# Agricultural and Environmental Systems Career Field

## Precision Applications in Agriculture, Food and Natural Resources

**Subject Code: 012035**

**Outcome & Competency Descriptions**

**Course Description:**

This course will provide a comprehensive overview of precision agriculture, emphasizing the integration of technology, data analysis, and sustainable practices to optimize production and resource utilization. Students will gain knowledge in the areas of electrical theory, electronic systems and controls applied to mapping, GIS, and equipment operation. Students will maintain, troubleshoot, and repair precision systems and components used in harvesting and storing agricultural and natural resources products.

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

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

**Outcome: 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.4. 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.

1.2.11. 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.

1.3.5. 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.

**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.

1.8.5 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).

**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.

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

1.12.14. Identify the source of electrical hazards and use shutdown and established lock-out/tag-out procedures.

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, to maintain and repair equipment.

**Outcome: 4.2. Equipment Operations**

Operate and maintain mechanical equipment and power systems.

**Competencies**

4.2.1. Follow original equipment manufacturer (OEM) recommended operating procedures and adjustment specifications as found in the operator's manual.

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 per the OEM (original equipment manufacturer) operators manual.

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

**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.

5.1.7. Differentiate the relationships among voltage, current, resistance and power in circuits.

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: 5.4. Surveying and Mapping**

Perform surveying procedures to construct a site plan.

**Competencies**

5.4.1. Identify civil drafting symbols and abbreviations.

5.4.2. Interpret maps, topographic site plans, deeds and aerial or satellite imagery for site planning.

5.4.3. Perform site measurements.

5.4.4. Integrate map and surveying data into geographic information system (GIS) or computer aided design (CAD) software.

5.4.5. Identify topographical and existing features of areas, including property lines, benchmarks, utilities, streets and setbacks, on survey maps, parcel maps and plats.

**Outcome: 5.5. Geographic Information Systems (GIS)**

Employ GIS computer applications to interpret data, maps and land use.

**Competencies**

5.5.1. Interpret and evaluate the accuracy of digital imagery and aerial photography.

5.5.2. Explain map projections and the use of scales.

5.5.3. Describe GIS data structures (e.g., vector, grid, triangulated irregular network [TIN]).

5.5.4. Explain digital elevation methods (e.g., digital elevation model [DEM], global positioning system [GPS]).

5.5.5. Interpret spatial interpolation and two- and three-dimensional functional spatial analyses.

5.5.6. Demonstrate ranging methods.

5.5.7. Identify sources of errors in GIS and formulate corrections and solutions.

5.5.8. Determine one’s position on the earth using GPS.

5.5.9. Integrate GPS data into GIS applications.

5.5.10. Identify desired user outcomes and create suitable instruction sheets and check sheets.

5.5.11. Assess soil compaction and analyze the correlation between soil compaction data and pixel value.

5.5.12. Identify suitability of given area for agricultural applications.

5.5.13. Analyze zonal statistics and perform raster manipulation.

5.5.14. Interpret results to create crop reports, prescriptions and application maps.

5.5.15. Conduct a temporal analysis to prepare recommendations.

5.5.16. Use geospatial technology to develop soil sampling grids or identify sampling sites for testing characteristics such as nitrogen, phosphorus, or potassium content, pH, or micronutrients.

**Outcome: 5.12. Precision Agriculture**

Analyze data from precision agriculture platforms and prepare recommendations.

**Competencies**

5.12.1. Identify a list of agricultural enterprises that can benefit from precision agriculture.

5.12.2. Identify and explain precision agriculture platforms and differentiate uses and benefits for specific platforms.

5.12.3. List specific precision agriculture techniques for pesticide application, yield mapping, soil analysis, tillage and planting operations, animal feed and water systems, temperature-controlled housing and specific machine functions.

5.12.4. Explain steps involved in procuring required equipment based on the desired outcome to meet a production goal.

5.12.5. Demonstrate proficiency using a multi-meter on precision components to determine reading from manufacture's specifications.

5.12.6. Determine the correct course of action based on preliminary troubleshooting findings.

5.12.7. Analyze each component in relation to the system and determine the suitability of a given component for different agriculture applications.

