

TRUMBULL PUBLIC SCHOOLS

Trumbull, Connecticut

ELECTRICITY I

DC ELECTRONICS

Technology Education

**Trumbull High School
2004**

Curriculum Writing Team

Mr. Michael Hays

Teacher

Mr. Lawrence Farrell

Department Chairman

Barbara F. Kmetz, Ed.D.

Director of Curriculum

ELECTRICITY I

DC Electronics

Table of Contents

Introduction	2
Philosophy	2
Goals	3
Unit 1 Safety	4
Unit 2 Generation of Electricity	5
Unit 3 Conductors and Insulators	6
Unit 4 Resistors and Capacitors	7
Unit 5 Ohm's Law and Series Circuits.	8
Unit 6 Parallel Circuits	9
Unit 7 Meters and Motors	10
Unit 8 Series Parallel Circuits	11
Unit 9 AC Voltage.....	12
Unit 10 Diodes	13
Unit 11 Transistors	14
Unit 12 Reactance and Impedance	15
Unit 13 DVOM Project... ..	16
Methods of Assessment	17
Course credit.....	18
Prerequisites	18
Texts	18
Syllabus.....	19
Grading	20

Trumbull High School Mission Statement

Trumbull High School educates students in a safe, inviting, and student-centered community. We encourage academic achievement, extracurricular participation, enthusiasm and self-confidence to foster independence and personal and social growth. We teach skills necessary for lifelong learning. We hold our school community to the ethical conduct and social awareness necessary to live and participate in a democratic, diverse and global society.

The Trumbull Board of Education, as a matter of policy, prohibits discrimination on the grounds of age, creed, sex, race, color, handicap, political affiliation, marital status, sexual orientation, or national origin.

INTRODUCTION

The basic Electricity I class is designed to give students with no previous training a basic knowledge of the principles of electricity. The fundamentals will include: atomic structure and electrical charges, nature of electricity, safety, Ohm's law, series and parallel circuits, motors and generators, and AC and DC voltage. Students may earn a half science credit if they have earned two other credits in science prior to graduation.

PHILOSOPHY **"This we believe"**

Technology Education is an essential learning experience for students of all grade levels, abilities, and backgrounds, so that they may confidently use, manage, assess, and understand technology.

Technology Education provides the basic knowledge and technical skills needed to participate in society. It increases the economic capacity of nations and allows students to understand and apply advanced technologies so they will be prepared for either post-secondary education or entering the workforce.

Technology Education enhances the opportunity for students to develop career awareness or career path preparation. It provides an exposure to a variety of technology related careers - from professional to industrial or service worker.

The knowledge base learned through technology education is important to everyone, as all members of society must continually learn in a changing society that is influenced by technology.

Education provides for academic, technical, and social growth. It allows involvement with tools, machines, materials, and systems of technology. It enables all students to derive meaning from concrete experiences that result from the integration of mathematics, science, humanities, and engineering concepts. Through direct experience with a wide array of processes and contexts, it helps to develop technological literacy.

Technology Education provides a wholesome change in learners by enhancing the understanding of how technology is changing the human-made world and the natural environment. It allows learners to experience the activities and habits of a designer, scientist, technologist, engineer, architect, producer, historian, and social critic as they engage in technological problems and issues of the present and future.

Technology Education develops self-evaluation of attitudes toward constructive work and how this work can be used for health, recreation, or

economic value. It helps to develop favorable attitudes toward creative thinking, and to character improvement - knowing and making the most of one's environment.

Technology Education requires competence, compassion, a desire for excellence, and a vision from its educators. Teachers must possess creativity, ingenuity, enjoy working with people, and maintain a high degree of personal and professional integrity.

GOALS

The goals and objectives of this course are aligned with *The Connecticut Framework: K-12 Curriculum Goals and Standards* for Vocational and Technical Education.

Students will:

- Identify career opportunities in the electrical field
- Demonstrate an ability to take responsibility for their actions
- Explain the need for lifelong learning
- Exhibit appropriate behavior in both school and other situations
- Develop critical thinking skills
- Design and conduct technical experiments
- Develop and implement alternative solutions to the same problem
- Apply organizational skills to classroom activities
- Present information in a clear and concise manner
- Incorporate technology into research papers and projects
- Demonstrate ability to work in groups
- Develop a safe and effective way to use electrical devices

UNIT 1

Safety and Course Requirements

Objectives: At the completion of this unit the student will be able to:

1. Explain and demonstrate safe working procedures, and classroom behavior.
2. Explain expectations for the course and evaluation procedure.
3. Analyze safety risks and create a safe working environment.

