**Course Description**

Students develop foundational skills in manufacturing by exploring a variety of production methods and processes. Through hands-on learning and technical analysis, they gain experience in areas such as machining, electronics, material selection, and blueprint interpretation. Emphasis is placed on process planning, quality control, and safe work practices to support efficient and sustainable manufacturing operations.

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome 1.1. Employability Skills:** Develop career awareness and employability skills (e.g. face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.

1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g. filling out job applications, résumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

1.1.8. Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism.

1.1.9. Give and receive constructive feedback to improve work habits.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.

**Outcome 1.3. Business Ethics and Law:** Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.

1.3.3. Use ethical character traits consistent with workplace standards (e.g. honesty, personal integrity, compassion, justice).

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g. quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g. harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission [EEOC]).

**Strand 2. Electrical/Electronics**

Learners apply principles of electricity and electronics related to electronic theory, alternating and direct current, electronic components, electronic skills, digital electronics and power supplies. Knowledge and skills may be applied to fundamentals of electricity, analyzing and evaluating circuits, assembling components into electrical circuits, creating circuits to perform tasks and operations, wiring components to construct a communications system and providing power to an electrical system.

**Outcome 2.8 Battery Technology:** Understand batteries its principles and applications.

**Competencies**

2.8.5 Identify common uses of batteries in a variety of industries (Manufacturing, Automotive, Construction etc.)

2.8.6 Research new developments in battery technology such as new materials and designs, and the impact they could have on manufacturing

**Outcome 2.9 Battery Production:** Explain battery production process, considering material usage and environmental impact.

**Competencies**

2.9.3 Describe the different manufacturing processes used in battery production (e.g., electrode fabrication, cell assembly, and electrolyte filling)

2.9.4 Explain the selection of appropriate materials for battery components, considering factors such as conductivity, stability, and environmental impact.

2.9.5 Describe the environmental impact of battery production, and understand sustainability practices that can help produce the technology responsibly

2.9.6 Understand the relevant regulations and standards governing battery production, including safety and transportation requirements.

**Strand 5. Design and Development**

Learners apply principles of design and development related to the design process,

sketching and visualization, modeling, drafting, materials and production and process

design.

**Outcome 5.4 Material Selection:** Select materials for design projects and components.

**Competencies**

5.4.1 Compare advantages of materials used in manufacturing based on physical properties.

5.4.2 Identify the production processes used to create inputs.

5.4.3 Determine the appropriate material to be used to create a product considering production process factors and category of material (e.g., organic materials, metals, polymers, ceramics and composites).

**Outcome 5.5 Production and Process Design:** Identify and evaluate production and process design.

**Competencies**

5.5.1 Explain methods of casting, molding, and stamping for metal and plastic manufacturing

5.5.2 Determine appropriate mold design necessary for the production process

5.5.4 Identify the planning and process procedures for production (e.g., corrective preventive actions, audit documentation, Process Failure Mode Effect Analysis [PFMEA]).

5.5.5 Determine critical characteristics and establish quality controls.

5.5.7 Identify criteria and constraints and determine how those will affect the design of the production process.

5.5.9 Monitor performance and compare to time, tool and material cost estimates.

5.5.10 Adjust the production as necessary to respond to variations in the manufacturing process.

**Outcome 5.6 Layout and Planning:** Plan a machining process.

**Competencies**

5.6.1 Determine product requirements, dimensions and tolerances from drawing and specifications.

5.6.2 Determine process steps (e.g., cut, drill, turn, mill, grind, heat treat).

5.6.3 Plan individual process steps based on industry standards (e.g., manufacturers' specifications, machining standards).

5.6.4 Schedule for machining equipment as required.

5.6.5 Determine the appropriate manufacturing technique that should be utilized when creating the product.

**Outcome 5.7** **Blueprint Interpretation:** Read, interpret, and utilize blueprints to produce accurate products.

**Competencies**

5.7.1 Identify and interpret standard symbols used in blueprints.

5.7.2 Demonstrate the ability to read and convert measurements from scaled drawings.

5.7.3 Differentiate between various line types (e.g., solid, dashed) and their meanings in a blueprint.

5.7.4 Analyze and interpret dimensions, tolerances, and annotations effectively.

**Outcome 5.8 Schematic Interpretation:** Read, interpret, and utilize schematics to produce accurate products.

**Competencies**

5.8.1 Identify and interpret standard symbols used in schematics.

5.8.2 Recognize and label key components and systems within a schematic

5.8.3 Trace the flow of systems of schematic diagrams.

5.8.4 Utilize reference notes and legends to clarify details and specifications of schematics

**Strand 6. Precision and Advanced Machining**

Learners apply principles of precision machining to measuring work pieces, drawing interpretation, inspection, bench work and layout, power saws, drilling machines, lathes and turning machines, milling machines and grinding machines.

