**Course Description:**

In this first course, students will learn the breadth of the Agricultural and Industrial Power Technology pathway. Students will learn the principles of power technology equipment systems which will include electronic and electrical systems, engines and fuels, hydraulic systems and power train components. Additionally, students will learn to safely operate and maintain machinery and equipment along with the principles of welding and metal fabrication.

**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, resumé 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 resumés.

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

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 (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) 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], United States 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 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, e-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 the 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 an 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: 1.6. Business Literacy**

Develop foundational skills and knowledge in entrepreneurship, financial literacy and business operations.

**Competencies**

1.6.1. Identify business opportunities.

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.

**Outcome: 1.8. Operations Management**

Plan, organize and monitor an organization or department to maximize contribution to organizational goals and objectives.

**Competencies**

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).

1.8.6. Identify the advantages and disadvantages of carrying cost and Just-in-Time (JIT) production systems and the effects of maintaining inventory (e.g., perishable, shrinkage, insurance) on profitability.

1.8.8. Identify routine activities for maintaining business facilities and equipment.

**Outcome: 1.10. Sales and Marketing**

Manage pricing, place, promotion, packaging, positioning and public relations to improve quality customer service.

**Competencies**

1.10.1. Identify how the roles of sales, advertising and public relations contribute to a company’s brand.

1.10.2. Determine the customer's needs and identify solutions.

1.10.3. Communicate features, benefits and warranties of a product or service to the customer.

1.10.4. Identify the company policies and procedures for initiating product and service improvements.

1.10.5. Monitor customer expectations and determine product/service satisfaction by using measurement tools.

1.10.6. Discuss the importance of correct pricing to support a product’s or service’s positioning in the marketing mix.

**Outcome: 1.12. Site and Personal Safety Procedures**

Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action.

**Competencies**

1.12.1. Use Occupational Safety and Health Administration (OSHA) defined procedures for identifying employer and employee responsibilities, working in confined spaces, managing worker safety programs, using ground fault circuit interrupters (GFCIs), maintaining clearance and boundaries and labeling.

1.12.2. Interpret safety signs and symbols.

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

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

1.12.6. Identify procedures for the handling, storage and disposal of hazardous materials.

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

1.12.8. Identify safety hazards and take corrective measures.

1.12.9. Identify, inspect and use safety equipment appropriate for the task.

1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.

1.12.15. Select and operate fire extinguishers based on the class of fire.

*An “X” indicates that the pathway applies to the outcome.*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | |  | Horticulture |
|  | Natural Resource Management | X | Power Technology | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | |  | Does not apply | | |

**Strand 4. Power Systems**

Learners apply principles of tool use, power transmission, hydraulics, two- and four-stroke cycle combustion, heating and cooling, exhaust, ignition, starting and charging, steering and lubrication systems to operate, to maintain or repair equipment.

**Outcome: 4.1. Tool, Stationary and Mobile Equipment Maintenance**

Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

**Competencies**

4.1.1. Identify the types of hand tools, power tools and stationary equipment and describe their functions.

4.1.2. Ensure the presence and functionality of safety systems and hardware.

4.1.3. Identify potential hazards and limitations related to the use of hand tools, power tools and stationary equipment.

4.1.4. Maintain machinery, equipment, instrument and facility cleanliness, appearance and safety.

4.1.5. Inspect and service the electrical connections and lamps.

4.1.6. Inspect for fluid leakage, fluid levels and the condition of fluids.

4.1.7. Clean, lubricate and adjust machinery and equipment.

4.1.8. Select fluids, maintain fluid levels and replace system filters.

4.1.9. Inspect and maintain fluid conveyance and storage components (e.g., hoses and lines, valves,

nozzles).

4.1.10. Inspect and replace drive belts.

**Outcome: 4.2. Equipment Operations**

Operate and maintain mechanical equipment and power systems.

**Competencies**

4.2.1. Follow manufacturer’s recommended operating procedures and adjustment specifications.

4.2.2. Differentiate among the functions, limitations and proper use of equipment, equipment controls and instrumentation.

4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.