Scope and Sequence

Emergency procedures and fire exits.
Safe use of laboratory equipment
Eye protection, and safety glasses
Proper use and storage of soldering equipment
Precautions for protection from electrocution

Assessment

The student will demonstrate behavior relative to safety in the laboratory.

Resources

Electricity and Basic Electronics
Soldering iron
Safety equipment such as protective eyewear and fire extinguishers

Time Allocation

3 Days

Projects

The students will bring in articles and stories about electrical safety.

UNIT 2

Generation of Electricity

Objectives: At the completion of this unit the student will be able to:

1. Explain the five ways that electricity is generated, give an example of each, and relate these to everyday life.
2. Understand basic atomic structure and principles of magnetism.
3. Develop an appreciation of the scope of electrical usage and careers in the field.
4. Explain and demonstrate the principles of magnetism.

Scope and Sequence

Magnets
Piezoelectric crystals
Batteries
Demonstration generator
Electric motors
Hydroelectric generation plants
Transmission systems
Photoelectric cells
Jacobs ladder
Transformers

Assessment

This unit requires the basic knowledge of the principles of generation of electricity. Students will complete activities, start a research paper about the new methods to produce electricity and respond to open-ended questions and short answer response questions.

Resources

Electricity and Basic Electronics by Stephen R. Matt
Field trip to view transmission lines, switch, gear, and transformer
Classroom project digital, volt, ohm, milliamp meter kit
Magnets, wire, various lab equipment such as meters and soldering equipment

Time Allocation 15 Days

Projects

The students will continue to assemble a DVOM kit. They will also bring articles about new developments and technology in relationship to the generation of electricity, in preparation for developing a topic for a term paper on this subject.

Unit 3

Conductors and Insulators

Objectives: At the completion of this unit the student will be able to:

1. Explain the difference between a conductor and an insulator.
2. Describe the properties that differentiate between the two.
3. Be able to strip and solder wire together in a successful solder joint.
4. Explain the function of fuses and switches and give examples when required.

Scope and sequence

Types of solder
Heat sinks
Type of wire and sizes
Material used for conductors
Material used for insulators
Different types of switches
Different types of current limiting devices
Circular mils
Wire strippers or similar tool

Assessment

The student will complete a series of projects using lab equipment and complete a unit exam. This unit requires proper soldering techniques and safety responsibilities necessary for completing projects. Critical thinking will also determine the student's ability to diagnose and repair failures in various electrical components.

Resources

Electricity and Basic Electronics
Soldering iron, wire, and rosin core solder
Videotapes.

Time Allocation 6 days

Projects

The student will assemble soldered connections using proper tools and techniques.

Unit 4

Resistors and Capacitors

Objectives: At the completion of this unit the student will be able to:

1. Identify different types of resistors and calculate their value.
2. Describe the properties of a capacitor, the factors that affect capacitance
3. Distinguish between different types of resistors and capacitors.
4. Explain the function of resistors and capacitors and give examples when required.
5. Be able to draw a simple schematic using the proper symbols for a battery, capacitor, and resistor.
6. Properly use DVOM to measure resistance

Scope and Sequence

Capacitors
Resistors
DVOM
Material used for capacitors
Material used for resistors
Different types of capacitors and resistors
Thermistors
Resistor color code chart

Assessment

The student will complete a series of projects using lab equipment and complete a unit exam. The student will calculate values using DVOM and charts. Rubrics will be used to grade projects such as the quality of soldering and wiring, and the proper values of resistors. The student will also complete a unit exam consisting of multiple-choice questions.

Resources

Textbook
Soldering iron, wire, and rosin core solder
Videotapes
DVOM

Time Allocation 10 days

Projects

The student will create simple circuits that are properly soldered and wired and calculate the values of resistors using charts and a DVOM. The students will continue with DVOM projects and evaluate as necessary proper assembly.

Unit 5

Ohm's Law and Series Circuits

Objectives: At the completion of this unit the student will be able to:

- 1 Explain the terms voltage, current and resistance.
- 2 Calculate the values for current, resistance, and voltage using Ohm's law.
3. Construct simple series circuits and calculate the values for voltage, amperage, and resistance.
4. Convert amps to micro amps and milliamps.
5. Be able to draw a simple schematic using the proper symbols for a series circuit.
6. Properly use DVOM to measure resistance, voltage and current.
7. Determine the amount of current that can prove fatal.
8. Define wattage using Ohm's law.
9. Understand the difference between voltage and voltage drop.

