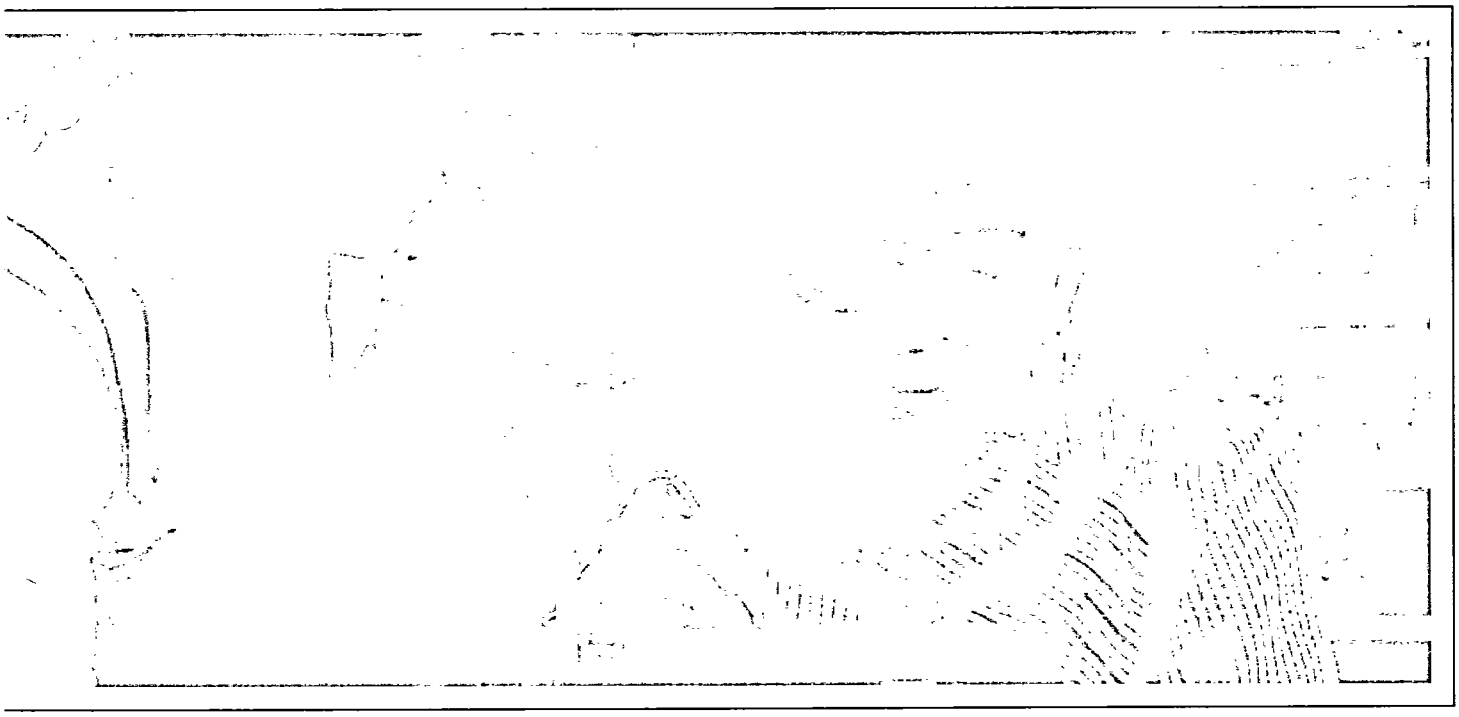
TECHNOLOGY EDUCATION
AC/DC ELECTRONICS

GRADES 9-12
ELECTIVE



The University of the State of New York
The State Education Department
Bureau of Home Economics
and Technology Education Programs
Division of Occupational Education
Albany, New York 12234

