I. INTRODUCTION

A. Electricity is a vital part of modern aviation technology. This course lays the foundation for further study of aviation electrical circuitry. This knowledge is necessary to understanding the way aircraft electrical systems function. This foundation will include aircraft electrical systems and their requirements including the use of ammeter, voltmeter and ohmmeter; series and parallel circuits; inductance and capacitance; magnetism; converting alternating current (AC) to direct current (DC); controlling devices; maintenance and servicing of aircraft batteries; and reading and interpreting aircraft electrical diagrams to include solid state devices and logic functions.

B. This is a required course of study for the Associate Degree of Applied Science in Aviation Maintenance Technology.

C. This course is occupationally related and serves as preparation for a career in the field of Aviation Maintenance.

D. Prerequisite: None

II. LEARNING OUTCOMES

Upon successful completion of this course the student will:

- Calculate and measure capacitance and inductance; calculate and measure electrical power; measure voltage, current, resistance and continuity; determine the relationship of voltage, current and resistance in electrical circuits; read and interpret aircraft electrical circuit diagrams including solid state devices and logical functions; inspect and service batteries; and demonstrate proper safety procedures. (C18-C20,F1,F4,F5,F10,F12)

III. INSTRUCTIONAL MATERIALS
A. The instructional materials identified for this course are viewable through www.ctcd.edu/books

B. Supplemental Reading: None


IV. COURSE REQUIREMENTS

The following will be required of each student for successful completion of this course:

A. Reading Assignment: Students are required to complete all reading assignments prior to the class in which the materials will be discussed. Students are subject to announced and unannounced written and oral examinations on assigned reading material.

B. Projects: The following ten projects will be completed by students only after coverage of the subjects by course material. Students are required to demonstrate proficiency and knowledge in each area. (Projects are to be assigned based on instructor discretion and availability of resources).

1. Compute the voltage and current in an electrical circuit.

2. Find the total resistance of a combination of resistors that are connected in parallel.

3. Find the power used by an electrical motor when the voltage and current are known.

4. Measure the voltage drop across each of the components in a series circuit.
5. Use an electrical schematic diagram to locate the source of a malfunction described by the examiner.

6. Measure the state of charge of a lead-acid battery.

7. Explain actions required to remove electrolyte that has been spilled from a lead-acid battery, and to protect the surface around the battery from corrosion.

8. Demonstrate the correct method to check a diode for serviceability, or if it is open or shorted.

9. Given a group of composition resistors, identify the resistance and tolerance of each one by the color code.

10. Measure the resistance of several components, using a multimeter.

C. Class performance: Students are required to attend all classes and to be in the classroom on time. The instructor can lower a student’s grade because of excessive tardiness. When absent from class for any reason, it is the student’s responsibility to arrange for and make up assignments missed during the absence.

D. Class Participation: Students will earn a satisfactory grade in the course by attending and regularly participating in class, giving complete attention to class activities, completion of all assigned work and successfully completing the examinations. Students are required to maintain a minimum GPA of 2.0 to receive a passing grade for the class and are encouraged to compute and monitor their GPA as the class progresses.

V. EXAMINATIONS

A. There will be four written examinations for this course covering all the lectures notes and reading material with a weight of 200 points each totaling 800 points.

B. Practicum:
The instructor will select ten projects listed above, carrying a point weight of 20 points each, totaling 200 points.

VI. SEMESTER GRADE COMPUTATION

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VII. NOTES AND ADDITIONAL INSTRUCTIONS FROM COURSE INSTRUCTOR

A. **Course Withdrawal**: It is the student's responsibility to officially drop a class if circumstances prevent attendance. In order to be officially withdrawn from the course, a student must obtain, complete and file an Application for Withdrawal form with the College. The student's transcript will show “W” or “F”, depending on whether the student was passing or failing at the time of withdrawal.

B. **Administrative Withdrawal**: Students not meeting course objectives or making satisfactory progress may be withdrawn at the discretion of the instructor.

C. **Cellular Phones and Beepers**: Cellular phones and beepers will be turned off while the student is in the classroom or laboratory.

D. **American’s with Disabilities Act (ADA)**: Disability Support Services provide services to students who have appropriate documentation of a disability. Students requiring accommodations for class are responsible for contacting the Office of Disability Support Services (DSS) located on the central campus. This service is available to all students, regardless of location. Explore the website at [www.ctcd.edu/disability-support](http://www.ctcd.edu/disability-support) for further information. Reasonable accommodations will be given in accordance with the federal and state laws through the DSS office.

E. **Instructor Discretion**: The instructor reserves the right of final decision in course requirements.

F. ** Civility**: Individuals are expected to be cognizant of what a constructive educational experience is and respectful of those participating in a learning environment. Failure to do so can result in disciplinary action up to and including expulsion.

