WARREN COUNTY SCHOOL DISTRICT

Planned Instruction

Course Title: Electronics Technology

Course Number: 00905

Suggested Educational Level(s): 10-12 grade

Suggested Periods per Week: 15 **Length of Period**: 40 minutes

Suggested Length Of Course: 3 consecutive years

Units Of Credit (If Appropriate): 3 per year / 9 total

Date Written: February 2005 **Date Approved**: June 13, 2005

Date Reviewed: 2004-2005 **Implementation Year**: 2005-2006

Teacher Certification Required: Vocational - Electronics

Standards Addressed (code):
Competencies based on the standards of the Electricians Technicians Association (ETA)
Reading, Writing, Speaking and Listening: 1.1.11, 1.2.11, 1.4.11, 1.5.11, 1.6.11, 1.8.11
Math: 2.1.11, 2.2.11, 2.3.11, 2.4.11, 2.5.11, 2.6.11, 2.7.11, 2.8.11, 2.10.11
Science and Technology: 3.1.11, 3.2.11, 3.4.11, 3.6.11, 3.7.11
Career Education and Work: 13.1.11, 13.2.11, 13.3.11

Relationship to Other Planned Instruction:

Physics, Algebra, Industrial Arts

Prerequisites: None

Special Requirements

In this field one must have mechanical aptitude, good numerical ability, and an interest in science and mathematics. Modifications will be made for special needs students.

Writing Team Members:
Timothy Sampson
Standards addressed (code and description):

Reading, Writing, Speaking and Listening

1.1.11	**Learning to Read Independently**
A	Locate various texts, media and traditional resources for assigned and independent projects before reading.
C	Use knowledge of root words and words from literary works to recognize and understand the meaning of new words during reading. Use these words accurately in speaking and writing.
D	Identify, describe, evaluate and synthesize the essential ideas in text. Assess those reading strategies that were most effective in learning from a variety of texts.
E	Establish a reading vocabulary by identifying and correctly using new words acquired through the study of their relationships to other words. Use a dictionary or related reference.
F	Understand the meaning of and apply key vocabulary across the various subject areas.
G	Demonstrate after reading understanding and interpretation of both fiction and nonfiction text, including public documents.
1.2.11	**Reading Critically in All Content Areas**
A	Read and understand essential content of informational texts and documents in all academic areas.
B	Use and understand a variety of media and evaluate the quality of material produced.
1.4.11	**Types of Writing**
B	Write complex informational pieces (e.g., research papers, analyses, evaluations, essays).
D	Maintain a written record of activities, course work, experience, honors and interests.
1.5.11	**Quality of Writing**
A	Write with a sharp, distinct focus.
B	Write using well-developed content appropriate for the topic.
C	Write with controlled and/or subtle organization.
1.6.11	**Speaking and Listening**
A	Listen to others.
C	Speak using skills appropriate to formal speech situations.
D	Contribute to discussions.
E	Participate in small and large group discussions and presentations.
F	Use media for learning purposes.
1.8.11	**Research**
A	Select and refine a topic for research
B	Locate information using appropriate sources and strategies
C	Organize, summarize and present the main ideas from research.

Math

2.1.11	**Numbers, Number Systems and Number Relationships**
A	Use operations (e.g., opposite, reciprocal, absolute value, raising to a power, finding roots, finding logarithms).
2.2.11	**Computation and Estimation**
A	Develop and use computation concepts, operations and procedures with real numbers in problem-solving situations.
B	Use estimation to solve problems for which an exact answer is not needed
C	Construct and apply mathematical models, including lines and curves of best fit, to estimate values of related quantities.
D	Describe and explain the amount of error that may exist in a computation using estimates