THE UNIVERSITY OF THE STATE OF NEW YORK

Regents of The University

MARTIN C. BARELL, *Chancellor*, B.A., I.A., LL.B	Muttontown
R. CARLOS CARBALLADA, *Vice Chancellor*, B.S.	Rochester
WILLARD A. GENRICH, LL.B.	Buffalo
EMLYN I. GRIFFITH, A.B., J.D.	Rome
JORGE L. BATISTA, B.A., J.D.	Bronx
LAURA BRADLEY CHODOS, B.A., M.A.	Vischer Ferry
LOUISE P. MATTEONI, B.A., M.A., Ph.D.	Bayside
J. EDWARD MEYER, B.A., LL.B.	Chappaqua
FLOYD S. LINTON, A.B., M.A., M.P.A.	Miller Place
MIMI LEVIN LIEBER, B.A., M.A.	Manhattan
SHIRLEY C. BROWN, B.A., M.A., Ph.D.	Albany
NORMA GLUCK, B.A., M.S.W.	Manhattan
ADELAIDE L. SANFORD, B.A., M.A., P.D.	Hollis
WALTER COOPER, B.A., Ph.D.	Rochester
CARL T. HAYDEN, A.B., J.D.	Elmira
DIANE O'NEILL MC GIVERN, B.S.N., M.A., Ph.D.	Staten Island

President of The University and Commissioner of Education
THOMAS SOBOL

Executive Deputy Commissioner of Education
THOMAS E. SHELDON

Deputy Commissioner for Elementary, Middle, and Secondary Education
ARTHUR L. WALTON

Assistant Commissioner for General and Occupational Education
LORRAINE R. MERRICK

Acting Director, Division of Occupational Education
LEE A. TRAVER

Chief, Bureau of Home Economics and Technology Education Programs
JEAN C. STEVENS

The State Education Department does not discriminate on the basis of age, color, religion, creed, disability, marital status, veteran status, national origin, race, gender or sexual orientation in the educational programs and activities which it operates. Portions of this publication can be made available in a variety of formats, including braille, large print or audiotape, upon request. Inquiries concerning this policy of equal opportunity and affirmative action should be referred to the Department's Affirmative Action Officer, NYS Education Building, 89 Washington Avenue, Albany, NY 12234.

OVERVIEW AND RATIONALE

The Alternating Current and Direct Current Electronics (AC/DC Electronics) curriculum was developed to help increase the technical literacy of students pursuing an articulated electronics sequence between high school and college. AC/DC Electronics provides a strong mathematical and scientific/technological base for the study of basic electronic components and circuitry. This course ensures a smooth transition between the survey type courses such as Introduction to Electricity/Electronics and other advanced electronic programs.

The number of competencies have been intentionally reduced to give instructors an opportunity to provide additional time for enrichment and/or in-depth studies of related topics often developed in electronics textbooks. Students should be encouraged to use calculators and computers throughout the curriculum to make quick estimates and to develop a stronger understanding of how the theoretical circuits function. Through "hands on" activities students will learn how basic electronic components and circuits relate in theory and practice. The laboratory experiences involve design, construction and testing which will strengthen the students' higher order problem-solving skills and give them an appreciation for electronic technology.

USE IN SEQUENCE: Elective course

This course is one of the New York State approved electives in Technology Education. It is one of several electives courses designed to give students a firm but broad exploration of the technical world in which they live.

Students completing a high school sequence in Technology Education must take a total of 1-3 units of elective course work to fulfill the "elective" portion of their sequence requirement. This course may also be taken by any student as an elective. If the instructor uses this syllabus as a guide for instruction, students may be granted Regents credit for the experience.

Several courses within Technology Education offerings can be offered on a 1/2-unit or 1-unit basis. Course work earning 1/2-unit must comprise a minimum of 54 hours of instruction and course work earning 1-unit must comprise a minimum of 108 hours of instructional time.

