6. Braze weld cast iron
- 4 3 2 1 0 7. Perform torch soldering operations on a variety of materials
- 4 3 2 1 0 8. Manually operate an oxyfuel torch to cut carbon steel structural materials of varying thicknesses
- 4 3 2 1 0 9. Plasma cut materials in shapes, bevels, and straight lines
- 4 3 2 1 0 10. Demonstrate safe set up of welding equipment
- 4 3 2 1 0 11. Weld joints in the F and H positions using a fast freeze electrode
- 4 3 2 1 0 12. Weld joints in the F and H positions using a low hydrogen electrode
- 4 3 2 1 0 13. Weld joints in the F and H positions using GMAW carbon steel
- 4 3 2 1 0 14. Weld joints in the F and H positions using GTAW carbon steel
- 4 3 2 1 0 15. Weld common pipe joints using SMAW, GMAW, and GTAW processes
- 4 3 2 1 0 16. Layout and weld a project from a print

**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.**

- 4 3 2 1 0 1. Demonstrate working knowledge of gears and gear drives
- 4 3 2 1 0 2. Calculate gear ratios
- 4 3 2 1 0 3. Apply working knowledge of hydraulic and pneumatic power
- 4 3 2 1 0 4. Calculate pressures and forces associated with hydraulic and pneumatic power
- 4 3 2 1 0 5. Incorporate application knowledge of linear motion concepts
- 4 3 2 1 0 6. Apply working knowledge of belt and belt drives
- 4 3 2 1 0 7. Utilize knowledge of ratings of motors
- 4 3 2 1 0 8. Identify and size for replacement various types of bearings and bushings
- 4 3 2 1 0 9. Apply working knowledge of chain and chain drives
- 4 3 2 1 0 10. Demonstrate application knowledge of adjustable variable speed drives
- 4 3 2 1 0 11. Troubleshoot various controls
- 4 3 2 1 0 12. Demonstrate working knowledge of couplings and U Joints
- 4 3 2 1 0 13. Demonstrate conceptual knowledge of the following predictive maintenance technologies: vibration analysis, infrared thermography, oil analysis, ultrasonic thickness measurement, passive ultrasonic leak detection
- 4 3 2 1 0 14. Describe common applications for the following predictive maintenance technologies: vibration analysis, infrared thermography, oil analysis, ultrasonic thickness measurement, passive ultrasonic leak detection

**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.

- 4 3 2 1 0 1. Apply needed caulking and/or paint to interior and exterior finishes.
- 4 3 2 1 0 2. Demonstrate ability to repair/replace damaged wallboard, wood trim and cabinetry.
- 4 3 2 1 0 3. Utilize knowledge of bearing walls when reconfiguring room design and/or constructing building additions.
- 4 3 2 1 0 4. Repair/replace floor coverings.
- 4 3 2 1 0 5. Troubleshoot and repair problems with HVAC systems.
- 4 3 2 1 0 6. Troubleshoot and repair water supply, water heater, and water drainage problems.
- 4 3 2 1 0 7. Troubleshoot and repair problems in lighting fixtures, including ballast replacement.
- 4 3 2 1 0 8. Utilize appropriate meters/tools to locate electrical circuit problems.
- 4 3 2 1 0 9. Replace breakers, plugs, switches and light fixtures.
- 4 3 2 1 0 10. Repair/Replace windows, storm windows, doors and storm doors.
- 4 3 2 1 0 11. Install and perform maintenance procedures on electric motors.
- 4 3 2 1 0 12. Evaluate and assess the extent and condition of remodeling/maintenance problems.
- 4 3 2 1 0 13. Develop a checklist to track preventative maintenance.

**38012 – SHEET METAL & HVACR (1 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, and to install and maintain HVAC and refrigeration systems.

- 4 3 2 1 0 1. Safely utilize and maintain tools common to the sheet metal trade.
- 4 3 2 1 0 2. Demonstrate blueprint reading skills including the interpretation of plans, elevations, schedules, and details.
- 4 3 2 1 0 3. Identify the three basic types of layout: parallel line, radial line, and triangulation.
- 4 3 2 1 0 4. Layout and fabricate a basic joint of ductwork, including seams and transverse joints.
- 4 3 2 1 0 5. Utilize a tape measure to obtain correct measurements for a ductwork detail.
- 4 3 2 1 0 6. Describe types and thicknesses of sheet metal.
- 4 3 2 1 0 7. Layout and fabricate basic sheet metal fittings.
- 4 3 2 1 0 8. 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)**

- 4 3 2 1 0 9. Safely utilize and maintain tools common to the mechanical trades industry.
- 4 3 2 1 0 10. Describe the refrigeration/cooling and heating process.
- 4 3 2 1 0 11. Describe various types of heating and cooling systems, including the pros, cons and applications of each.
- 4 3 2 1 0 12. Demonstrate basic electrical knowledge of how electrical circuits operate.
- 4 3 2 1 0 13. Correctly use a multi-meter to identify voltage, continuity, and ohms.
- 4 3 2 1 0 14. Install basic programmable heat/cool thermostat.
- 4 3 2 1 0 15. Describe thermostat wire and identify what each color should be used for.

- 4 3 2 1 0 16. Correctly measure, cut, and join piping/tubing.
- 4 3 2 1 0 17. Explain different types of refrigerant and their applications.
- 4 3 2 1 0 18. Connect and read manifold gauges for troubleshooting.
- 4 3 2 1 0 19. Recover, vacuum, and refill refrigerant.
- 4 3 2 1 0 20. Troubleshoot and repair problems with HVAC/Refrigeration systems.
- 4 3 2 1 0 21. Research future trends in “green technology” for the HVAC industry.
- 4 3 2 1 0 22. 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.