E	Recognize that the degree of precision needed in calculating a number depends on how the results will be used and the instruments used to generate the measure
F	Demonstrate skills for using computer spreadsheets and scientific and graphing calculators
2.3.11	**Measurement and Estimation**
A	Select and use appropriate units and tools to measure to the degree of accuracy required in particular measurement situations
B	Measure and compare angles in degrees and radians.
2.4.11	**Mathematical Reasoning and Connections**
D	Use truth tables to reveal the logic of mathematical statements.
E	Demonstrate mathematical solutions to problems (e.g., in the physical sciences).
2.5.11	**Mathematical Problem Solving and Communication**
A	Select and use appropriate mathematical concepts and techniques from different areas of mathematics and apply them to solving non-routine and multi-step problems.
B	Use symbols, mathematical terminology, standard notation, mathematical rules, graphing and other types of mathematical representations to communicate observations, predictions, concepts, procedures, generalizations, ideas and results
C	Present mathematical procedures and results clearly, systematically, succinctly and correctly
D	Conclude a solution process with a summary of results and evaluate the degree to which the results obtained represent an acceptable response to the initial problem and why the reasoning is valid
2.6.11	**Statistics and Data Analysis**
A	Design and conduct an experiment using random sampling. Describe the data as an example of a distribution using statistical measures of center and spread. Organize and represent the results with graphs.
2.7.11	**Probability and Predictions**
D	Use experimental and theoretical probability distributions to make judgments about the likelihood of various outcomes in uncertain situations.
2.8.11	**Algebra and Functions**
A	Analyze a given set of data for the existence of a pattern and represent the pattern algebraically and graphically
C	Use patterns, sequences and series to solve routine and non-routine problems
E	Use equations to represent curves (e.g., lines, circles, ellipses, parabolas, hyperbolas).
F	Identify whether systems of equations and inequalities are consistent or inconsistent.
2.10.11	**Trigonometry**
B	Identify, create and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean Theorem.

Science and Technology

3.1.10	**Unifying Themes**
A	Discriminate among the concepts of systems, subsystems, feedback and control in solving technological problems.
B	Describe concepts of models as a way to predict and understand science and technology.
C	Apply patterns as repeated processes or recurring elements in science and technology.
D	Apply scale as a way of relating concepts and ideas to one another by some measure.
E	Describe patterns of change in nature, physical and man made systems.
3.2.10	**Inquiry and Design**
A	Apply knowledge and understanding about the nature of scientific and technological knowledge

B	Apply process knowledge and organize scientific and technological phenomena in varied way
C	Apply the elements of scientific inquiry to solve problems
D	Identify and apply the technological design process to solve problems
3.4.10	**Physical Science, Chemistry and Physics**
B	Analyze energy sources and transfers of heat.
C	Distinguish among the principles of force and motion
3.6.10	**Technology Education**
C	Apply physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design to real world problems.
3.7.10	**Technological Devices**
A	Identify and safely use a variety of tools, basic machines, materials and techniques to solve problems and answer questions.
B	Apply appropriate instruments and apparatus to examine a variety of objects and processes.

Career Education and Work

13.1.11	**Career Awareness and Planning**
A	Analyze career options based on student interests, abilities, aptitudes and accomplishments.
B	Analyze how the changing male/female roles relate to career choice.
C	Evaluate opportunities for career preparation.
D	Justify the selection of a career.
E	Evaluate all opportunities for the transition from secondary to postsecondary education, training or work.
F	Evaluate individual career plan using decision
G	Analyze the opportunity cost/benefit of continuous learning.
13.2.11	**Career Acquisition (Getting a Job)**
A	Know and demonstrate industry acceptable job interviewing techniques.
B	Analyze and evaluate complex technical tasks using sophisticated processes.
C	Analyze workplace problems and cite technological solutions.
F	Analyze performance-based assessment components.
G	Analyze the need for manipulative/motor skills.
13.3.11	**Career Retention (Keeping a Job)**
A	Analyze work habits needed to advance within a career.
B	Evaluate conflict resolution skills.
C	Evaluate team member's roles to describe and illustrate active listening techniques.
G	Analyze the availability and societal and economic factors of lifelong participation in career preparation and advancement opportunities.

COURSE DESCRIPTION:

The Electronics Technology program provides students with learning experiences in analog and digital electronic equipment. Instruction also includes analysis and construction of A.C. and D.C. circuits and some troubleshooting and repair. Students are given the opportunity to learn electronics through the use of a new computer laboratory, which utilizes the latest electronic simulation software, computer aided instruction and laboratory equipment.

Graduates in Electronics Technology will be prepared to pursue two- or four-year college technical programs such as technician/engineering, computers or electrical technology trades.

Electronics graduates may also qualify for advanced placement in associated and bachelor degree programs, through articulation agreements with several post-secondary schools.

Electronics technicians assemble, install, maintain, and repair electronic devices and equipment. Such electronic devices and equipment include a broad range of industrial, business, communications, and consumer products ranging from missile, radar, and automotive control systems; to computer-assisted design and drafting (CAD) machinery; to personal computers and the routers and switches that direct Network traffic; to public transportation signaling systems; to telephones, fax machines, and pagers; to radios, televisions, and home entertainment systems; to children's toys. Often working under the direction of more formally educated electronics engineers, computer engineers, and others; electronics technicians in all fields are the essential workers who help keep the American economy innovative and productive.