Students with Disabilities

The Board of Regents, through the part 100 Regulations of the Commissioner, the Action Plan, and The Compact for Learning, has made a strong commitment to integrating the education of students with disabilities into the total school program. According to Section 100.2(s) of the Regulations of the Commissioner of Education, "Each student with a handicapping condition as such term is defined in Section 200.1(ii) of this Chapter, shall have access to the full range of programs and services set forth in this Part to the extent that such programs and services are appropriate to such student's special educational needs." Districts must have policies and procedures in place to make sure that students with disabilities have equal opportunities to access diploma credits, courses, and requirements.

The majority of students with disabilities have the intellectual potential to master the curricula content requirements for a high school diploma. Most students who require special education attend regular education classes in conjunction with specialized instruction and/or related services. These students must attain the same academic standards as their nondisabled peers to meet graduation requirements, and, therefore, must receive instruction in the same content areas, at all grade levels. This will ensure that they have the same informational base necessary to pass statewide testing programs and meet diploma requirements.

Teachers certified in the subject area should become aware of the needs of students with disabilities who are participating in their classes. Instructional techniques and materials must be modified to the extent appropriate to provide students with disabilities the opportunity to meet diploma requirements. Information or assistance is available through special education teachers, administrators, the Committee on Special Education (CSE) or student's Individualized Education Program (IEP).

Strategies for Modifying Instructional Techniques and Materials

1. Students with disabilities may use alternative testing techniques. The needed testing modification must be identified in the student's Individualized Education Program (IEP). Both special and regular education teachers need to work in close cooperation so that the testing modifications can be used consistently throughout the student's program.

2. Identify, define and pre-teach key vocabulary. Many terms in this syllabus are specific and some students with disabilities will need continuous reinforcement to learn them. It would be helpful to provide a list of these key words to the special education teacher in order to provide additional reinforcement in the special educational setting.

3. Assign a partner for the duration of a unit to a student as an additional resource to facilitate clarification of daily assignments, timelines for assignments, and access to daily class notes.

4. When assigning long-term projects or reports, provide a timeline with benchmarks as indicators for completion of major sections. Students who have difficulty with organizational skills and time sequence may need to see completion of sections to maintain the organization of a lengthy project or report.

Infusing Awareness of Persons with Disabilities Through Curriculum

In keeping with the concept of integration, the following subgoal of the Action plan was established.

In all subject areas, revisions in the syllabi will include materials and activities related to generic subgoals such as problem solving, reasoning skills, speaking, capacity to search for information, the use of libraries and increasing student awareness of and information about the disabled.

The purpose of this subgoal is to ensure that appropriate activities and materials are available to increase student awareness of disabilities.

This curriculum, by design, includes information, activities, and materials regarding persons with disabilities. Teachers are encouraged to include other examples as may be appropriate to their classroom or the situation at hand.

STUDENT LEADERSHIP SKILLS

Development of leadership skills is an integral Part of occupational education in New York State. The New York State Education Department states that, "Each education agency should provide to every student the opportunity to participate in student leadership development activities. All occupational education students should be provided the opportunity to participate in the educational activities of the student organization(s) which most directly relate(s) to their chosen educational program."

Leadership skills should be incorporated in the New York State occupational education curricula to assist students to become better citizens with positive qualities and attitudes. Each individual should develop skills in communications, decision making/problem solving, human relations, management, and motivational techniques.

Leadership skills may be incorporated into the curricula as competencies (Performance Objectives) to be developed by every student or included within the Suggested Instructional Strategies. Teachers providing instruction through occupational educational curricula should familiarize themselves with the competencies. Assistance may be requested from the State advisor of the occupational student organization related to the program area.

Students who elect to become active members of one of the student leadership organizations chartered by the New York State Education Department have the advantage of the practical forum to practice leadership skills in an action oriented format and have the potential for recognition of their achievements at the local, State, and national level.