4.2.4. Perform appropriate start-up, operating and shut-down procedures.

4.2.5. Select and operate the equipment and attachments needed to complete the task including levers, pedals or valves.

**Outcome: 4.3. Engines**

Apply concepts to service components of both small and large internal combustion engines.

**Competencies**

4.3.1. Assess the physical and mechanical principles of engine operation, including motion, friction and thermodynamics.

4.3.2. Retrieve and record stored on-board diagnostics (OBD) trouble codes and clear codes where

applicable.

4.3.3. Locate the name plate and determine engine specifications.

4.3.4. Analyze, evaluate and troubleshoot an engine.

4.3.5. Compare and contrast two-cycle and four-cycle engines and their operating principles.

4.3.6. Evaluate engine head and engine block components to determine serviceability according to the manufacturer’s specifications.

4.3.7. Remove and replace components comprising the engine block and engine head.

4.3.8. Employ the requirements for engine servicing to maintain emission requirements.

**Outcome: 4.4. Lubrication and Cooling Systems**

Inspect lubrication and cooling systems operation.

**Competencies**

4.4.1. Explain principles of engine lubrication and cooling.

4.4.2. Perform lubrication, cooling system and pressure and sensor tests.

**Outcome: 4.5. Fuel, Air Induction and Exhaust System**

Diagnose and repair fuel, air induction and exhaust systems.

**Competencies**

4.5.1. Explain principles of exhaust, intake and turbocharger design and operations.

4.5.8. Explain fuel injection theory.

4.5.12. Understand and explain exhaust gas recirculation and exhaust gas treatment systems and methods.

4.5.15. Check and refill the diesel exhaust fluid (DEF) and service the diesel particulate filter (DPF).

**Outcome: 4.6. Ignition System**

Perform ignition system diagnosis and repair.

**Competencies**

4.6.1. Explain basic ignition system theory.

4.6.2. Use wiring diagrams and schematics to troubleshoot and repair ignition system components.

**Outcome: 4.7. Transmission of Power**

Diagnose and service power train components.

**Competencies**

4.7.1. Describe the features, benefits and applications of mechanical power transmission components (e.g., belts, chains, gears, bearings, universals).

4.7.2. Describe the physical and mechanical principles of mechanical, hydraulic, pneumatic and electrical power transfer.

4.7.3. Describe the features, benefits and applications of mechanical, hydraulic, pneumatic and electrical transmission.

4.7.12. Replace damaged and non-functioning power train components.

**Outcome: 4.8. Starting and Charging Systems**

Identify, inspect and repair starting and charging system components.

**Competencies**

4.8.1. Differentiate between electrical and engine mechanical problems that cause a slow crank or no crank condition.

4.8.2. Use wiring diagrams and schematics to troubleshoot and repair starting and charging system components.

**Outcome: 4.9. Steering, Suspension, and Traction**

Diagnose and repair steering, suspension and traction systems.

**Competencies**

4.9.1. Evaluate traction, ballasting and weight transfer on power equipment, including towing and trailering systems.

4.9.2. Evaluate and formulate solutions for vehicle stability to include automatic leveling devices, center of gravity, roll-over potential and wheel base dimensions.

4.9.3. Remove, inspect, repair or replace steering systems components, including linkages, gearbox, rack, power steering components and electronically controlled systems.

4.9.4. Align steering components, including tires and tracks.

4.9.5. Interpret tire and track wear patterns and consider product construction to evaluate replacement needs.

4.9.6. Differentiate bearing noise, vehicle pull and wheel vibration, shimmy and noise to determine vehicle efficiency.

**Outcome: 4.11. Hydraulic Systems**

Diagnose, repair and rebuild hydraulic systems.

**Competencies**

4.11.1. Interpret symbols and schematic drawings related to hydraulic system design.

4.11.2. Describe the physical and mechanical principles of hydraulics.

4.11.3. Explain the features, benefits and applications of the different types of hydraulic and hydrostatic systems.

4.11.4. Describe the application and operation of major components, including pumps, motors, valves and accumulators.

4.11.8. Evaluate system cleanliness to determine efficiency.

4.11.12. Prevent contamination of a hydraulic system.

**Outcome: 4.12. Brakes**

Identify, inspect and replace components of braking systems.

