Ohio CTE: Agricultural and Environmental Systems

Elements of Production

Electrical Theory: Interpret and apply electrical and electronic principles and theories. 5.1

1. **Read and interpret wiring diagrams and symbols.** 5.1.1
2. **Describe the features, benefits, and applications of electrical and electronic systems.** 5.1.2
3. **Describe the relationship between electrical effects and electromagnetic effects.** 5.1.3
4. **Explain methods of producing electrical current.** 5.1.4
5. **Describe the differences between alternating current (AC) and direct current (DC).** 5.1.5
6. **Compare and contrast conductors and insulators.** 5.1.6
7. **Differentiate the relationships among voltage, current, resistance, and power in circuits and understand the basics of transformers.** 5.1.7
8. **Measure the amperage of AC and DC electrical systems and system components.** 5.1.8
9. **Calculate voltage, current, resistance, impedance, and power in circuits using Ohm's Law, Kirchhoff's Law, and Watt's Law.** 5.1.9
10. **Describe the purpose of grounding and common methods used for grounding.** 5.1.10
11. **Describe the uses of series, parallel, and series-parallel circuits.** 5.1.11
12. **Use a digital multimeter to determine voltage, current, frequency, and phase.** 5.1.12
13. **Identify and describe single-phase and three-phase power and the advantages of each.** 5.1.13

Structural Electrical Circuits: Describe features of an electrical schematic that illustrates a wiring system and interpret

1. **Describe over-current protective devices and their functions.** 5.2.1
2. **Identify key information and follow manufacturer's recommendation to repair or replace motors per manufacturer specifications.** 5.2.2

and install the design. 5.2	**3** Map circuits and label the service panel directory to reflect devices installed on each circuit. 5.2.3
	4 Calculate service requirements for an electrical installation and evaluate for safe capacity. 5.2.4
	5 Identify types of cable, conduit, boxes, switches, outlets, and other common wiring devices. 5.2.5
	6 Identify fasteners, anchors, and fire stop systems. 5.2.6
	7 Select materials and lay out rough-in wiring runs according to specifications, drawings, and code requirements. 5.2.7
	8 Select and install lighting technologies and systems. 5.2.8
	9 Make conductor terminations and connect appliances to circuits. 5.2.9
	10 Identify and apply basic troubleshooting with electrical systems and circuits. 5.2.10
Design and Estimate: Interpret basic site plan for a desired outcome or company specification. 5.3	**1** Identify and interpret symbols, drawings, prints, and blueprints. 5.3.1
	2 Apply proportional measurement and scale techniques. 5.3.2
	3 Complete a site inventory and analysis, including physical conditions, code and utilities requirements, and the environmental impact. 5.3.3
	4 Develop a program list, including intended use, budget, economics, customer wants and needs, and maintenance. 5.3.4
	5 Identify and apply the principles of balance, proportion, scale, focal point, emphasis, rhythm, harmony, and unity to create a design. 5.3.5
	6 Identify and apply the elements of line, function, form, texture, and color to create a design. 5.3.6
	7 Identify and apply design, organizational, and spatial principles into a design. 5.3.7
	8 Calculate the space requirements and compute various attributes, including length, angle measurement, surface area, and volume. 5.3.8
	9 Identify construction documents, common scales, specifications, and materials used in construction or fabrication. 5.3.9
	10 Identify material, input, and equipment needs based on availability to calculate costs in production or application. 5.3.10
	11 Establish the sequential steps of construction and installation. 5.3.11

Surveying and Mapping: Perform surveying procedures to construct a site plan. 5.4	1 **Identify civil drafting symbols and abbreviations.** 5.4.1
	2 **Interpret maps, topographic site plans, deeds, and aerial or satellite imagery for site planning.** 5.4.2
	3 **Perform site measurements.** 5.4.3
	4 **Integrate map and surveying data into geographic information system (GIS) or computer aided design (CAD) software.** 5.4.4
	5 **Identify topographical and existing features of areas, including property lines, benchmarks, utilities, streets, and setbacks, on survey maps, parcel maps, and plats.** 5.4.5
Geographic Information Systems (GIS): Employ GIS computer applications to interpret data, maps, and land use. 5.5	1 **Interpret and evaluate the accuracy of digital imagery and aerial photography.** 5.5.1
	2 **Explain map projections and the use of scales.** 5.5.2
	3 **Describe GIS data structures (e.g., vector, grid, triangulated irregular network [TIN]).** 5.5.3
	4 **Explain digital elevation methods (e.g., digital elevation model [DEM], global positioning system [GPS]).** 5.5.4
	5 **Interpret spatial interpolation and two- and three-dimensional functional spatial analyses.** 5.5.5
	6 **Demonstrate ranging methods.** 5.5.6
	7 **Identify sources of errors in GIS and formulate corrections and solutions.** 5.5.7
	8 **Determine one's position on the earth using GPS.** 5.5.8
	9 **Integrate GPS data into GIS applications.** 5.5.9
	10 **Identify desired user outcomes and create suitable instruction sheets and check sheets.** 5.5.10
	11 **Assess soil compaction and analyze the correlation between soil compaction data and pixel value.** 5.5.11
	12 **Identify suitability of given area for agricultural applications.** 5.5.12
	13 **Analyze zonal statistics and perform raster manipulation.** 5.5.13
	14 **Interpret results to create crop reports, prescriptions, and application maps.** 5.5.14