SYLLABUS OBJECTIVES

Through the implementation of this syllabus, the student will be able to:

1. Practice safe working behaviors around electricity.
2. Measure electronic voltage, current and resistance in direct and alternating current circuits.
3. Identify basic electrical/electronic components and know how to operate them.
4. Design electronic circuits using mathematical skills.
5. Apply the scientific principles of electronics to the testing and understanding of direct and alternating current circuits.

PERFORMANCE OBJECTIVES

The performance objectives of the syllabus are intended to clearly present what students are expected to know, do and be like, following instruction in a given topic. The knowledge (**K**), skills (**S**) and attitudes (**A**) that students should acquire are identified for each topic, under "competencies to be developed".

SYLLABUS OUTLINE

	Estimated Learning Time
I. Module: **Introduction to Understanding Electricity and Electronics**	**10 hours**
Topics:	
A. Safety	4 hours
B. Calculations/Notations	6 hours
II. Module: **DC Fundamentals**	**20 hours**
Topics:	
A. Electron Theory	6 hours
B. Voltage	6 hours
C. Resistance/Ohms Law	8 hours
III. Module: **DC Circuits**	**24 hours**
Topics:	
A. Series Circuits	8 hours
B. Parallel Circuits	8 hours
C. Complex Circuits	8 hours
Total Learning Time:	**54 hours**

	Estimated Learning Time
IV. Module: **Magnetism and Current Generation**	**14 hours**
Topics:	
A. Magnetic Theory	4 hours
B. Alternating Current	5 hours
C. Transformers	5 hours
V. Module: **Capacitance and Inductance**	**10 hours**
Topics:	
A. Capacitive Devices	5 hours
B. Inductive Devices	5 hours
VI. Module: **AC Reactive Circuits**	**15 hours**
Topics:	
A. Resistive Circuits	3 hours
B. Capacitive Reactance Circuits	5 hours
C. Inductive Reactance Circuits	2 hours
D. Inductive/Capacitive Reactance Circuits	5 hours
VII. Module: **AC/DC Conversions Circuits**	**15 hours**
Topics:	
A. Semiconductor Diode	5 hours
B. Power Supply	10 hours
	Total Learning Time: 108 hours

SYLLABUS COMPONENT

Estimated Learning Time

I. Module: **Introduction to Understanding Electricity and Electronics** 10 hours

A. Topic: **Safety** 4 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to demonstrate laboratory safety procedures/practices.

Competencies to be Developed:

After studying this topic, the student will be able:

a. Know the value of wearing safety glasses during laboratory experiences. (A)(K)
b. Demonstrate safe laboratory working habits around electricity. (S)
c. Understand the procedures to follow taken if an accident occurs. (A)(K)(S)

Suggested Instructional Strategies:

1. Have students write slogans about the proper use of safety glasses.
2. Have students design a poster that illustrates a safe working habit around tools and/or electricity.
3. Have students role play the procedures to follow in the event of an electrical accident.

B. Topic: **Calculations/Notations** 6 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to demonstrate, explain and apply calculations and notations used in electronics.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Express calculations with the proper notation and prefix. (K)
b. Use a calculator/computer to solve mathematical expressions. (K)(S)
c. Select the proper algorithm to solve electronic problems. (K)
d. Appreciate the benefits of knowing how to perform and use these calculations/notations. (A)

Suggested Instructional Strategies:

1. Give students basic algebraic problems to solve using a calculator/computer. (K)(S)
2. Have students select from a list an expression/algorithm with which to solve a series of mathematical problems, from simple to complex. (K)(S)
3. Have students write a computer algorithm for solving a mathematical expression. (K)(S)

II. Module: **DC Fundamentals** **20 hours**

A. Topic: **Electron Theory**

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will understand electron theory.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Define atom, matter, element and compound. **(K)**
b. Identify and describe the parts of an atom. **(K)**
c. Describe how current flows in a circuit. **(K)**
d. Describe and demonstrate how electron flow is affected by conductors and non-conductors. **(K)(S)**

Suggested Instructional Strategies:

1. Give students a Periodic Table, and have them identify various conductors and non-conductors.
2. Have students draw and label the parts of an atom.
3. Have students illustrate how electrons flow through a conductor.