Specific Educational Objectives to be taught and recommended time:

Electronics Technology Lesson Topics

Year	
One	**01.00 - Safety and Class Introduction**
	02.00 - Components, Quantities, and Units
	03.00 - Instruments, tools and fasteners
	04.00 - Atoms, Voltage, Current, and Resistance in Electric Circuits
	05.00 - Ohm's & Watt's Law, Energy, and Power
	06.00 - Electric Connections
	07.00 - Measuring Voltage, Current and Resistance
	08.00 - Circuit Conductors and Wire Sizes
	09.00 - Batteries
	10.00 - Series Circuits
	11.00 - Parallel Circuits
	12.00 - Series-Parallel Circuits
	13.00 - Magnetism and Electromagnetism
	14.00 - Introduction to Alternating Current and Voltage
	15.00 - Electronic Test Lab Equipment
	16.00 - Capacitors
	17.00 - RC Circuits
	18.00 - Inductors
	19.00 - RL Circuits
	20.00 - RLC Circuits and Resonance
	21.00 - Pulse Response of Reactive Circuits
	22.00 - Printed Circuit Boards (soldering and desoldering)
	23.00 - Transformers

Two	**24.00 - Circuit Protection Devices**
	25.00 - Residential Wiring Requirements and Devices
	26.00 - Residential Branch Circuit Wiring
	27.00 - Appliance Cords and Connections
	28.00 - Lighting Equipment
	29.00 - Electric Motors
	30.00 - Relays
	31.00 - Motor Controls
	32.00 - Power Transmission (Pulleys, Gears & Electric Motors)
Three	**33.00 - Introduction to Semiconductors**
	34.00 - Diodes and Applications
	35.00 - Special-Purpose Diodes
	36.00 - Transistors and Thyristors
	37.00 - Transistor Bias Circuits
	38.00 - BJT Amplifiers
	39.00 - Field-Effect Transistors (FETs)
	40.00 - FET Amplifiers
	41.00 - Amplifiers and Oscillators
	42.00 - Operational Amplifiers (Op-Amps)
	43.00 - Applications of Op-Amps
	44.00 - Introductory Digital Concepts
	45.00 - Number Systems, Operations, and Codes
	46.00 - Logic Gates
	47.00 - Boolean Algebra and Logic Simplification
	48.00 - Combinational Logic
	49.00 - Integrated Circuits
	50.00 - Computer Technologies and Applications
	51.00 - Job Seeking/Keeping & Leadership Skills

Formative Assessments:

- Quizzes
- Computer Aided Training Software
- Written Tests
- Teacher monitoring and assessment of hands-on activities

Summative Assessments:

- Students are organized by group, typically organized by the year they started the program.

- Students will move to the next group, after passing the final exam test with a 70% score.

Required/Approved Textbooks and Materials:

Book Title: Electronics Fundamental – Floyd (Year One)
Publisher: Prentice Hall
ISBN #: 0-13-835216-X
Copyright: 1998
Date of Adoption: 1998

Book Title: Electronic Devices – Floyd (Year Two)
Publisher: Prentice Hall
ISBN #: 0-13-649146-4
Copyright: 1999
Date of Adoption: 1999

Book Title: Digital Fundamentals – Floyd (Year Three)
Publisher: Prentice Hall
ISBN #: 0-13-080850-4
Copyright: 2000
Date of Adoption: 2000

Book Title: Essentials of Electronics – 2nd ed.
Publisher: Glencoe McGraw-Hill
ISBN #: 0-07-821048-8
Copyright: 2001
Date of Adoption: 2004

Book Title: Electrical Power
Publisher: Goodheart-Wilcox
ISBN #: 1-56637-366-2
Copyright: 1998
Date of Adoption: 2004

Electronics Work Bench (EWB) – Circuit Simulation Software
Interactive Image Technologies
EBW-01-06469

Electronics Technician CBT (EWB) – Circuit Training Program
Interactive Image Technologies

ETCAI Training Program
from: ETCAI products

Outline of Content Sequence and objectives These are WCCC teacher-developed competencies based on the standards of the Electricians Technicians Association (ETA)

