**Course Description:**

This course introduces students to modern manufacturing organizations, technology, business systems, and problem solving. Provides the fundamentals of Lean Manufacturing, Quality Systems and Statistical Process Control, documentation and standard operating procedures, concepts in measurement, geometric dimensioning and tolerancing, visualization and graphics.

**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.

1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits, and abusive behavior.

**Outcome 1.2. Leadership and Communications:** Process, maintain, evaluate, and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.1. Extract relevant, valid information from materials and cite sources of information.

1.2.2. Deliver formal and informal presentations.

1.2.3. Identify and use verbal, nonverbal, and active listening skills to communicate effectively.

1.2.4. Use negotiation and conflict-resolution skills to reach solutions.

1.2.5. Communicate information (e.g. directions, ideas, vision, workplace expectations) for an intended audience and purpose.

1.2.6. Use proper grammar and expression in all aspects of communication.

1.2.7. Use problem-solving and consensus-building techniques to draw conclusions and determine next steps.

1.2.8. Identify the strengths, weaknesses, and characteristics of leadership styles that influence internal and external workplace relationships.

1.2.9. Identify advantages and disadvantages involving digital and/or electronic communications (e.g. common content for large audience, control of tone, speed, cost, lack of non-verbal cues, potential for forwarding information, longevity).

1.2.10. Use interpersonal skills to provide group leadership, promote collaboration, and work in a team.

1.2.11. Write professional correspondence, documents, job applications, and résumés.

1.2.12. Use technical writing skills to complete forms and create reports.

1.2.13. Identify stakeholders and solicit their opinions.

1.2.14. Use motivational strategies to accomplish goals.

**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.

1.3.6. Identify deceptive practices (e.g. bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance.

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]).

1.3.8. Verify compliance with computer, copyright, and intellectual property laws and regulations.

1.3.9. Identify potential conflicts of interest (e.g. personal gain, project bidding) between personal, organizational, and professional ethical standards.

**Outcome 1.4. Knowledge Management and Information Technology:** Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g. phone, radio equipment, fax machine, scanner, public address systems).

1.4.2. Select and use software applications to locate, record, analyze, and present information (e.g. word processing, electronic mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations, and codes (e.g. property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure, and monitor business records.

1.4.6. Use electronic database to access and create business and technical information.

1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g. lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

**Outcome 1.5. Global Environment:** Evaluate how beliefs, values, attitudes, and behaviors influence organizational strategies and goals.

**Competencies**

1.5.1. Describe how cultural understanding, cultural intelligence skills, and continual awareness are interdependent.

1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.

1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.

1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments.

1.5.5. Recognize the ways in which bias and discrimination may influence productivity and profitability.

1.5.6. Analyze work tasks for understanding and interpretation from a different cultural perspective.

1.5.7. Use intercultural communication skills to exchange ideas and create meaning.

1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

**Outcome 1.6 Business Literacy:** Develop foundational skills and knowledge in entrepreneurship, financial literacy and business operations.

**Competencies**

1.6.5 Describe organizational structure, chain of command, the roles and responsibilities of the organizational departments and interdepartmental interactions.

1.6.6 Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry.

1.6.7 Identify the effect of supply and demand on products and services.

1.6.8 Identify the features and benefits that make an organization's product or service competitive.

1.6.9 Explain how the performance of an employee, a department and an organization is assessed.

1.6.11 Describe how all business activities of an organization work within the parameters of a budget.

**Outcome 1.8 Operations Management:** Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.

**Competencies**

1.8.1 Forecast future resources and budgetary needs using financial documents (e.g., balance sheet, demand forecasting, financial ratios).

1.8.2 Select and organize resources to develop a product or a service.

1.8.4 Identify alternative actions to take when goals are not met (e.g., changing goals, changing strategies, efficiencies).

1.8.5 Use inventory and control systems to purchase materials, supplies and equipment (e.g., Last In, First Out [LIFO]; First In, First Out [FIFO]; Just in Time [JIT]; LEAN).