**Outcome 6.1 Subtractive Manufacturing:** Perform subtractive manufacturing using a variety of methods and techniques

**Competencies**

6.1.1 Describe the steps of the subtractive manufacturing (e.g., pre-processing processing and post-processing).

6.1.2 Identify the type of material, tooling, and subtractive method required to meet product specifications

6.1.3 Select appropriate machine, cutting tool, work holding device, speeds, cutting fluids, and end of arm tooling required to produce the part

**Outcome 6.2 Additive Manufacturing:** Apply standard practices of additive manufacturing.

**Competencies**

6.2.1 Describe the steps of the additive manufacturing (e.g., pre-processing processing and post-processing).

6.2.2 Identify the type of material, tooling, and additive method required to meet product specifications

6.2.3 Select appropriate machine, work holding device, speeds and end of arm tooling required to produce the part

**Outcome 6.3 Tooling:** Identify necessary and appropriate tooling to be used in production

**Competencies**

6.3.1 Classify various types of end-of-arm tooling used in machining. (i.e.: Grippers, Vacuums etc.)

6.3.2 Identify various types of materials used to create end-of-arm tools

6.3.3 Describe the functionality and purpose of the end-of-arm tool

6.3.4 Select an appropriate end-of-arm tool based off job specifications and material requirement

**Outcome 6.4. Computer Numerical Control (CNC):** Apply standard practices of CNC operations and

part inspection.

**Competencies**

6.4.1 Identify CNC machine components and controllers.

6.4.2 Plan a CNC production process for jobs in a machining cell.

**Outcome 6.5 Semiconductors:** Understand, describe, and apply semiconductor manufacturing processes and technologies.

**Competencies**

6.5.1 Describe a semiconductor product, such as a silicon wafer, and it's relevance to other products/technologies.

6.5.2 Explain the history of integrated circuit technology with a focus on function, size, power usage, and application.

6.5.3 Describe cleanroom requirements, purpose and maintenance.

6.5.4 Describe semiconductor processing, tools and chemistry.

6.5.5 Describe how a wafer is made.

**Strand 7 Computer Integrated Manufacturing**

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**Outcome 7.5 Automation:** Conceptualize the use of automation in manufacturing and apply this technique to a production process

**Competencies**

7.5.1 Describe key concepts of automation and its importance in advanced manufacturing

7.5.2 Identify various automation tools and techniques and explain their functions (e.g., robots, sensors, controls etc.)

7.5.8 Identify processes in the production that can be automated

**Strand 9 Technical Math and Science:**

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**Outcome 9.4 Measurement and Interpretation:** Interpret drawings and documentation and perform measurements.

**Competencies**

9.4.1 Identify measuring tools and gradations used in precision machining and their purposes.

9.4.2 Identify typical measurements in precision machining (e.g., angles, diameter, hardness).

9.4.3 Identify measuring systems and convert between systems.

9.4.4 Identify information and symbols provided in drawings and specifications.

9.4.5 Skill in taking accurate measurements of material properties, components, and finished products using appropriate measuring tools & equipment

9.4.6 Evaluate the influence environmental factors can have on a part (e.g., temperature)

9.4.7 Ability to utilize a variety of different measuring instruments

9.4.8 Identify advanced measuring techniques and understand how they are being used to measure work pieces (Probing, Scanning etc.)

**Strand 10 Maintenance and Safety**

Learners apply principles of protection, prevention and mitigation to create and maintain safe working conditions at manufacturing sites. Knowledge and skills may be applied in all aspects of personal and site safety, including handling materials, using tools and equipment, working with and around electricity and using personal protective equipment.

**Outcome 10.1 Site Safety:** Handle materials, prevent accidents and mitigate hazards.

**Competencies**

10.1.1 Knowledge of safety standards and regulations, including Hazard Communication (HAZCOM) and Occupational Safety and Health Administration (OSHA) requirements (e.g., Working at Heights, Confined Space)

10.1.2 Knowledge of risk identification, evaluation, and mitigation strategies

10.1.5 Identify source of electrical and mechanical hazards and use shut-down and established lock out/tag-out procedures.

10.1.6 Identify and eliminate worksite clutter in accordance with standards for cleanliness and safety.

10.1.8 Identify the location of emergency flush showers, eyewash fountains, Safety Data Sheets (SDSs), fire alarms and exits.

10.1.9 Respond effectively to manufacturing-related emergencies and adapt response plans.

10.1.10 Identify the components of a hazardous materials safety plan.

**Outcome 10.2 Personal Safety:** Practice personal safety.

**Competencies**

10.2.1 Interpret personal safety rights according to the Employee Right to Know plan.

10.2.2 Describe how working under the influence of drugs and alcohol increases the risk of accidents, lowers productivity, raises insurance costs and reduces profits.

10.2.3 Select, use, store, maintain and dispose of personal protective equipment (PPE) appropriate to job tasks, conditions and materials.

10.2.4 Identify workplace risk factors associated with lifting, operating and moving heavy objects and establish an ergonomics process.

10.2.5 Identify, inspect and use safety equipment appropriate for a task.

10.2.6 Use safe practices when working with electrical, mechanical, or other equipment.