Scope and sequence

Switches, resistors, wire and light bulbs	DVOM
Wattage	Ohm's law
Current	Resistance
Amperage	Voltage drop
Polarity	Electromotive force
Ampere	Coulomb
Milliamp and microamp	

Assessment

Assessment will be based on completion and calculation of values of the circuit according to specific rubrics such as completion of the project and accuracy of calculations. This requires the knowledge of safety in regards to proper meter usage and current limits.

Resources

Electricity and Basic Electronics
Soldering iron, wire, resistors, light bulbs and sockets.
Videotapes.
DVOM
Lab voltage source

Time Allocation 15 days

Projects

The student will complete a series circuit using lab equipment and complete a unit exam. The student will calculate values using DVOM and Ohm's law. The student will bring in articles relative to safety and consumer use of electricity and the relevance of total resistance in a circuit.

UNIT 6

Parallel Circuits

Objectives: At the completion of this unit the student will be able to:

1. Explain the difference between series and parallel circuits.
2. Use Ohm's law to calculate current in parallel circuits
3. Calculate total resistance in a parallel circuit using Ohm's law.
4. Describe uses for parallel circuits.
5. Contrast the different voltage values between series and parallel circuits
6. Use reciprocal fractions to calculate total resistance.

Scope and Sequence

Parallel circuits
Resistance in parallel circuits
Total resistance in a parallel circuit
Addition of reciprocal fractions
Conductance formula
Parallel power sources.
Equal resistors in parallel

Assessment

The student will use reciprocal fractions to calculate total resistance in a parallel circuit.

Resources

Electricity and Basic Electronics
Soldering iron
DVOM
Resistors, switches, voltage source, and miscellaneous shop supplies.

Time Allocation

5 Days

Projects

The student will create a breadboard circuit using laboratory supplies to create a parallel circuit. Work will also continue on individual student projects including DVOM.

UNIT 7

Meters and Motors

Objectives: At the completion of this unit the student will be able to:

1. Define the difference between analog and digital meters.
2. Explain proper usage of meters, and safety requirements.
3. Describe the basic components of electric motors and the different types, and applications.
4. Contrast the difference between electric motors and electric generators.

Scope and Sequence

Analog meters	Digital meters
Galvanometer	Auto range
D'arsonval movement	Commutator
Meter reading, and range selection	Brushes
Safety precautions	Armature
Bearings	Induction motors
Synchronous motors	Poles and r.p.m.
Generator output	AC generator/alternator
Eddy currents	Rectifiers

Assessment

The student will demonstrate the ability to visually identify and describe the various parts of an electric motor and generator, using an exam procedure. The student will also be able to properly and safely use meters according to defined rubrics.

Resources

Electricity and Basic Electronics
Various electric motors and generators
DVOM

Time Allocation

5 Days

Projects

The student will be asked to describe individual experiences with the use and operation of generators, alternators and motors, using family and friends as a resource.

UNIT 8 SERIES PARALLEL CIRCUITS

Objectives: At the completion of this unit the student will be able to:

1. Determine which parts of the circuit are in series and which parts are in parallel.
2. Calculate equivalent resistance and total resistance of the series parallel circuit.
3. Explain a voltage divider circuit.
4. Contrast the difference between capacitors in series and capacitors in parallel and calculate capacitance in a series parallel circuit.
5. Define an open circuit, and a short circuit.

Scope and Sequence

Resistors	Digital meters
Capacitors	Equivalent resistance
Schematics of series parallel circuits	Power supplies in series
Safety precautions	Microfarads
Circuit analysis	Total capacitance
Dielectric	Variable capacitor
Polarity	

Assessment

The student will demonstrate the ability to visually identify and calculate the parameters of the series circuit, including total resistance, total capacitance and equivalent resistance. Worksheet, lab experiments and a unit exam will be used for assessment.

Resources

Electricity and Basic Electronics
Resistors
DVOM
Capacitors
Wire, lights etc
Lab experimenter
Power supplies

Time Allocation

10 Days

Projects

Students will build various circuits on paper as well as actual working models and be asked to discuss actual application in real life of the necessary uses of series of series parallel circuits.

UNIT 9

AC VOLTAGE

Objectives: At the completion of this unit the student will be able to:

1. Compare and contrast the difference between AC and DC voltage.
2. Explain how AC current is produced.
3. Draw and label a sine wave.
4. Explain the various properties of the sine wave including amplitude, frequency, period, and root mean square.
5. List various applications of AC current.

Scope and Sequence

Inductors	Digital meters
Sine waves	Square waves
RMS	Frequency
Period	Amplitude
Peak voltage	Hertz
Phase relationship	Safety precautions
Circuit analysis	

Assessment

The students will create a short paper on magnetic induction using outside resources to identify the necessity for AC voltage. Unit questions and oral responses will be used to identify strengths and weaknesses.