B. Topic: **Voltage** 6 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will understand the concept of voltage and voltage sources.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Define voltage (potential difference or electromotive force). **(K)**
b. Identify direct current voltage sources. **(K)(S)**
c. Sketch electronic schematic symbols for power sources. **(K)(S)**
d. Measure voltage using a multimeter. **(K)(S)**

Suggested Instructional Strategies:

1. Using a multimeter, have students measure the output voltages of cells in both series and parallel.
2. Have students construct a simple cell and measure its voltage.
3. Using a power source, conductors, switches and lamps, have students design, construct and test a simple circuit.

C. Topic: **Resistance/Ohms Law** 8 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will understand and be able to apply Ohms Law to simple circuits.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Define resistance. (K)
b. Identify resistive components by means of shape and color coding. (K)(S)
c. Read the value of a resistive device using a multimeter. (K)(S)
d. Use Ohms Law to determine the voltage, current and resistance of a simple circuit. (K)(S)

Suggested Instructional Strategies:

1. Provide students with practice time to solve Ohms Law problems using calculators/computers.
2. Have students measure and record voltage, current and resistance on teacher prepared simple circuits and verify against Ohms Law calculations.
3. Have students identify and determine the value of resistive devices on commercial equipment.

III. Module: **DC Circuits** **24 hours**

A. Topic: **Series Circuits** 8 hours

1. **Performance Statement**

Upon satisfactory completion of this topic, the student will construct a series circuit.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Calculate voltage, current and resistance for a series circuit. (K)(S)
b. Identify and construct a series circuit. (K)(S)
c. Measure voltage, current and resistance in series circuits. (K)(S)

Suggested Instructional Strategies:

1. Have students design series circuits for predetermined voltages and currents.
2. Have students design and construct a voltage divider.
3. Have students design and construct a line voltage indicator or a high/low voltage indicator (digital probe).

B. Topic: **Parallel Circuits** 8 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will construct a parallel circuit.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Calculate voltage, current and resistance for parallel circuits. (K)(S)
b. Construct a parallel circuit. (K)(S)
c. Measure voltage, current and resistance in parallel circuits. (K)(S)

Suggested Instructional Strategies:

1. Have students design parallel circuits for given voltages and currents.
2. Have students construct and test parallel circuits on a breadboard.
3. Have students construct a digital multiplexed voltage ladder.

C. Topic: **Complex Circuits** 8 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will construct a complex circuit.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Calculate, on paper, all values necessary for a complex circuit. (K)(S)

b. Construct a complex circuit. (K)(S)

c. Describe and demonstrate the skills needed to perform various measurements in their complex circuits. (K)(S)

d. Verify, with the use of a VOM and/or DMM, the paper calculations. (K)(S)

Suggested Instructional Strategies:

1. Have students design, construct and test series-parallel circuits.
2. Have students design, construct and test a loaded voltage divider.
3. Have students design, construct and test a battery charging circuit with charging indicator.

IV. Module: **Magnetism and Current Generation** **14 hours**

A. Topic: **Magnetic Theory** 4 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to generate current by using magnetic energy.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Describe and demonstrate how magnetism is used to generate electricity. (K)

b. Explain the magnetic effect of current flowing through a conductor. (K)

c. Appreciate the effect of magnetism in the operation of common household appliances. (A)

Suggested Instructional Strategies:

1. Using a magnet, coil of wire and a galvanometer, have students generate electrical current.
2. Have students deflect an oscilloscope or TV beam with an externally applied permanent magnet.
3. Using a compass, 3 feet of wire and 6 VDC , have students observe the effect of current flowing through the single conductor.

