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| **TEXAS CTE LESSON PLAN**  [www.txcte.org](http://www.txcte.org) | |
| **Lesson Identification and TEKS Addressed** | |
| **Career Cluster** | Science, Technology, Engineering, and Mathematics |
| **Course Name** | AD/DC Electronics |
| **Lesson/Unit Title** | Inductance |
| **TEKS Student Expectations** | **130.405. (c) Knowledge and Skills**  (4) The student develops skills for managing a project. The student is expected to:  (A) implement project management methodologies, including initiating, planning, executing, monitoring and controlling, and closing a project;  (7) The student develops an understanding of basic alternating current (AC) electricity principles. The student is expected to:  (A) describe AC and give examples of its application and generation;  (C) explain the relationship between mechanical load and current in a generator;  (D) identify the purpose and application of a transformer;  (E) identify voltage and current values relative to a turns ratio in a transformer;  (F) describe and calculate capacitance and capacitive reactance; and  (G) describe and calculate inductance and inductive reactance.  (8) The student implements the concepts and skills that form the technical knowledge of electronics using project-based assessments. The student is expected to:  (A) apply Ohm's law, Kirchhoff's laws, and power laws to actual or simulated circuits;  (C) demonstrate an understanding of magnetism and induction as they relate to electronic circuits;  (9) The student applies the concepts and skills to simulated and actual work situations. The student is expected to:  (B) apply electrical theory to generators, electric motors, and transformers |
| **Basic Direct Teach Lesson**  (Includes Special Education Modifications/Accommodations and  one English Language Proficiency Standards (ELPS) Strategy) | |
| **Instructional Objectives** | The student will be able to demonstrate an understanding of inductance concepts by correctly performing the procedures outlined on the lab activity handouts and by scoring at least   1. % on the *Inductance Exam*.   **Specific Objectives**   * Describe inductance * Define terms associated with inductance * Name three scientific laws dealing with inductance * Describe the meaning of scientific laws including Oersted’s Law, Faraday’s Law, and Lenz’s Law * Identify factors contributing to self-inductance * Recall formulas associated with inductance * Identify factors that affect the amount of inductance of a coil * Identify factors that determine mutual inductance * Identify facts about transformer ratios * Demonstrate the ability to determine transformer ratios |
| **Rationale** | When completed, students will be able to identify what inductance is and the properties, laws and mathematical rules that support the idea. |
| **Duration of Lesson** | Three 45-minute class periods and one 45-minute lab |
| **Word Wall/Key Vocabulary**  *(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* | **Terms**   * **Inductor-** a device (usually a coil) that introduces inductance into an electrical circuit * **Inductance-** the property of an electric circuit where a varying current induces an electromotive force(EMF) in that circuit or another circuit * **Self-inductance-** the property of an electric circuit when an EMF is induced back into itself by a changeof circuit current * **Henry-** the unit of inductance * **Permeability-** the measure of the ease with which material will pass lines of flux * **Mutual inductance-** the property of two circuits whereby an EMF is induced in one circuit by a changeof current in the other * **Coupling coefficient-** a number indicating the fraction of flux lines of one circuit cutting another circuit * **Transformer-** a device that transfers a changing current and voltage from one circuit to anotherthrough inductive coupling |
| **Materials/Specialized Equipment Needed** | **Instructional Aids**   * Lab Activity #1 * Lab Activity #2 * Assignment #1 * Assignment #2 * Assignment #3 * Assignment #4 * Assignment #5 * Answer Key#1-#5 Assignments * Inductive Reactance Written Exam and Answer Key * Inductive Reactance Exam and Answer Key |
| **Anticipatory Set**  (May include pre-assessment for prior knowledge) | **Preparation**   * Review this lesson document prior to each class * Review and become familiar with the terminology and the example problems   Have materials and handouts ready prior to the start of the lesson   * Have parts and equipment ready before lab   The purpose of the lesson is for students to be able to demonstrate an understanding of inductance concepts.   * **Say**  1. Now that we understand magnetism, we need to understand the relationship between electricity and magnetism.  * **Ask**  1. We know about electromagnets; can anybody give me examples of other things or situations where electricity and magnetism are related?  * **Ask**   1. Electricity and magnetism cause motors and generators to work, but did you know that a magnetic field is created around any wire conducting electricity? * **Show**   1. A motor (like a portable drill) * **Say**   1. The reason this motor works is because electricity is converted into a magnetic field using the principle of inductance. |
| **Direct Instruction \*** | * + 1. Introduction     2. Overview     3. Terms and definitions     4. Symbols and units  1. Laws involving induction    * 1. These laws are based on the historical discovery of the links between electricity and magnetism.      2. Oersted’s Law deals with a current creating a magnetic field around a conductor.      3. Faraday’s law deals with the creation of electricity from magnetism.      4. Lenz’s Law deals with how induced electricity compares to the originating electricity (self-induction) or magnetism (mutual induction). 2. What is Inductance    * 1. The property of an electric conductor or circuit that causes an electromotive force to be generated by a change in the amount of current.      2. An inductor is not a linear device like a resistor.      3. Inductance works two ways as described in   Oersted’s Law and Faraday’s Law.   * + 1. When we say, “inductance opposes a change in current,” that means that when the applied voltage creates an increased current through a linear device like a resistor, the inductor opposes that increase.     2. When the applied voltage creates a decreasing current in a linear device, the inductor returns energy back to the circuit which maintains current.  1. Inductors   A. An inductor is a coil of wire either wrapped around air or some type of iron core.   1. The core material is determined in part by how much inductance is wanted and the range of current used. 2. Inductors in series add inductance values, the same as resistors in series. 3. Inductors in parallel divide using the 1 over X formula, the same as resistors in parallel 4. Transformers   A. A transformer’s turn ratio is used to identify both the voltage ratio and the current ratio.  B. The voltage ratio is directly proportional to the turns ratio.  C. The current ratio is inversely proportional to the turns ratio.  D. Power in equals power out.  E. Power equals voltage times current (P=VI)  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **Guided Practice \*** | The students will observe, ask questions, and analyze the demonstration to be presented by the teacher. The teacher will use materials as listed in the lab activities to instruct how to read, measure, and record data as needed.  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | The students will perform the lab and answer the discussion questions in *Lab Activity #1* and *Assignments #1* *through #4* and will turn them in for evaluation.  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **Lesson Closure** | **Review**  Students will quiz each other on terms and concepts using flash cards. |
| **Summative/End of Lesson Assessment \*** | **Informal Assessment**  The teacher will ask questions and observe students working in the lab.  **Formal Assessment**  Students will complete the lab and assignments; they will also take the *Inductance Exam*.  *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*  None |
| **References/Resources/**  **Teacher Preparation** |  |
| **Additional Required Components** | |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** | |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy**  **Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies**  **Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication**  **90 Second Speech Topics** |  |
| **Other Essential Lesson Components** | |
| **Enrichment Activity**  (e.g., homework assignment) | The use of the multimeter to accurately measure voltage, current, resistance, and power can be used to develop technical problem-solving skills needed in the workplace. |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSA, Technology Student Association (TSA) |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)