**Course Description**

Students will learn the fundamental principles of electricity with emphasis on AC (alternating current) circuits. They will use concepts of Ohm’s Law, the Power Formula and Kirchhoff’s Law with series, parallel and series-parallel circuit applications. The relationship between electricity and magnetism and motor theory will also be introduced. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of function generator, digital multimeter (DMM) and oscilloscope.

**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, résumé 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 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.

**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 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.

1.3.7. 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**

1.4.2. 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.

**Outcome 1.5. Global Environment:** Evaluate how beliefs, values, attitudes and behaviors influence organizational strategies and goals.

**Competencies**

1.5.1. Describe how cultural understanding, cultural intelligence skills and continual awareness are interdependent.

1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.

1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.

1.5.4. Recognize barriers in cross‐cultural relationships and implement behavioral adjustments.

1.5.5. Recognize the ways in which bias and discrimination may influence productivity and profitability.

1.5.6. Analyze work tasks for understanding and interpretation from a different cultural perspective.

1.5.7. Use intercultural communication skills to exchange ideas and create meaning.

1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

**Strand 2. Electrical/Electronics**

Learners apply principles of electricity and electronics related to electronic theory, alternating and direct current, electronic components, electronic skills, digital electronics and power supplies. Knowledge and skills may be applied to fundamentals of electricity, analyzing and evaluating circuits, assembling components into electrical circuits, creating circuits to perform tasks and operations, wiring components to construct a communications system and providing power to an electrical system.

**Outcome 2.1. Electrical and Electronic Theory:** Explain electrical and electronic principles and theory.

**Competencies**

2.1.1. Describe the structure of atoms and their relationship to electricity.

2.1.2. Compare electrical properties and electromagnetic effect.

2.1.3. Explain methods of producing electrical current.

2.1.5. Compare alternating current (AC) and direct current (DC).

2.1.6. Define the units of measurement for voltage, current, power and resistance.

2.1.7. Describe the relationships between voltage, current, resistance and power in circuits.

2.1.8. Determine voltage, current, resistance and power in circuits using Ohm’s Law, Kirchhoff’s Law and Watt’s Law.

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

2.1.10. Evaluate frequency and phase.

2.1.11. Identify methods of varying capacitance.

2.1.12. Calculate true power, apparent power, reactive power and power factor.

2.1.13. Determine impedance.

2.1.14. Compare peak (PK), root mean square (RMS) and average voltage.

**Outcome 2.2. Circuits:** Construct and analyze alternating current (AC) circuits and direct current (DC) circuits.

**Competencies**

2.2.1. Compare conductors and insulators.

2.2.2. Identify common types of transformers and list uses for each.

2.2.3. Explain step‐up/step‐down voltage methods.

2.2.4. Describe lamination and explain why laminations are used.

2.2.5. Identify types of capacitors and common usages for each.

2.2.6. Identify types of inductors and explain the purposes of different core materials.

2.2.7. Identify the function of inductors and capacitors in series and parallel circuits.

2.2.8. Explain the uses of series, parallel and series‐parallel circuits.

2.2.9. Construct and troubleshoot series, parallel and series‐parallel circuits.

2.2.10. Analyze wiring schematics and diagrams for accuracy and function.

2.2.11. Use circuit theorems in circuit analysis (e.g. Maximum power transfer, Thevenin, Source Transformation).

2.2.12. Use analysis techniques in circuit analysis (e.g. mesh, loop, superposition, single & double subscript notation).

**Outcome 2.3. Codes and Regulations:** Explain and apply the National Electrical Code (NEC) and other building codes.

**Competencies**

2.3.1. Explain the role of Underwriters Laboratory (UL), Canadian Standards Association (CSA) and Intertek Testing Service/Edison Testing Laboratory (ITS/ETL).