B. Topic: **Alternating Current** 5 hours

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to describe and illustrate the differences between alternating and direct current.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Illustrate the difference between an AC and a DC generator. (K)(S)
   b. Explain and demonstrate the generation of alternating current (AC). (K)(S)
   c. Define terms associated with alternating current generation. (K)

   Suggested Instructional Strategies:

   1. Have students use a galvanometer to measure a low voltage alternating and direct current generator.
   2. Have students measure and record the differences observed between alternating and direct current voltages taken from a calibrated oscilloscope and a multimeter.
   3. Have students construct a small DC or AC generator.

C. Topic: **Transformers** 5 hours

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to describe how electrical energy can be transferred from one electrical circuit to another.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Demonstrate the transfer of electrical energy from one circuit to another through a transformer. (S)
   b. Construct and test a simple step-up or step-down transformer. (K)(S)
   c. Calculate and measure the expected changes in current, voltage and power for a commercial transformer circuit. (K)(S)

Suggested Instructional Strategies:

1. Have students construct a small transformer and test it using a multimeter.
2. Have students measure the resistance of primary and secondary windings, calculate expected voltage changes and verify results with a meter.
3. Have students measure the output of a transformer using a neon lamp (NE-2), when either AC or DC is applied.

V. Module: **Capacitance and Inductance** **10 hours**

A. Topic: **Capacitive Devices** 5 hours

1. **Performance Statement**

Upon satisfactory completion of this topic, the student will be able to identify capacitors and explain how they are used within electrical circuits.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Identify capacitors and explain how they are constructed, rated and used within electronic circuits. **(K)(S)**
b. Calculate series and parallel capacitance. **(K)**
c. Construct and test a resistive/capacitive (RC) circuit. **(K)(S)**

Suggested Instructional Strategies:

1. Have students construct and test the charging or discharging rate of a resistive/capacitive timing circuit.
2. Have students graph the charging/discharging current flow through a capacitor.
3. Have students construct a capacitor and measure its ability to store electrons.

B. Topic: **Inductive Devices** 5 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to identify inductors and explain how they are used within electrical circuits.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Ientify inductors and explain how they are constructed, rated and used within electronic circuits. (S)(K)

b. Calculate series and parallel inductance. (K)

c. Construct and test a resistive/inductive (RL) circuit. (S)(K)

Suggested Instructional Strategies:

1. Have students construct, calculate and test a resistance inductance (RL) circuit using a 6 volt AC and DC lamp in series (or parallel) with an inductor (5 henry).
2. Have students identify inductors within electrical and electronic circuits.
3. Have students graph the current flow through an inductorVI. Module: AC Reactive Circuits

VI: Module: **AC Reactive Circuits** **15 hours**

A. Topic: **Resistive Circuits** 3 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to calculate and measure the effect of resistance on an alternating current (AC) circuit.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Illustrate and describe the phase relationship of current and voltage in a resistive circuit. (S)(K)

b. Calculate the voltage, current and resistance of series and parallel AC circuits. (S)(K)

Suggested Instructional Strategies:

1. Have students construct, calculate and measure low voltage AC resistive circuits.
2. Have students construct or analyze house wiring circuits as examples of simple AC resistive circuits.
3. Have students write computer program(s) to solve reactance circuits.

B. Topic: **Capacitive Reactance Circuits** 5 hours

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to understand, calculate and measure the resistive effect of capacitance in an AC circuit.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Calculate, construct and measure the resistive effect of a resistive/capacitive (RC) circuit. (S)(K)
   b. Understand the phase relationship between current and voltage in a capacitive AC circuit. (K)
   c. Calculate the voltage, current and reactance of series and parallel capacitive circuit. (S)(K)
   d. Understand how capacitance is used within electronic circuitry. (A)

   Suggested Instructional Strategies:

   1. Have students construct and test a power supply suitable for use with a portable radio.
   2. Have students record the ripple output of a commercial power supply using an oscilloscope and multimeter under different loads. (Use a power supply found within a small radio or other electronic device.)
   3. Using a integrated multivibrator circuit (NE555 or equivalent) and an appropriate resistive/capacitive circuit, have students create a measurable frequency generation circuit.