Resources

Electricity and Basic Electronics
Research items such as newsprint and the Internet
DVOM
Wire, lights etc
Lab experimenter
Power supplies
DVOM project

Time Allocation

5 Days

Projects

Students will work with outside resources to identify needs for AC voltage and create a short paper on the subject to generate oral discussion on various topics. Continued progress will be made on the DVOM project kits.

UNIT 10 DIODES

Objectives: At the completion of this unit the student will be able to:

1. Explain the flow of electricity through a diode.
2. Propose an explanation of the PN junction and how it functions in a diode.
3. Construct a schematic using diodes to explain biasing in a circuit.
4. Assess various diodes to determine their polarity.
5. Explain the need for a rectifier circuit.
6. Determine proper meter usage for testing diodes.

Scope and Sequence

Diodes	Digital meters
Rectifiers	Color codes
PN junctions	Biasing
Peak inverse voltage	Diodes in series
Diodes in parallel	Substitution and cross-reference
Zener diode	Safety precautions
Circuit analysis	

Assessment

Students will research and test various diodes and create circuits that will be evaluated by specific rubrics to determine compliance. Unit questions and oral responses will be used to identify strengths and weaknesses

Resources

Electricity and Basic Electronics
Diodes
DVOM
Color code charts.
Soldering iron and solder
Power supplies
DVOM project

Time Allocation

5 Days

Projects

Students will work with diodes and determine proper biasing in a circuit and discuss the needs for diodes in rectifier circuits bringing in examples of real life applications, using friends and family for resources. Students will continue to progress with construction on the DVOM project kits.

UNIT 11 TRANSISTORS

Objectives: At the completion of this unit the student will be able to:

1. Explain the flow of electricity through a transistor.
2. Define the difference between a PNP and NPN junction.
3. Develop an understanding for the need for transistors.
4. Appraise the differences between switching and amplification diodes.
5. Identify different types of transistors.
6. Relate the new technology that has affected transistors by miniaturization, and their uses in technology applications.

Scope and Sequence

NPN PNP	Digital meters
Switching	Amplification
Germanium	Silicon
Transistor manufacturing	Total current
Gain	Collector
Base	Emitter
P N junctions	Safety precautions
Circuit analysis	

Assessment

Students will research developments in transistor technology and give an oral presentation on this technology to the class. Various media and the Internet will be used to define the presentation that will be assessed by rubrics to determine content and effort.

Resources

Electricity and Basic Electronics
Mass media
Internet
DVOM
Transistors
Soldering iron and solder
Power supplies
DVOM project

Time Allocation 10 Days

Projects

Students will work with transistors and determine proper applications for switching and amplification. Continued progress will be made towards completion of DVOM project.

UNIT 12

REACTANCE AND IMPEDANCE

Objectives: At the completion of this unit the student will be able to:

1. Explain the opposition offered by inductors to any change in current called reactive inductance, and define its relationship to ohms.
2. Define phase between voltage and current.
3. Construct vectors to determine impedance.
4. Account for the need for inductance in transformer usage.
5. Develop an understanding for the need for inductors.
6. Explain the behavior of capacitors in AC and DC circuits.
7. Define voltage drops across resistors and capacitors.
8. Graph the relationship between current and voltage in inductor circuits.

Scope and Sequence

Impedance	Reactance
Vectors	Inductive reactance
Phase between voltage and current	RL circuits
Phase angle	Equivalent circuit
Transformer loading	Capacitive reactance
Time constants	Vector addition
Voltage drops	Safety precautions
Circuit analysis	

Assessment

Various worksheets and chalkboard will be used to determine comprehension of vector addition to determine RL circuits and will be assessed by rubrics. Unit exam and chapter questions will be assessed by rubrics.

Resources

Electricity and Basic Electronics
Worksheets
DVOM
Transformer
Soldering iron and solder
Power supplies
DVOM project
Inductors

Time Allocation 10 Days

Projects

Students will work with inductors to determine actual usage in real life applications. Continued progress will be made towards completion of DVOM project.

UNIT 13

EVALUATION AND TESTING OF DVOM PROJECT

Objectives: At the completion of this unit the student will be able to:

1. Test and evaluate any failures and apply critical thinking to resolve any issues.
2. Test and evaluate accuracy of DVOM for measuring AC and DC current, voltage and resistance.
3. Affect any repairs that can be performed to increase meter performance.
4. Include reasons for failure beyond the student's control.

Scope and Sequence

- Safety precautions
- DVOM project
- Proper testing procedures
- Testing leads
- Performance evaluation

Assessment

The DVOM project is a semester project and will be evaluated by rubrics that encompass performance, troubleshooting procedure, proper assembly technique, and total project compliance.