	01.00 - Safety and Class Introduction
1	Outline safety rules and safe practices that apply to conditions in the home, outdoors, school lab, and on the job.
2	Identify and follow the Electronic Technology Program's Rules and Procedures
3	Describe display positive student/teacher attributes
4	Discuss applications of electronics
5	Explain the factors that determine the severity of an electric shock.
6	Outline the first-aid procedure for bleeding, burns, and electric shock.
7	Describe the mouth-to-mouth method of artificial respiration.
8	List the procedures to be followed in the case of an electrical fire.
9	Identify hazardous materials and describe their characteristics.
10	Discuss computer applications in electronics

	02.00 - Components, Quantities, and Units
1	Recognize some common electrical components and measuring instruments
2	State basic electrical and magnetic quantities and their units
3	Use scientific notation (powers of ten) to express quantities
4	Use engineering notation and metric prefixes to express large and small values
5	Convert from one metric prefix to another
6	Define metric prefixes and convert metric units of measurements
7	Perform unit conversions
8	Perform metric conversions
9	Identify the basic schematic symbols for: resistors, capacitors, switches, batteries, potentiometer, etc…

	03.00 - Instruments, tools and fasteners
1	Identify and state the use for common electrical/electronic measuring devices.
2	Identify and state the use for common tools used in the electrical/electronic industry.
3	Outline the procedure to be followed for the proper care and use of tools.
4	Identify and state the features of common fastening devices.

	04.00 - Atoms, Voltage, Current, and Resistance in Electric Circuits
1	Describe the basic structure of an atom
2	Explain the relationship between atomic structure and the conductor / insulator property of materials.
3	Explain the concept of electrical charge
4	Define voltage and discuss its characteristics
5	Define current and discuss its characteristics
6	Discuss resistance and its characteristics
7	Identify resistors by their color code, or given the color code for a given resistor value
8	Describe a basic electrical circuit : Source, Conductor, Load
9	Design Basic circuit structure
10	Make basic circuit measurements

	05.00 - Ohm's & Watt's Law, Energy, and Power
1	Explain Ohm's Law
2	Use Ohm's Law to determine voltage, current, or resistance
3	Define Energy and Power
4	Calculate power in a circuit using watt's law

5	Identify and use KWH
6	Properly read a residential electric meter
7	Calculate power usage and total electric costs per KWH
8	Properly select resistors based on power consideration
9	Explain energy conversion and voltage drop
10	Discuss power supplies and their characteristics
11	Describe a basic approach to troubleshooting

	06.00 - Electric Connections
1	Describe the negative effects of a poorly formed electric connection.
2	Properly remove insulation from a wire.
3	Correctly install terminal-screw, crimp-on, and mechanical connectors.
4	Explain the principles of soldering.
5	Properly insulate wire repairs.
6	Assemble, test, and install cables used as part of electronic interconnection systems.

	07.00 - Measuring Voltage, Current and Resistance
1	Compare the operation of analog and digital meters.
2	Correctly read an analog scale and digital meter display.
3	Use a multimeter to measure voltage, current, and resistance.
4	List the safety precautions to be observed when using multimeters.
5	Explain the multimeter specifications and special features

	08.00 - Circuit Conductors and Wire Sizes
1	Identify uses for different conductor forms.
2	Properly select wire-insulating materials.
3	Compare the AWG size and diameter of conductors.
4	List the factors that determine a conductor’s ampacity rating.
5	Identify the factors that contribute to the resistance value of a conductor.
6	Calculate line-voltage drop and line power loss.

	09.00 - Batteries
1	Compare the characteristics and application of different types of cells.
2	Explain the ways in which cells and batteries are rated.
3	Design a suitable connection of cells to obtain a desired voltage and current capacity.
4	Explain how cells and batteries are tested.
5	Properly charge a rechargeable battery.

	10.00 - Series Circuits
1	Identify a series circuit
2	Determine the current in a series circuit
3	Determine the total resistance in a series circuit
4	Apply Ohm's Law in a series circuit
5	Determine the total effect of voltage sources in series
6	Apply Kirchhoff’s voltage law
7	Determine power in a series circuit
8	Use a series circuit as a voltage divider
9	Determine and identify ground in a series circuit

10	Construct a series resistive circuit
11	Troubleshoot series circuits

	11.00 - Parallel Circuits
1	Identify a parallel circuit
2	Determine the voltage across a parallel circuit
3	Apply Kirchhoff's Current Law
4	Determine total parallel resistance
5	Apply Ohm's Law in a parallel circuit
6	Use a parallel circuit as a current divider
7	Determine power in a parallel circuit
8	Construct a parallel resistive circuit
9	Troubleshoot parallel circuits
10	Describe some basic applications of parallel circuits