	15 Conduct a temporal analysis to prepare recommendations. 5.5.15
	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. 5.5.16
Construction: Follow architectural plans to construct and repair agricultural structures and hardscapes. 5.6	1 Compare and contrast the structural properties, grades, and types of construction materials. 5.6.1
	2 Lay out, cut, smooth, shape, and bore construction materials. 5.6.2
	3 Lay out, cut, and install decks and floors. 5.6.3
	4 Lay out, cut, assemble, and brace framing components. 5.6.4
	5 Lay out, cut, and install stairs and steps. 5.6.5
	6 Lay out, cut, and install roof framing, roof trim accessories, and roofing materials. 5.6.6
	7 Install exterior doors and window units with hardware. 5.6.7
	8 Install exterior sheathing and siding with trim accessories. 5.6.8
	9 Install and repair glass, rigid plastic panels, or film plastic. 5.6.9
	10 Install and repair draft stops, weather stripping, thermal insulation, and vapor barriers. 5.6.10
	11 Analyze a surface's condition and select and apply abrasives and fillers. 5.6.11
	12 Contrast surface coatings and apply under appropriate environmental conditions. 5.6.12
	13 Review and apply facility and fencing options in a production setting. 5.6.13
Brick, Block and Concrete: Follow a design layout to install a structure using bricks, pavers, blocks, stone, or concrete. 5.7	1 Describe the physical properties of bricks, pavers, mortar, blocks, and concrete. 5.7.1
	2 Explain the chemical reactions within and between materials. 5.7.2
	3 Describe air ratio and slump. 5.7.3
	4 Perform layout and elevations using measurements to scale. 5.7.4
	5 Mix, place , and finish bricks, pavers, blocks, stone, or concrete. 5.7.5
	6 Install cut bricks, pavers, blocks, stone, or concrete with or without adhesives. 5.7.6

7 Install footers, lintels, sills, poured walls, floors, and accessories per manufacturer's specifications. 5.7.7

8 Install gravel and sand pads. 5.7.8

9 Layout and construct forms and reinforce them using steel, wire, and other materials. 5.7.9

10 Layout and install anchor bolts in concrete. 5.7.10

11 Install joints in concrete (e.g. expansion, saw cut vs tooled joint). 5.7.11

12 Select curing, coloring, and texturing additives or specialty finishes and apply to concrete for a specific purpose. 5.7.12

Water Distribution Systems: Calculate the demand for specific water applications and design and install water supply and drainage components. 5.8

1 Calculate water demand for specific applications. 5.8.1

2 Compare the types, applications, and operating principles of pumps and controls. 5.8.2

3 Locate water system entry points, walls, and chases. 5.8.3

4 Identify components of supply and drainage systems and describe their functions. 5.8.4

5 Describe how waste moves from a fixture through the drain system to the environment. 5.8.5

6 Describe factors that are considered when planning and installing a supply and drainage system. 5.8.6

7 Estimate and compute length, angle of measurement, area, surface area, and volume to calculate pipe legs and pipe sizes. 5.8.7

8 Calculate the slope required for drainage components. 5.8.8

9 Select supply and drainage components based on their application for a given purpose. 5.8.9

10 Explain the impact of modifying structural members to accommodate supply and drainage lines. 5.8.10

11 Join pipe, pipefittings, and valves of similar and dissimilar materials using solder, brazing, solvents, and mechanical means of joining. 5.8.11

12 Connect plumbing fixtures and appliances to a supply and drainage system. 5.8.12

13 Compare and contrast sources of contamination in water supplies and methods of filtering and disinfecting water. 5.8.13

	14 Prevent freezing and mechanical damage to pipes. 5.8.14
	15 Describe how water moves from the source through the water distribution system to the fixture. 5.8.15
	16 Test a water supply and drainage system for leaks and pressure using soap, inert gas, electronic sensors, and fluorescent dye. 5.8.16
	17 Maintain plumbing fixtures. 5.8.17
	18 Identify, describe, and install cross connection and backflow prevention devices. 5.8.18
Physics and Metallurgy of Welding: Apply the physics and metallurgy of welding in joining materials. 5.9	1 Assess how the welding arc produces a weld. 5.9.1
	2 Identify the factors that affect the deposit of weld metal and melting (e.g. speed, metal type, travel speed, amps, voltage, angles of electrode). 5.9.2
	3 Describe the effects of arc length and shielding gases on the arc. 5.9.3
	4 Identify key variables that determine the type of metal transfers. 5.9.4
	5 Analyze the relationship between wire feed speed and welding current. 5.9.5
	6 Describe pulsed arc transfer mode. 5.9.6
	7 Compare and contrast the relationship of wire size to deposition rate and current ranges. 5.9.7
	8 Compare constant current and constant voltage power sources and how they relate to the self-regulation of arcs. 5.9.8
	9 Explain conditions when arc blow occurs and how to reduce arc blow. 5.9.9
	10 Identify and describe the changes during solidification. 5.9.10
	11 Identify and describe concepts of common crystal structures in metallic materials. 5.9.11
	12 Identify and describe the types of weld imperfections and indicate their effects on material properties. 5.9.12
Joining and Cutting Ferrous and Non-Ferrous Materials with Heat: Join and cut ferrous and non-ferrous materials using heat in horizontal and vertical positions. 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. 5.10.1
	2 Determine the correct welder type, wire diameter, and gas to be used in a specific welding situation. 5.10.2

	3 Compare and contrast ferrous and non-ferrous material welding operating characteristics and performance. 5.10.3
	4 Identify and select the appropriate joint design, weld type, and welding position. 5.10.4
	5 Set up and adjust the welder according to the material being welded and influencing conditions. 5.10.5
	6 Store, handle, and install high pressure gas cylinders. 5.10.6
	7 Clean, prepare, align, and secure post-weld material. 5.10.7
	8 Compensate for the effects of expansion and contraction forces when joining ferrous and non-ferrous materials. 5.10.8
	9 Employ protective methods for surrounding equipment and materials during welding and cutting operations. 5.10.9
	10 Perform continuous, stitch, tack, plug, and butt welds with and without backing and fillet welds. 5.10.10
	11 Cut ferrous and non-ferrous materials using oxy fuel and plasma equipment based on the various applications. 5.10.11
Fabricating with Cold Ferrous and Non-Ferrous Materials: Repair ferrous and non-ferrous material structures and equipment through cutting, shaping, forming, and joining stock. 5.11	1 Evaluate ferrous and non-ferrous structures and equipment and plan the method of repair. 5.11.1
	2 Lay out and cut ferrous and non-ferrous material. 5.11.2
	3 Shape stock through bending, cutting, drilling, and filing. 5.11.3
	4 Form and assemble metal through cutting and bending. 5.11.4
	5 Edge metal through wiring, turning, beading, and crimping. 5.11.5
	6 Identify various methods of fastening ferrous and non-ferrous material. 5.11.6
	7 Fasten ferrous and non-ferrous material using a range of hardware. 5.11.7
	8 Process ferrous and non-ferrous material through tapping, threading, torquing, and smoothing. 5.11.8
	9 Analyze the surface condition and select and apply abrasives and fillers for ferrous and non-ferrous material. 5.11.9
	10 Contrast surface coatings and apply them under appropriate environmental conditions. 5.11.10

Precision Agriculture: Analyze data from precision agriculture platforms and prepare recommendations. 5.12	**1** Identify a list of agricultural enterprises that can benefit from precision agriculture. 5.12.1
	2 Identify and explain precision agriculture platforms and differentiate uses and benefits for specific platforms. 5.12.2
	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. 5.12.3
	4 Explain steps involved in procuring required equipment based on the desired outcome to meet a production goal. 5.12.4
	5 Demonstrate proficiency using a multi-meter on precision components to determine reading from manufacture's specifications. 5.12.5
	6 Determine the correct course of action based on preliminary troubleshooting findings. 5.12.6
	7 Analyze each component in relation to the system and determine the suitability of a given component for different agriculture applications. 5.12.7
	8 Apply precision agriculture information to specifically reduce the negative environmental impacts of production practices. 5.12.8
	9 Explain how programable logic control (PLC) works and determine equipment malfunctions related to plc failure. 5.12.9
	10 Interpret results and prepare recommendations to present findings to stakeholders. 5.12.10
	11 Determine precision system based on cost and recommendation for an operation. 5.12.11
	12 Explain and figure variable rate for production goal. 5.12.12
	13 Identify and troubleshoot problems that arise with computer/network/hardware and software compatibility problems. 5.12.13
	14 Calibrate, repair, and maintain electronic equipment per manufacturer's specifications. 5.12.14
	15 Identify and describe functions of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming. 5.12.15
Electronic Systems: Learners apply principles of electronics related to electronic	**1** Describe static (open circuit) and dynamic (closed circuit) testing principles. 5.13.1

theory, alternating and direct current, electronic components, electronic circuits, digital electronics, and power supply. 5.13	**2** Measure the source voltage and perform voltage drop and current draw tests in electronic circuits. 5.13.2
	3 Identify and describe the principles of capacitance and inductance. 5.13.3
	4 Identify and describe the functions of non-suppressed, suppressed, and bistable relays. 5.13.4
	5 Inspect and test switches, connectors, relays, solenoid, and wires of electronic circuits. 5.13.5
	6 Identify, manufacture, and repair or replace terminal connectors per OEM specifications. 5.13.6
	7 Perform solder repair of electrical wiring. 5.13.7
	8 Locate shorts, grounds, opens, and resistance problems in electronic circuits. 5.13.8
	9 Inspect, test, and reset or replace or reset fusible links, circuit breakers, and fuses per OEM specifications. 5.13.9
Motors and Programmable Logic Controllers: Learners 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. 5.14	**1** Identify types and components of single phase and three phase motors. 5.14.1
	2 Interpret motor nameplate information and motor specifications. 5.14.2
	3 Calculate motor loads. 5.14.3
	4 Determine motor rotation needed for the installed load and explain the process for reversing rotation (i.e. three phase and single phase). 5.14.4
	5 Interpret schematics and control diagrams for building a motor circuit. 5.14.5
	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). 5.14.6
	7 Explain the starting sequence of motor components within a given circuit. 5.14.7
	8 Troubleshoot and repair motor starting systems to verify operation according to schematics and control diagrams. 5.14.8
	9 Describe the use of Programmable Logic Circuits (PLC) in manufacturing automation. 5.14.9
	10 Identify Programmable Logic Controller (PLC) components. 5.14.10
	11 Design a motor control program using manual and automatic modes. 5.14.11

	12 Monitor and troubleshoot a network and hardwired system with a Programmable Logic Controller (PLC). 5.14.12
	13 Monitor and troubleshoot Programmable Logic Controller (PLC) operation. 5.14.13
	14 Install and maintain Programmable Logic Controllers (PLCs). 5.14.14
Animal Behavior: Apply management practices to assure animal welfare considering species-specific behaviors, human safety, social influences, public perception, and regulations associated with animal welfare. 5.15	1 Understand social influences, public perception, and regulations that are associated with animal welfare. 5.15.1
	2 Describe the adaptations and special senses (e.g., sight, hearing, smell, touch) of animals and how they contribute to animal behavior. 5.15.2
	3 Identify and describe the innate behavioral patterns of animals. 5.15.3
	4 Describe social relationships involved in behavioral adjustment and adaptation (e.g., animal-to-animal and human-to-animal interaction). 5.15.4
	5 Interpret an animal's intent based on its vocalization, body posture, and chemical means of communication. 5.15.5
	6 Recognize behavior abnormalities and recommend corrective action. 5.15.6
	7 Humanely handle, restrain, and move animals. 5.15.7
	8 Identity and describe the life expectancy and productive use of animals. 5.15.8
	9 Identify and describe the impacts of animal welfare and handling on meat quality and food safety. 5.15.9
	10 Compare and contrast proper and improper handling, equipment uses, and strategies that impact food quality. 5.15.10
	11 Identify methods to minimize animal stress and safety (physiology, psychological, and nutritional). 5.15.11
	12 Examine an animal to evaluate its general condition. 5.15.12
Biosecurity: Connect the sources and causes of contamination and develop protocols to implement biosecurity procedures. 5.16	1 Investigate sources and origins of agents that can contaminate processed and unprocessed food products. 5.16.1
	2 Identify activities and biological agents that contribute to the risk of acquiring or preventing a specific disease. 5.16.2
	3 Identify sources of biological and chemical tampering points. 5.16.3
	4 Assess a facility's biosecurity, classify the level of risk, and recommend improvements. 5.16.4

5 **Implement biosecurity procedures to prevent cross-site contamination (e.g., proper use and disposal of personal protective equipment [PPE] from site to site, vehicle cleaning between farm and processing site).** 5.16.5

6 **Screen and test animals and plant products for infectious agents or contamination.** 5.16.6

7 **Select bio-containment practices (e.g., quarantine, eradicate, showering into facilities) to manage pests and diseases.** 5.16.7

8 **Manage the biosecurity of raw materials and finished products during transportation (e.g., security seals, chain of custody).** 5.16.8