Resources

- Electricity and Basic Electronics
- DVOM
- Power supplies
- Batteries
- Test leads.
- Soldering iron and solder

Time Allocation

5 Days

Projects

Students complete work on DVOM project and test any necessary to evaluate performance using any resources in the classroom that are applicable.

METHODS OF ASSESSMENT

Teachers of Electricity 1 will evaluate students using a variety of techniques in order to accommodate and recognize different learning styles.

The exams will be multiple choice, true/ false and will use open-ended questions to develop the student's critical thinking to determine the proper answers.

Core assessment should be implemented each marking period and should show students' progress in the following areas:

1. Lab work and projects
2. Research projects.
3. Multiple choice quizzes.
4. Multiple choice and true and false exams.
5. Unit textbook questions.

Evaluation will include an assessment of the following student activities:

Lab work

1. Ability to design and construct circuits.
2. Proper soldering and assembly techniques.
3. Ability to determine circuit parameters.
4. Ability to use meters, power supplies and other laboratory equipment.
5. Ability to work safely with electricity, and electronic components.
6. Ability to apply problem-solving techniques.

Research project

1. Select proper methods for collecting research related to the topic.
2. Properly typed paper on the topic, including bibliography, and footnotes.
3. A concise and clear oral presentation of the project.

Multiple choice quizzes and exams

1. Identify course content
2. Develop critical thinking.
3. Relate lab work to course content.

Additional assessment creative expression of independent thought, which may include:

1. Oral presentations using effective speech and presentation techniques.
2. Mass media, media center and Internet research.

Final examination

1. The ability to identify, synthesize and evaluate material covered in the course and to apply critical thinking to problem solving.

Course Credit

One half credit in Technology Education.

In addition, a half credit in science may be earned provided that the student has earned two other science credits prior to graduation. The class meets for one period for one semester.

Prerequisites

No prerequisite is required for this class however, it is suggested that that students have a reasonable understanding of basic mathematical concepts in order to complete this class successfully.

Text and Related Resources

Electricity and Basic Electronics Goodheart-Wilcox 1982

Electricity 1 / DC Electronics Syllabus

Trumbull High School educates students in a safe, inviting, student-centered community. We encourage academic achievement, extra curricular participation, enthusiasm, and self-confidence to foster independence and personal social growth. We teach skills necessary for life-long learning. We hold our school community to the ethical conduct and social awareness to live and participate in a democratic, diverse and global society.

Course Requirements:

The student will be required to develop a vocabulary, basic troubleshooting skills, and critical thinking relative to the repair of electronic components. Poor attendance and classroom management issues can adversely affect grades.

Extra credit will be given for extra projects, and research beyond the normal scope of the curriculum.

Goal; The goal of Electricity I is to develop in the student an understanding of basic DC circuits, and how to evaluate these circuits both mathematically and visually, to determine the proper parameters of the circuit. The exploration and identification of various electronic components will be done using various laboratory techniques in a safe and effective manner.

Grading Rubric:

Safety	20%
Proper equipment usage	20%
Term paper	10%
Exams and tests	30%
Final project	15%
Classroom participation	5%

Mr. Hays

**Electricity I / DC Electronics
Grading Evaluation Sheet**

Name _____

Period _____

Attendance	10%	_____
Class participation	20%	_____
Quizzes	10%	_____
Test	15%	_____
Classroom skills	5%	_____
Behavior	10%	_____
Home work	5 %	_____
Term papers	10%	_____
Classroom projects.....	15%	_____
Total		_____

Scoring for Classroom Projects

The following are used to determine classroom project grades.

Participation 30%..... ____

Safety 20%..... ____

Effort..... 30%..... ____

Time 20%..... ____

Scoring for Multi-Meter Project

Mr. Hays

Proper soldering of components	20%	___
Proper function of meter	20%	___
Safe use of shop equipment and supplies	10%	___
AC voltage test of a 120 volt circuit	10%	___
DC voltage test of a 9 volt battery.....	10%	___
Ohm test of a 10 ohm resistor	10%	___
Neatness and assembly technique	20%	___

Total _____

Rubric for Term Paper Electricity 1 / DC Electronics

Paper explains the topic	30%	_____
Paper is neat, double spaced, and 12 font	10%	_____
Paper has an introductory paragraph	10%	_____
Paper reaches a conclusion based on the premise of the paper	10%	_____
All material is properly documented.....	10%	_____
The paper is presented in a clear and concise manner	20%	_____
Correct spelling, punctuation, and grammar	10%	_____

Total _____