5.12.8. Apply precision agriculture information to specifically reduce the negative environmental impacts of production practices.

5.12.9. Explain how programable logic control (PLC) works and determine equipment malfunctions related to plc failure.

5.12.10. Interpret results and prepare recommendations to present findings to stakeholders.

5.12.11. Determine precision system based on cost and recommendation for an operation.

5.12.12. Explain and figure variable rate for production goal.

5.12.13. Identify and troubleshoot problems that arise with computer/network/hardware and software compatibility problems.

5.12.14. Calibrate, repair and maintain electronic equipment per manufacturer's specifications.

5.12.15. Identify and describe functions of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

**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 supply.

**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.

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

5.13.6. Identify manufacture 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.

**Outcome: 5.14. Motors and Programmable Logic Controllers**

Learns will apply the principles of installing motors, variable-frequency drives (VFD) and power wiring; as well as program, install and monitor digital computers used for automation of electronic mechanical processes to perform tasks.

**Competencies**

5.14.1. Identify types and components of single phase and three phase motors.

5.14.2. Interpret motor nameplate information and motor specifications.

5.14.3. Calculate motor loads.

5.14.4. Determine motor rotation needed for the installed load and explain the process for reversing rotation (i.e. three phase and single phase).

5.14.5. Interpret schematics and control diagrams for building a motor circuit.

5.14.6. Wire single phase and three phase circuits and install motor control devices (e.g. contactors, starters, variable-frequency drive (VFD) and motor speed controls).

5.14.7. Explain the starting sequence of motor components within a given circuit.

5.14.8. Troubleshoot and repair motor starting systems to verify operation according to schematics and control diagrams.

5.14.9. Describe the use of programmable logic circuits (PLC) in manufacturing automation.

5.14.10. Identify programmable logic controller (PLC) components.

5.14.11. Design a motor control program using manual and automatic modes.

5.14.12. Monitor and troubleshoot a network and hardwired system with a programmable logic controller (PLC).

5.14.13. Monitor and troubleshoot programmable logic controller (PLC) operation.

5.14.14. Install and maintain programmable logic controllers (PLCs).

**Strand 6. Environmental Science**

Learners apply earth, life and physical sciences to the production, extraction, processing, protection, use and renewal of both renewable and non-renewable resources.

**Outcome: 6.1. Soils**

Apply knowledge of soil characteristics and soil information resources to overcome any existing soil use limitations while maintaining or improving soil quality.

**Competencies**

6.1.3. Collect, test and analyze soil samples for physical and chemical properties.

6.1.9. Evaluate soil survey data and implement management decisions.

**Strand 8. Plant Science**

Learners apply principles of plant anatomy, physiology, nutrition and genetics to the research and development, selection and reproduction, planting, fertilization, health, harvesting and management of plants in a domestic and/or natural environment.

**Outcome: 8.1. Plant Nutrition**

Select and apply macronutrients and micronutrients based on deficiencies identified from the use of industry-driven testing, application, methods and optimum management strategies that account for environmental factors.

**Competencies**

8.1.5. Collect soil and plant tissue for testing and analysis using standard industry practice.

8.1.11. Select the methods and time of nutrient application and apply nutrients.

8.1.12. Describe and apply the 5 R's of nutrient management: (1)right source of fertilizer at the (2) right rate at the (3) right time in the (4) right place with the (5) right irrigation method.

**Outcome: 8.5. Harvesting**

Describe and implement harvesting methods.

**Competencies**

8.5.2. Describe safety precautions to take when harvesting.

8.5.3. Evaluate techniques to maximize yield through mechanical or hand harvesting methods.

8.5.4. Calculate and evaluate potential yield and loss due to harvesting.

8.5.5. Evaluate the impact of harvest techniques on the quality of plants and plant products.

8.5.6. Identify and implement harvesting methods and equipment.

**Outcome: 8.6. Handling and Storage**

Handle and store plants and plant products to maximize quality and longevity.

**Competencies**

8.6.2. Explain, monitor, and manipulate conditions for optimal handling and storage of plants and plant products.

8.6.3. Calculate potential yield and loss due to processing and storage.

8.6.5. Identify storage methods and storage capacity for plants and plant products.