C. Topic: **Inductive Reactance Circuits** 2 hours

1. **Performance Statement:**

   Upon satisfactory completion of this topic, the student will be able to understand, calculate and measure the resistive effect of inductance in an AC circuit.

   Competencies to be Developed:

   After studying this topic, the student will be able to:

   a. Design a resistive inductance (RL) timing circuit. (S)(K)
   b. Understand the phase relationship between current and voltage in an inductive circuit. (K)
   c. Calculate the voltage, current and reactance of series and parallel capacitive circuit. (S)(K)

d. Understand how inductance is used within electronic circuitry. (A)

Suggested Instructional Strategies:

1. Using an inductor as the timing element (RL), have students construct an oscillator.
2. Have students construct, calculate, test and plot the voltage across a series resistor and a 25mhy choke at different frequencies.
3. Have students design a computer algorithm for calculating the reactive components of an inductive reactance circuit.

D. Topic: **Inductive/Capacitive Reactance Circuits** 5 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to construct and test low or high band pass filters.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Construct and test resistive, inductive and capacitive circuits (RLC). (S)(K)
b. Explain how RLC circuit can be used to block or pass electronic signals. (K)(A)
c. Design a low or high pass filter. (S)(K)
d. Construct and explain how a resonance circuit works in a radio. (S)(K)(A)

Suggested Instructional Strategies:

1. Have students construct and test the effect of different rated filter inductor/capacitors on a DC power supply.
2. Have students construct a low or high pass filter circuit to pass or reject a band of generated frequencies. (example a radio interference filter).
3. Have students construct a tuner for an AM radio or crystal set.

VII. Module: **AC/DC Conversions Circuits** **15 hours**

A. Topic: **Semiconductor Diode** 5 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to design circuits using diodes as a current controlling device.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Explain and demonstrate how semiconductors can control current flow. (S)(K)

b. Calculate the current flow in a series or parallel diode circuit. (S)(K)

c. Demonstrate the use of Light Emitting Diodes (LED) in low voltage circuits. (S)(K)

Suggested Instructional Strategies:

1. Have students construct and test current flow in an LED circuit.
2. Using an LED and resistor, have students design a power-on indicator.

B. Topic: **Power Supply** 10 hours

1. **Performance Statement:**

Upon satisfactory completion of this topic, the student will be able to design, construct and explain the operation a power supply.

Competencies to be Developed:

After studying this topic, the student will be able to:

a. Construct and test a single diode (filtered and unfiltered) power supply. (S)(K)

b. Design, construct and test a diode bridge (filtered and unfiltered) power supply. (S)(K)

c. Construct, test and explain how a regulated power supply operates. (S)(K)(A)

Suggested Instructional Strategies:

1. Have students construct and test a regulated power supply circuit under a load.
2. Have students construct and test a voltage doubler circuit.
3. Have students construct and test a variable or bipolar power supply.

EQUIPMENT LIST

Suggested equipment to support the Instructional Strategies of AC/DC Electronic Theory:

	Module I	Module II	Module III	Module IV	Module V	Module VI	Module VII
Multimeter		*	*	*	*	*	*
Galvanometer				*			
Permanent Magnet				*			
Oscilloscope				*	*	*	*
Variable Power Supply		*	*	*	*	*	*
Frequency Counter					*	*	*
Audio Signal Generator				*	*	*	*
RF Signal Generator					*	*	*
Portable Radio (Load)					*	*	*
Calculator/Computer	*	*	*	*	*	*	*
Resistor Substitution Box		*	*	*	*	*	*
Capacitor Substitution Box					*	*	*
Test Inductor					*	*	*
Circuit Bread Board	*	*	*	*	*	*	*