VIII. COURSE OUTLINE

A. **Module One**: Introduction to Electricity
1. **Learning Outcomes:** upon successful completion of this module, the Student will:

   a. Explain electron flow, conductors, semiconductors and insulators.

   b. Explain useful work capabilities associated with electron flow and direction of electron flow.

   c. Differentiate between static and current electricity.

   d. Explain the production of electricity from heat, chemical action, pressure, light and magnetism.

   e. Explain Ohm’s law and the multiple applications of this useful formula.

   f. Explain direct current, multiple types of (DC) circuits and the use of Kirchhoff’s laws; used to calculate voltage drops within these circuits.

2. **Learning Activities:** Fundamentals

   Successfully complete examination 1 covering material presented in module 1. (F1,F4,F5,F10,F12)

3. **Module One Outline:** An Introduction to Electricity

   a. **Introduction to Electricity**
      1. Electron Flow
      2. Valence Electrons
      3. Conductors
      4. Insulators
      5. Semiconductors
      6. Ions
      7. Useful Work
      8. Direction of the Flow of Electricity

   b. **Types of Electricity**
      1. Static Electricity
      2. Current Electricity

   c. **Production of Electricity**
      1. Electricity from Heat
      2. Electricity from Chemical Action
      3. Electricity from Pressure
      4. Electricity from Light
5. Electricity from Magnetism

d. Electrical Relationships
   1. Ohm’s Law

   Examples of Ohm’s Law Problems

   2. Metric Prefixes

e. Direct Current Electricity
   1. Direct Current Circuits
      a) Series Circuits
      b) Analysis of a Series Circuit
      c) Parallel Circuits
      d) Analysis of a parallel Circuit
      e) Series-Parallel Circuits
      f) Kirchhoff’s Law
      g) Circuits with Two Power Sources
      h) Bridge Circuits

Finding the Equivalent Resistance of a Bridge Circuit

B. Module Two: Alternating Current Electricity

1. Learning Outcomes: upon successful completion of this module, the Student will:

   a. Explain the production of Alternating Current and typical use of Alternating Current.

   b. Discuss Amplitude, Phase and Power

   c. Explain the effects of Capacitance in an AC Circuit and the use of Ohm’s law in determining values in both series and parallel circuits.

   d. Explain the effects of Inductance in AC Circuits and the use of Ohm’s law in series and parallel inductive reactance circuits.

   e. Explain circuits utilizing Capacitive Reactance and Inductive Reactance and Resonance in both Series and Parallel AC Circuits.

   f. Explain Three-Phase Alternating Current Electricity.

2. Learning Activities: Alternating Current Electricity
Successfully complete examination 2 covering material presented in module 2. (F1,F4,F5,F10,F12)

3. **Module Two Outline**: Alternating Current Electricity

   a. Production and Use of Alternating Current Electricity
   b. Alternating Current Terms and Values
      1. Amplitude
      2. Phase
      3. Power
   c. Effects of Capacitance in an AC Circuit
      1. Capacitance in an AC Circuit
      2. Ohm’s Law for Capacitive Circuits
      3. Series R-C Circuits
         Power in a Series R-C Circuit
      4. Parallel R-C Circuits
   d. Effects of Inductance in AC Circuits
      1. Self Induction
      2. Inductive Reactance
      3. Phase Shift in an Inductive Circuit
      4. Ohm’s Law for Inductive Circuits
      5. Series R-L Circuits
         Power in a Series R-L Circuit
      7. Parallel R-L Circuits
   e. Circuits with Resistance, Inductance and Capacitance
      1. Series R-L-C Circuits
      2. Parallel R-L-C Circuits
      3. Resonance
         a) Series Resonance
         b) Parallel Resonance
         c) L-C Filters
      4. Three-Phase Alternating Current Electricity

C. **Module Three**: Electrical Circuit Components

1. **Learning Outcomes**: upon successful completion of this module, the Student will:
   
a. Demonstrate correct use of Electrical Measuring Instruments.
   
b. Explain the function of Conductors, Resistors, Switches, Circuit Protection Devices, Capacitors, Inductors, Transformers, Rectifiers and Terminal Strips.
   
c. Explain the function and use of Solid-State Devices.
d. Discuss the typical types of Integrated Circuits.

2. Learning Activities:

Successfully complete examination 3 covering material presented in module 3. (F1,F4,F5,F10,F12)

3. Equipment and Materials:

Multimeters, bread boards, Variable DC/AC power supplies, 22 gage single strand insulated copper wire, an assortment of 1/8 watt resistors, capacitors, transformers, large assortment of solid-state devices for exhibit, testing and identification.

