## Agricultural and Environmental Systems Career Field

## Electronic & Electrical Systems

**Subject Code: 010215**

**Outcome & Competency Descriptions**

**Course Description:**

Students will diagnose, test and repair the electronic and electrical components found in industrial power equipment. Students will learn the physical principles of electricity and apply this knowledge in the maintenance, diagnostics and repair of electrical and electronic systems. Students will learn the physical and mathematical principles of electronics, controllers and sensors and will learn the operation of onboard computers and programmable controllers. Site and personal safety along with business and employability skills are emphasized throughout the course.

**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.

1.2.10. 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.

**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.

**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 are assessed.

**Outcome: 1.8. Operations Management**

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

**Competencies**

1.8.8. 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**

1.10.2. 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.

1.12.3. Interpret personal safety rights according to the employee Right to Know plan.

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.

1.12.11. Set up for ergonomic workflow.

1.12.12. Apply inspection, rejection criteria, hitch configurations and load handling practices to slings and rigging hardware.

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

**Strand 4. Power Systems**

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

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

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

**Competencies**

4.1.1. Inspect, clean, maintain and perform preventive maintenance on equipment.

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

4.1.3. Ensure the presence and functionality of safety equipment.

4.1.4. Identify potential hazards and limitations related to the use of equipment.

4.1.5. Maintain organization, and cleanliness of facilities, machinery, equipment and tools for safety and appearance.

4.1.6. Inspect and service the electrical systems and components.

4.1.11. Identify and maintain accuracy of tooling, machinery and equipment when performing preventive maintenance and repairs.

4.1.12 Compare alternative sources of power for equipment.

**Outcome: 4.3. Engines**

Apply concepts to service components of both small and large internal combustion engines per the OEM (original equipment manufacturer) operators manual.

**Competencies**

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

4.3.3. Locate data plate and determine engine specifications.

4.3.4. Analyze, evaluate and troubleshoot an engine.

4.3.10 Identify, describe and troubleshoot module communication errors (e.g., controller area network [CAN], BUS systems).

4.3.11 Inspect and test computerized engine control system sensors, powertrain control modules (PCMs), actuators and circuits.

**Outcome: 4.6. Ignition System**

Perform ignition system diagnostics 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.

4.6.3. Diagnose and repair ignition system problems for drivability.

4.6.4. Inspect, test, and replace ignition system circuit wiring and components.

4.6.5. Identify, describe, adjust ignition system timing, timing advance and retard.

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

Identify, inspect and repair starting and charging system components.

**Competencies**

4.8.1. Identify and differentiate between electrical and engine problems that cause a slow crank or no crank condition.

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

4.8.3. Inspect, test and replace fuses, relays, circuit breakers, and solenoids.

4.8.4. Perform charging system output tests.

4.8.5. Inspect, remove, replace and adjust alternator drive belts, pulleys, tensioners and check pulley and belt alignment.

4.8.6. Remove, inspect and install an alternator and starter per original equipment manufacturer (OEM) specification.

4.8.7. Measure and diagnose the causes of excessive key-off battery drain (parasitic draw).

4.8.8. Identify the high voltage circuit of electric or hybrid electric vehicles and related safety precautions.

**Strand 5. Elements of Production**

Learners apply principles of practice related to the management and maintenance of food, agriculture and natural resources systems.

**Outcome: 5.1. Electrical Theory**

Interpret and apply electrical and electronic principles and theories.

**Competencies**

5.1.1 Read and interpret wiring diagrams and symbols.

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

5.1.3. Describe the relationship between electrical effect and electromagnetic effect.

5.1.4. Explain methods of producing electrical current.

5.1.5. Describe the differences between alternating current (AC) and direct current (DC).

5.1.6. Compare and contrast conductors and insulators.

5.1.7. Differentiate the relationships among voltage, current, resistance and power in circuits and understand the basics of transformers.

5.1.8. Measure the amperage of AC and DC electrical systems and system components.

5.1.9. Calculate voltage, current, resistance, impedance and power in circuits using Ohm’s Law, Kirchhoff’s Law and Watt’s Law.

5.1.10. Describe the purpose of grounding and common methods used for grounding.

5.1.11. Describe the uses of series, parallel and series-parallel circuits.

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

**Outcome: 5.13. Electronic Systems**

Learners apply principles of electronics related to electronic theory, alternating and direct current, electronic components, electronic circuits, digital electronics, and power supplies.

**Competencies**

5.13.1. Describe static (open circuit) and dynamic (closed circuit) testing principles.

5.13.2. Measure the source voltage and perform voltage drop and current draw tests in electronic circuits.

5.13.3. Identify and describe the principles of capacitance and inductance.

5.13.4. Identify and describe the functions of non-suppressed, suppressed and bistable relays.

5.13.5. Inspect and test switches, connectors, relays, solenoid and wires of electronic circuits.

5.13.6. Identify manufacturer and repair or replace terminal connectors per OEM specifications.

5.13.7. Perform solder repair of electrical wiring.

5.13.8. Locate shorts, grounds, opens and resistance problems in electronic circuits.

5.13.9 Inspect, test, and reset or replace or reset fusible links, circuit breakers and fuses per OEM specifications.