- 4 3 2 1 0 1. Safely utilize and maintain tools common to the sheet metal trade.
- 4 3 2 1 0 2. Demonstrate blueprint reading skills including the interpretation of plans, elevations, schedules, and details.
- 4 3 2 1 0 3. Identify the three basic types of layout: parallel line, radial line, and triangulation.
- 4 3 2 1 0 4. Layout and fabricate a basic joint of ductwork, including seams and transverse joints.
- 4 3 2 1 0 5. Utilize a tape measure to obtain correct measurements for a ductwork detail.
- 4 3 2 1 0 6. Describe types and thicknesses of sheet metal.
- 4 3 2 1 0 7. Layout and fabricate basic sheet metal fittings.
- 4 3 2 1 0 8. 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.

- 4 3 2 1 0 1. Safely utilize and maintain tools common to the mechanical trades industry.
- 4 3 2 1 0 2. Describe the heating and cooling process.
- 4 3 2 1 0 3. Demonstrate the use of a duct calculator and the formulas used to calculate heat loads.
- 4 3 2 1 0 4. Apply layout to HVAC projects.
- 4 3 2 1 0 5. Describe various types of heating and cooling systems, including the pros, cons and applications of each.
- 4 3 2 1 0 6. Demonstrate basic electrical knowledge of how electrical circuits work and how they are used within the industry.
- 4 3 2 1 0 7. Install basic and programmable heat/cool thermostats.
- 4 3 2 1 0 8. Describe thermostat wire and identify what each color should be used for.
- 4 3 2 1 0 9. Research future trends in “green technology” for the HVAC industry.
- 4 3 2 1 0 10. Troubleshoot and repair problems with HVAC systems.
- 4 3 2 1 0 11. Correctly measure, cut and join piping/tubing.
- 4 3 2 1 0 12. Demonstrate proper soldering techniques.
- 4 3 2 1 0 13. 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.

- 4 3 2 1 0 1. Demonstrate proper use of basic hand and power tools used in the plumbing trade.

- 4 3 2 1 0 2. Correctly measure, cut and join plastic, carbon steel and/or stainless steel piping/tubing.
- 4 3 2 1 0 3. Identify and install the most common types of sinks and toilets.
- 4 3 2 1 0 4. Identify and describe the functions of the major components of a water distribution system.
- 4 3 2 1 0 5. Identify and install pipe hangers and supports.
- 4 3 2 1 0 6. Identify the types of schedules and drawings used within the plumbing trade.
- 4 3 2 1 0 7. Demonstrate proper soldering techniques.
- 4 3 2 1 0 8. Identify different types of plumbing systems and their components.
- 4 3 2 1 0 9. Demonstrate proper safety procedures within the plumbing trade.
- 4 3 2 1 0 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.

- 4 3 2 1 0 1. Cut, ream, thread and bend conduit.
- 4 3 2 1 0 2. Compute branch circuit loads and explain installation requirements.
- 4 3 2 1 0 3. Demonstrate the procedure for safely using a clamp-on ammeter and a voltage tester.
- 4 3 2 1 0 4. Demonstrate procedures for installing raceways and boxes.
- 4 3 2 1 0 5. Demonstrate ability to correctly pull wire through conduit.

- 4 3 2 1 0 6. Select and install appropriate service entrance equipment according to codes.
- 4 3 2 1 0 7. Demonstrate the ability to properly ground electrical circuits according to codes.
- 4 3 2 1 0 8. Install breakers, plugs and switches.
- 4 3 2 1 0 9. Explain basic characteristics of series and parallel circuits.
- 4 3 2 1 0 10. Recognize and install various types of lighting fixtures.
- 4 3 2 1 0 11. Describe characteristics and functions of various fire alarm systems.
- 4 3 2 1 0 12. Describe characteristics and functions of various security and burglar alarm systems.
- 4 3 2 1 0 13. Describe the uses, characteristics and theory of low voltage systems.
- 4 3 2 1 0 14. Demonstrate knowledge of the uses and installation process for Closed Circuit TV.
- 4 3 2 1 0 15. Describe the components of and uses for electric lock hardware.
- 4 3 2 1 0 16. Demonstrate safe use of electric hand and power tools.
- 4 3 2 1 0 17. Understand and interact with LAN systems as a part of an overall security installation.
- 4 3 2 1 0 18. Demonstrate ability to install a lightning protection system.
- 4 3 2 1 0 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.

- 4 3 2 1 0 1. Compare & contrast the principles of hydraulics & pneumatics.
- 4 3 2 1 0 2. Demonstrate a working knowledge of hydraulics & pneumatics terminology.
- 4 3 2 1 0 3. Identify basic hydraulic and pneumatic symbols.
- 4 3 2 1 0 4. Read and understand Schematic Diagrams
- 4 3 2 1 0 5. Design and construct basic hydraulic and pneumatic circuits
- 4 3 2 1 0 6. Demonstrate proper use of pneumatic and hydraulic-operated Tools
- 4 3 2 1 0 7. Explain the operation of air compressors and vacuum pumps
- 4 3 2 1 0 8. Perform diagnostic procedures on hydraulic and pneumatic systems
- 4 3 2 1 0 9. Compare & contrast the use of synthetic and petroleum-based lubricants in hydraulic systems
- 4 3 2 1 0 10. Create a comprehensive maintenance schedule for hydraulic & pneumatic systems
- 4 3 2 1 0 11. Identify components in a fluid power/pneumatic circuit

**13348- WORK-BASED MAINTENANCE EXPERIENCE (.5Credit)**

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)

- 4 3 2 1 0 1. Work with a client to develop a client-driven product or perform maintenance tasks.
- 4 3 2 1 0 2. Demonstrate ability to access and utilize industry resources
- 4 3 2 1 0 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.