1.8.7 Collect information and feedback to help assess the organization's strategic planning and policymaking processes.

1.8.8 Identify routine activities for maintaining business facilities and equipment.

1.8.10 Analyze how business management and environmental management systems (e.g., health, safety) contribute to continuous improvement and sustainability.

**Strand 5. Pre‐Engineering: 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 5.2. Sketching, Drawing, and Visualization:** Conceptualize, sketch, and draw design projects and components.

**Competencies**

5.2.1. Compare technical sketching and drawing.

5.2.2. Sketch possible solutions to an existing design problem.

5.2.3. Apply tolerancing techniques when dimensioning.

5.2.4. Apply annotations on sketches and drawings.

5.2.7. Sketch geometric forms and shapes.

5.2.8. Describe geometric constraints (e.g. geometric dimension and tolerancing [GD&T], run out, location, and form).

5.2.9. Select a view to graphically communicate a design solution.

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

**Competencies**

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

5.5.4 Determine critical characteristics and establish quality controls.

5.5.5 Employ project scheduling techniques (e.g., critical path methodology [CPM], project evaluation and review technique [PERT]).

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

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

**Competencies**

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

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

6.1.3 Identify measuring systems and convert between systems.

6.1.4 Identify information and symbols provided in drawings and specifications.

6.1.5 Measure and inspect work pieces according to product specifications.

**Outcome 6.2 Layout and Planning:** Plan a machining process.

**Competencies**

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

**Outcome 6.11 Quality:** Apply quality processes.

**Competencies**

6.11.1 Describe quality control systems and their benefits (e.g., Statistical Process Control (SPC), Six Sigma, Total Quality Management (TQM), Lean Management, “Plan‐Do‐Check‐Act” and International Organization of Standardization standards, especially ISO 9001 for manufacturers).

6.11.6 Explain the basic principles and purpose of Quality Control and Quality Systems

6.11.7 Describe the seven basic tools of quality control.

6.11.8 Describe data set characteristics.

6.11.9 Describe types of variation and control charts.

6.11.10 Interpret a variety of charts and diagrams used in Statistical Process Control (SPC).

6.11.11 Assess the stability of a process using statistical methods.

6.11.12 Interpret SPC charts to identify assignable causes and corrective actions.

**Strand 7 Industrial 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 7.3 Industrial Maintenance Safety:** Plan, develop and ensure industrial maintenance safety.

**Competencies**

7.3.10 Deliver set‐up and operational procedures.

7.3.11 Demonstrate cleanroom gowning (Lab) using Standard Operating Procedures (SOP).

**Outcome 7.4 Industrial Maintenance Installation and Repair:** Inspect, maintain and repair industrial equipment.

**Competencies**

7.4.1 Identify installation techniques using manuals, checklists, and regulations.

7.4.3 Maintain inspection processes and records.

7.4.4 Calibrate and adjust manufacturing equipment.

7.4.5 Inspect and correct machine malfunctions.

7.4.7 Describe costs and benefits of proactive versus reactive maintenance.

7.4.8 Describe predictive time based, and preventative maintenance schemas.

**Strand 9 Fundamentals of Applied Physics**

**Outcome 9.1 Physics of Engineering:** Learn the fundamentals of physics as it relates to engineering.

**Competencies**

9.1.1 Display and interpret numbers in scientific notation and logarithmic scales

9.1.2 Describe and convert SI and US system units of measurement.

9.1.3 Identify and use both metric and inch rules.

9.1.4 Express physical quantities with appropriate number of significant digits, units and dimensions.

9.1.5 Perform operations on whole numbers, fractions and mixed numbers.

9.1.6 Analyze measurements and perform technical calculations.

9.1.11 Describe and justify the importance of dimensional measurement.

9.1.12 Identify/differentiate engineering drawings.

9.1.13 Interpret basic schematics or diagrams, including a parts list.

9.1.14 Use facility drawings to locate equipment.