2.3.2. Identify information in the National Electrical Code (NEC) and other applicable codes.

**Outcome 2.4. Electronic Components:** Describe the functions and purposes of electronic components.

**Competencies**

2.4.1. Identify resistor values from color codes or other marks.

2.4.2. Compare resistor compositions and their uses.

2.4.3. Identify symbols for electronic components.

2.4.11. Define surface mount components.

**Outcome 2.5. Electronic Connections:** Connect individual components into an electrical circuit.

**Competencies**

2.5.1. Define the purpose of a connection and the differences between a good and bad connection.

2.5.2. Describe methods of electrical connections and the purpose for each method.

2.5.3. Select type of electrical connection for electrical components.

2.5.5. Use electrical connections to connect individual electronic units.

2.5.6. Combine components per wiring prints, schematics and block diagrams.

**Outcome 2.7. Cabling and Wiring:** Connect components to construct low-voltage, data and communication systems using coaxial or fiber optic cables and twisted pair or balanced wires.

**Competencies**

2.7.1. Describe the types, purposes and uses of cables and wires.

2.7.2. Identify the construction, impedance characteristics and use of cables and wires.

2.7.3. Explain how the characteristics of cables and wires cause impedance.

**Outcome 2.8. Power Supplies:** Provide power to electrical circuits.

**Competencies**

2.8.1. Identify the differences between transformer-powered supplies and line-connected supplies.

2.8.5. Select and install fuses and circuit breakers.

**Strand 5. Pre‐Engineering: Design and Development**

Learners apply principles of design and development related to the design process, sketching and visualization, modeling, drafting, materials and production and process design.

**Outcome 5.1. The Design Process:** Use the engineering design process and quality assurance principles to analyze and solve design problems.

**Competencies**

5.1.1. Describe the role of research, development and experimentation in design problem solving.

5.1.3. Develop multiple solutions and select an approach.

5.1.4. Develop a design proposal and make a model/prototype.

5.1.5. Evaluate and redesign a prototype using collected data.

**Outcome 5.2. Sketching, Drawing and Visualization:** Conceptualize, sketch and draw design projects and components.

**Competencies**

5.2.1. Compare technical sketching and drawing.

5.2.2. Sketch possible solutions to an existing design problem.

5.2.4. Apply annotations on sketches and drawings.

5.2.5. Create sketches using integration sketching techniques and styles.

5.2.10. Use reverse engineering to determine the strengths and weaknesses of a design.

**Outcome 5.3. Computer-Aided Drafting and Modeling:** Computer-aided Drafting and Modeling to illustrate the design of projects and components.

**Competencies**

5.3.2. Evaluate a sketch and generate a model utilizing three-dimensional modeling.

5.3.3. Compare conceptual, physical and mathematical design models used to check design.

5.3.17. Add technical elements (e.g. parts lists, titles, finishes, tolerances, specifications, hidden surfaces) to drawings.

**Strand 7. Industrial Maintenance and Safety**

Learners apply principles of protection, prevention and mitigation to create and maintain safe working conditions at manufacturing sites. Knowledge and skills may be applied in all aspects of personal and site safety, including handling materials, using tools and equipment, working with and around electricity and using personal protective equipment.

**Outcome 7.1. Site Safety**: Handle materials, prevent accidents and mitigate hazards.

**Competencies**

7.1.1. 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.

7.1.6. Identify source of electrical and mechanical hazards and use shut‐down and established lock out/tag‐out procedures.

7.1.7. Identify and eliminate worksite clutter in accordance with standards for cleanliness and safety.

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

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

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

7.1.11. Identify the components of a hazardous materials safety plan.

7.1.13. Set up for ergonomic workflow.

**Outcome 7.2. Personal Safety:** Practice personal safety.

**Competencies**

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

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

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

7.2.4. Identify workplace risk factors associated with lifting, operating and moving heavy objects and establish an ergonomics process.

7.2.5. Identify, inspect and use safety equipment appropriate for a task.

7.2.6. Use safe practices when working with electrical, mechanical, or other equipment.