4. Module Three Outline: Electrical Circuit Components

a. Electrical Measuring Instruments
   1. Voltmeters
   2. Ammeters
   3. Ohmmeters
b. Conductors
c. Resistors
   1. Composition Resistors Color Code
   2. Wire-wound Resistors
   3. Variable Resistors
d. Switches
   Relays and Solenoids
e. Circuit Protection Devices
   1. Fuses
   2. Circuit Breakers
f. Capacitors
   1. Energy Stored in Capacitors
   2. Series and Parallel Capacitors
   3. Capacitive Time Constant
g. Inductors
   1. Self Induction
   2. Mutual Induction
   3. Series and Parallel Inductances
   4. Inductive Time Constant
h. Transformers
   1. Types of Transformers
   2. Transformer Ratios
   3. Transformer Phase
   4. Transformer Losses
i. Rectifiers  
j. Terminal Strips  
k. Solid-State Devices  
l. Semiconductor Theory  
m. Semiconductor Diodes  
n. Zener Diodes  
o. Silicon Controlled Rectifiers  
p. Triacs  
q. Transistors  
  1. Bipolar Transistors  
  2. Field Effect Transistors  
  3. Unijunction Transistors  
r. Optoelectronics Devices  
  1. Light Emitting Diodes  
  2. Semiconductor-Light Sensors  
     a) Photodiodes  
     b) Phototransistor  
     c) Photofets  
     d) Light-Activated Silicon Controlled Rectifier  
     e) Photoresistors  
     f) Solar Cells  
s. Integrated Circuits  
t. Digital Integrated Circuits  
  1. Buffer  
  2. Inverter  
  3. Three-State Buffer  
  4. Three-State Inverter  
  5. AND Gate  
  6. NAND Gate  
  7. OR Gate  
     a) INCLUSIVE OR Gate  
     b) EXCLUSIVE OR Gate  
  8. NOR Gate  
u. Linear (Analog) Integrated Circuits  
  Operational Amplifiers  

D. **Module Four:** Chemical Energy, Aircraft Batteries, Magnetism, Electrical Motors and Generators and Aircraft Electrical Circuits  

1. **Learning Outcomes:** upon successful completion of this module, the Student will:  

   a. Explain multiple types of Simple, Primary, and Secondary Chemical cells comprised of different chemical elements.
b. Describe Lead-Acid Batteries, Charging and Installation.


d. Describe Magnetism; Permanent and Electromagnets.

e. Describe different types of Direct Current and Alternating Current Electric Motors.

f. Describe Electrical Generators

g. Explain typical Aircraft Electrical Circuits.

2. Learning Activities:

a. Successfully complete examination 4 covering material presented in this module. (F1,F4,F5,F10,F12)

b. Complete projects: 1-10. (C18,F1,F4,F5,F10,F12)

3. Equipment and Materials:

a. Multimeters, bread boards, Variable DC/AC power supplies, 22 gage single strand insulated copper wire, an assortment of 1/8 watt resistors, capacitors, transformers, large assortment of solid-state devices for exhibit, testing and identification; electrical schematic diagrams.

b. Lead-Acid aircraft battery, Nickel Cadmium aircraft Battery, charging/discharging equipment, goggles, chemical resistant gloves, Chemical resistant Aprons, multimeter and distilled water. Note: lead-acid and nickel cadmium batteries must not be stored or serviced in the close proximity.

4. Module Four Outline: Chemical Energy, Aircraft Batteries, Magnetism, Electrical Motors and Generators and Aircraft Electrical Circuits

a. Chemical Energy into Electricity
   1.Simple Chemical Cell
   2.Primary Cells
      a) Carbon-Zinc Cells
      b) Alkaline-Manganese Cells
      c) Mercury Cells
d) Silver Oxide Cells
e) Lithium Cells

3. Secondary Cells
   a) Lead-Acid Cells
      1) Chemical Changes During Discharge
      2) Chemical Changes During Charge
   b) Sintered-Plate Nickel-Cadmium Cells
      1) Thermal Runaway
      2) Cell Memory
      3) Cell Voltage Changes During Discharge

b. Aircraft Batteries
   Lead-Acid Batteries
   a) Battery Charging
   b) Battery Installation

c. Nickel-Cadmium Batteries
   1. Battery Construction
   2. Chemical Changes During Discharge
   3. Chemical Changes During Charge
   4. Battery Servicing
   5. Capacity Reconditioning
   6. Thermal Runaway

d. Magnetism
   1. Permanent Magnetism
   2. Electromagnets

e. Electrical Motors
   1. Direct Current Motors
      a) Permanent Magnet DC Motors
      b) Shunt-Wound DC Motors
      c) Series-Wound DC Motors
      e) Compound-Wound DC Motors
   2. Alternating Current Motors
      a) Universal Motors
      b) Induction Motors
         1) Single-Phase Induction Motors
         2) Split-Phase Induction Motors
         3) Capacitor-Start Induction Motors
         4) Shaded-Pole Induction Motor
      c) Repulsion Motors
      d) Three-Phase Induction Motors

f. Electrical Generators
   Direct Current Generators

g. Aircraft Electrical Circuits
   1. Electrically Retractable Landing Gear
   2. Electrically Operated Fuel Valves