**Competencies**

4.12.1. Identify and locate components of braking systems.

4.12.8. Remove, inspect and replace brake components and inspect for leaks.

**Outcome: 4.13. Heating and Air Conditioning Systems**

Diagnose and repair vehicle heating and air conditioning systems.

**Competencies**

4.13.1. Apply the physical and mechanical principles of heating and cooling to heating, ventilating and air conditioning (HVAC) systems.

4.13.2. Interpret symbols and diagrams to ensure proper repair and replacement.

4.13.3. Identify the major components of the HVAC system, their functions and the overall operation of the system.

*An “X” indicates that the pathway applies to the outcome~~.~~*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | |  | Horticulture |
|  | Natural Resource Management | X | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**Strand 5. Structural Engineering**

Learners apply the principles of engineering related to electricity, structural repair and design, use of brick, block and concrete, water distribution, and metal working to design, construct, manage and maintain structures and biological systems used in agriculture, food and natural resources.

**Outcome: 5.1. Electrical Theory**

Interpret and apply electrical and electronic principles and theories.

**Competencies**

5.1.1. Interpret symbols and wiring diagrams.

5.1.2. Describe the features, benefits and applications of electrical and electronic systems.

5.1.13. Use a digital multimeter to determine voltage, current, frequency and phase.

**Outcome: 5.9. Physics and Metallurgy of Welding**

Apply the physics and metallurgy of welding in joining materials.

**Competencies**

5.9.1. Assess how the welding arc produces a weld.

5.9.2. Identify the factors that affect heat transfer and melting.

5.9.3. Describe the effects of arc length and shielding gases on the arc.

5.9.4. Identify key variables that determine the type of metal transfers.

5.9.5. Analyze the relationship between wire feed speed and welding current.

5.9.6. Describe pulsed arc transfer mode.

5.9.7. Apply the effects of wire size to deposition rate and current ranges.

5.9.8. Compare constant current and constant voltage power sources and how they relate to the self-regulation of arcs.

5.9.9. Explain conditions when arc blow occurs and how to reduce arc blow.

5.9.11. Apply concepts of how the common crystal structure in metallic materials affects welds.

5.9.13. Critique the types of weld imperfections and indicate their effects on material properties.

**Outcome: 5.10. Joining and Cutting Metals with Heat**

Join and cut steel using heat in horizontal and vertical positions.

**Competencies**

5.10.1. Classify, select, handle and store electrodes and match them to the job requirements based on the desired level of penetration and heat range.

5.10.2. Determine the correct welder type, wire diameter and gas to be used in a specific welding situation.

5.10.3. Compare and contrast metal welding operating characteristics and performance (e.g., oxy-fuel, shielded metal arc, gas tungsten arc, braising, soldering).

5.10.4. Select the joint design, weld type and welding position.

5.10.5. Set up and adjust the welder according to the material being welded and influencing conditions.

5.10.6. Store, handle and install high pressure gas cylinders.

5.10.7. Clean, prepare, align and secure the metal to be welded.

5.10.8. Compensate for the effects of expansion and contraction forces when joining metals.

5.10.9. Employ protective methods for surrounding equipment and materials during welding and cutting operations.

5.10.10. Perform continuous, stitch, tack, plug, butt and pinch welds with and without backing and fillet welds.

5.10.11. Conduct tests on each weld type and causes of defects.

5.10.12. Cut steel using oxy fuel and plasma equipment.

**Outcome: 5.11. Fabricating with Cold Metals**

Repair metal structures and equipment through cutting, shaping, forming and joining metal stock.

**Competencies**

5.11.1. Evaluate metal structures and equipment and plan the method of repair.

5.11.2. Lay out and cut metal.

5.11.3. Shape stock through bending, cutting, drilling and filing.

5.11.8. Process cold metals through tapping, threading, torqueing and smoothing.

5.11.9. Analyze the surface condition and select and apply abrasives and fillers for metals.

5.11.10. Contrast surface coatings and apply them under appropriate environmental conditions.

*An “X” indicates that the pathway applies to the outcome~~.~~*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management |  | Bioscience | | |  | Horticulture |
|  | Natural Resource Management | X | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |