**Solar and Wind Energy**

Subject Code: 010717

Course & Unit Descriptions

**Course Description:**

Students will conduct Energy Site Assessments by using and interpreting resource maps, performance data, zoning requirements and interferences, installation timelines and price. They will read plans, lay out components and assemble electrical system components. Students will perform system checkouts and interpret results from mechanical and electrical diagnostic reports and compile and maintain system records. Throughout the course, students will apply safety regulations and identify and resolve public safety issues.

**Unit: Safety**

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.

Competency:

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.

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

1.12.13 Demonstrate the proper use of American National Standards Institute (ANSI) hand signals.

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.

1.12.17 Identify symptoms of exposure to health-threatening environments (e.g., temperature; chemical noise, vibration, harshness [NVH] hazards).

**Unit: History of Solar and Wind Energy**

Outcome 9.1

Energy Sources: Identify energy sources according to their economic viability, sustainability and environmental impact.

Competency:

9.1.2 Identify, compare and contrast renewable energy sources and the technology used to generate energy.

9.1.3 Identify, compare and contrast alternative energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).

9.1.4 Identify the social, economic and environmental drivers and barriers that influence the development and use of energy sources.

9.1.7 Determine best management practices (e.g., carbon sequestration, conservation, animal safety, efficiency) that lessen environmental impact.

Outcome 9.4

Solar Energy: Plan, install and maintain a solar array that can collect, store and distribute solar energy.

Competency:

9.4.1 Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP]) and how they produce energy.

Outcome 9.5

Wind Energy: Plan and maintain a wind energy installation that captures, stores and distributes electrical energy.

Competency:

9.5.3 Identify and describe technical standards and regulations for wind turbines.

**Unit: Site Selection**

Following local, state, and national regulations, students will identify locations where alternative energy processing centers can be designed and built. Students will use design and build principles along with surveying and mapping to determine layout and designs. Students will research local government and societal issues to determine if a site is suitable for construction.

Outcome 1.3

Business Ethics and Law: Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

Competency:

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.

1.3.4 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.

Outcome 5.3

Design and Estimate: Plan and design a basic site plan for a desired outcome.

Competency:

5.3.1 Identify, interpret and use symbols, lines, dimensions, views, sections, site plans, floor plans, specifications, common scales, detail drawings and abbreviations on drawings and prints.

5.3.3 Complete a site inventory and analysis, including physical conditions, code and utilities requirements and the environmental impact.

5.3.4 Develop a program list, including intended use, budget, economics, customer wants and needs and maintenance.

Outcome 5.4

Surveying and Mapping: Perform surveying procedures to construct a site plan.

Competency:

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 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.

Competency:

6.1.2 Describe the relationship among physical properties of soils.

6.1.6 Apply soil conservation practices to reduce soil erosion and compaction.

6.1.8 Describe soil limitations in agronomic, urban and natural resource practices.

6.1.9 Evaluate soil survey data and implement management decisions.

Outcome 9.1

Energy Sources: Identify energy sources according to their economic viability, sustainability and environmental impact.

Competency:

9.1.5 Calculate fuel equivalents among energy sources.

Outcome 9.4

Solar Energy: Plan, install and maintain a solar array that can collect, store and distribute solar energy.

Competency:

9.4.2 Conduct a site evaluation to identify an appropriate solar panel installation.

Outcome 9.5

Wind Energy: Plan and maintain a wind energy installation that captures, stores and distributes electrical energy.

Competency:

9.5.2 Conduct a site evaluation to identify an appropriate wind turbine installation.

**Unit: Installation**

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

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).

4.1.11 Calibrate metering, monitoring and sensing equipment.

Outcome 4.2

Equipment Operations: Operate and maintain mechanical equipment and power systems.

Competency:

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 5.3

Design and Estimate

Plan and design a basic site plan for a desired outcome.

Competency:

5.3.1 Identify, interpret and use symbols, lines, dimensions, views, sections, site plans, floor plans, specifications, common scales, detail drawings and abbreviations on drawings and prints.

5.3.3 Complete a site inventory and analysis, including physical conditions, code and utilities requirements and the environmental impact.

Outcome 5.6

Construction: Follow architectural plans to construct and repair simple outdoor structures and minor building additions.

Competencies

5.6.1 Compare and contrast the structural properties, grades and types of construction materials.

Outcome 5.7

Brick, Block and Concrete: Follow a design layout to install a structure using bricks, pavers, blocks, stone or concrete.

Competencies

5.7.1 Describe the physical properties of bricks, pavers, mortar, blocks and concrete.

Outcome 9.4

Solar Energy: Plan, install and maintain a solar array that can collect, store and distribute solar energy.

Competency:

9.4.3 Select the appropriate solar energy application for commercial and residential solar power.

9.4.4 Design a layout of solar arrays and associated equipment.

9.4.5 Identify and describe technical standards and regulations for a solar energy installation.

9.4.6 Interpret an electric schematic for a solar energy installation.

9.4.7 Install, test and maintain a solar energy installation.

Outcome 9.5

Wind Energy:Plan and maintain a wind energy installation that captures, stores and distributes electrical energy.

Competency:

9.5.1 Describe the internal and external components of wind energy installation.

9.5.4 Describe and differentiate the manufacturing processes for producing wind turbines.

9.5.5 Select and design an appropriate wind energy installation for commercial and residential applications.

9.5.6 Interpret an electric schematic for a wind energy installation.

**Unit: Operation & Maintenance**

Outcome 4.1

Tool, Stationary and Mobile Equipment Maintenance: Inspect, clean, maintain and perform planned preventative maintenance on tools, machinery, implements and equipment.

Competency:

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.

4.1.11 Calibrate metering, monitoring and sensing equipment.

Outcome 4.2

Equipment Operations: Operate and maintain mechanical equipment and power systems.

Competency:

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.

Outcome 4.11

Hydraulic Systems: Diagnose, repair and rebuild hydraulic systems.

Competency:

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.

4.11.5 Test and diagnose operating systems.

4.11.6 Test, diagnose and repair or replace fluid conveyance components (e.g., hoses, lines, fittings).

4.11.7 Test and diagnose electronic controls for hydraulic systems.

4.11.8 Evaluate system cleanliness to determine efficiency.

4.11.9 Locate hydraulic fittings and ports.

4.11.10 Remove, inspect and replace major components, including master cylinders and seals.

4.11.11 Measure flow rate, pressure and temperature.

4.11.12 Prevent contamination of a hydraulic system.

Outcome 5.1

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

Competency:

5.1.1 Interpret symbols and wiring diagrams.

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

5.1.4 Describe the relationship between electrical effect and electromagnetic effect.

5.1.5 Explain methods of producing electrical current.

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

5.1.7 Compare and contrast conductors and insulators.

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

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

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

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

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

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

Outcome 5.2

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

Competency:

5.2.1 Describe over-current protective devices and their functions.

5.2.2 Identify the types of motors and uses for each.

5.2.3 Map circuits and label the service panel directory to reflect devices installed on each circuit.

5.2.4 Calculate service requirements for an electrical installation and evaluate for safe capacity.

5.2.5 Identify types of cable, conduit, boxes, switches, outlets and other common wiring devices.

5.2.6 Identify fasteners, anchors and fire stop systems.

5.2.7 Select materials and lay out rough-in wiring runs according to specifications, drawings and code requirements.

Outcome 9.1

Energy Sources**:** Identify energy sources according to their economic viability, sustainability and environmental impact.

Competency:

9.1.6 Trace the transformations of energy within a system (e.g., mechanical to electrical, chemical to mechanical).

Outcome 9.4

Solar Energy: Plan, install and maintain a solar array that can collect, store and distribute solar energy.

Competency:

9.4.7 Install, test and maintain a solar energy installation.

Outcome 9.5

Wind Energy:Plan and maintain a wind energy installation that captures, stores and distributes electrical energy.

Competency:

9.5.7 Test and maintain wind energy components.

**Unit: Environmental Health**

Outcome 6.3

Air Quality: Analyze, interpret and manage the biological, chemical and physical properties of air quality.

Competency:

6.3.1 Determine the chemical and physical properties of air (e.g., composition, density, pressure).

Outcome 6.8

Contaminants and Pollution Control: Assess an affected area, determine the source and type of contaminant and respond.

Competency:

6.8.2 Determine the types, sources and impact of natural and man-made contaminants.

6.8.3 Monitor, analyze and quantify levels of contaminants from point and non-point sources.

6.8.6 Describe the environmental impact from both industrial and nonindustrial processes.

6.8.10 Develop and implement various emergency response plans.

Outcome 6.9

Hazardous Materials and Waste Management: Follow and apply handling, storage and recording procedures for hazardous materials and waste.

Competency:

6.9.2 Describe health and safety practices for reducing risks from hazardous materials (e.g., safety data sheet [SDS], employer notification forms, personal protective equipment [PPE]).

6.9.3 Demonstrate appropriate responses for major types of hazardous materials disasters (e.g., chemical releases, fires, explosions).

6.9.5 Demonstrate safe management, handling, disposal and recycling procedures for hazardous materials and waste.

6.9.6 Perform site assessments to detect and identify the presence and storage of hazardous materials.

Outcome 9.1

Energy Sources: Identify energy sources according to their economic viability, sustainability and environmental impact.

Competency:

9.1.8 Perform an energy evaluation to determine the best social, economic and environmental solution.

Outcome 9.4

Solar Energy: Plan, install and maintain a solar array that can collect, store and distribute solar energy.

Competency:

9.4.8 Compare and contrast equipment disposal methods.

**Unit: Business/Economics**

Outcome 1.3

Business Ethics and Law: Analyze how professional, ethical and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

Competency:

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.

1.3.4 Identify how federal and state consumer protection laws affect products and services.

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.

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

Outcome 1.6

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

Competency:

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.

Outcome 1.10

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

Competency:

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.

Outcome 1.11

Principles of Business Economics: Examine and employ economic principles, concepts and policies to accomplish organizational goals and objectives.

Competency:

1.11.1 Identify the economic principles that guide geographic location of an industry's facilities (e.g., relative scarcity, price, quantity of products and services).

1.11.4 Determine how the quality, quantity and pricing of goods and services are affected by domestic and international competition in a market economy.

1.11.8 Identify the relationships between economy, society and environment that lead to sustainability.

1.11.9 Describe how laws and regulations influence domestic and international trade.

**Unit: Leadership & Employability Skills**

Students will develop critical thinking and problem solving skills through the use of a variety of practical scenarios. Students will demonstrate leadership skills through participation with peer groups, support services, and professional organizations.

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.

Competency:

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.

Competency:

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.

1.2.13 Identify stakeholders and solicit their opinions.

1.2.14 Use motivational strategies to accomplish goals.