	12.00 - Series-Parallel Circuits
1	Identify series-parallel relationships
2	Analyze a series-parallel circuit
3	Analyze loaded voltage dividers
4	Determine the loading effect of a voltmeter on a circuit
5	Analyze a Wheatstone bridge
6	Analyze a circuit with more than one source
7	Apply Thevenin's theorem to simplify a circuit for analysis
8	Calculate total resistance of a series-parallel circuit with multiple resistor
9	Calculate series/parallel combination circuits
10	Construct series/parallel combination circuits
11	Measure voltage and current and resistance in a series/parallel circuit
12	Troubleshoot series-parallel circuits

	13.00 - Magnetism and Electromagnetism
1	Explain the principles of magnetic fields
2	Discuss Lenz's and Faraday's Laws
3	Explain the principles of electromagnetism
4	Describe the principle of operation for several types of electromagnetic devices
5	Explain magnetic hysteresis
6	Discuss the principle of electromagnetic induction
7	Describe some applications of electromagnetic induction

	14.00 - Introduction to Alternating Current and Voltage
1	Identify a sinusoidal waveform and measure its characteristics
2	Describe how sine waves are generated
3	Find the radian / degree relationship of an AC sine-wave
4	Determine the voltage and current values of sine waves
5	Describe angular relationships of sine waves
6	Mathematically analyze a sinusoidal waveform
7	Find: A.C. instantaneous values
8	Measure Duty cycle of a sine-wave, square-wave and triangle-wave.
9	Apply the basic circuit laws to ac resistive circuits

10	Determine total voltages which have both ac and dc components
11	Identify the characteristics of basic nonsinusoidal waveforms and characteristics of 3 phase systems
12	Use the oscilloscope to measure waveforms

	15.00 - Electronic Test Lab Equipment
1	Operate an oscilloscope to observe and measure signals.
2	State the various functions of the basic front-panel controls of an oscilloscope.
3	Obtain a sweep on an oscilloscope
4	Measure A.C. (Frequency, Time and Period) w/ a 'scope
5	Set frequency and voltage with a signal generator
6	Compare the output signals of audio, function, pulse, and radio frequency signal generators.
7	Define specifications related to lab power supplies.
8	Design and build a simple Wheatstone-bridge resistance measurement circuit.

	16.00 - Capacitors
1	Describe the basic structure and characteristics of a capacitor
2	Construct a capacitor
3	Discuss various types of capacitors
4	Discuss the capacitor charge and discharge curve and calculate the RC time constant
5	Analyze series capacitors
6	Analyze parallel capacitors
7	Describe how a capacitor operates in a dc switching circuit
8	Describe how a capacitor operates in an ac circuit.
9	Discuss some capacitor applications
10	Test a capacitor

	17.00 - RC Circuits
1	Describe the relationship between current and voltage in an RC circuit
2	Determine impedance and phase angle in a series RC circuit
3	Analyze a series RC circuit
4	Construct an R.C. circuit
5	Perform R.C. circuit calculations
6	Measure A.C. phase shift of an R.C. circuit with a 'scope
7	Determine impedance and phase angle in a parallel RC circuit
8	Analyze a parallel RC circuit
9	Analyze series-parallel circuits
10	Determine power in RC circuits
11	Discuss some basic RC applications
12	Troubleshoot RC circuits

	18.00 - Inductors
1	Describe the basic structure and characteristics of an inductor
2	Construct an inductor
3	Discuss various types of inductors
4	Analyze series inductors
5	Analyze parallel inductors
6	Analyze inductive dc switching circuits
7	Analyze inductive ac circuits

8	Discuss some inductor applications
9	Test an inductor

	19.00 - RL Circuits
1	Describe the relationship between current and voltage in an RL circuit
2	Determine impedance and phase angle in a series RL circuit
3	Analyze a series RL circuit
4	Perform R.L. circuit calculations
5	Measure A.C. phase shift of an R.L. circuit with a 'scope
6	Determine impedance and phase angle in a parallel RL circuit
7	Analyze a parallel RL circuit
8	Analyze series-parallel RL circuits
9	Determine power in RL circuits
10	Discuss some basic RL applications
11	Construct an R.L. circuit
12	Troubleshoot RL circuits

	20.00 - RLC Circuits and Resonance
1	Determine the impedance and phase angle of a series RLC circuit
2	Analyze series RLC circuits
3	Analyze a circuit for series resonance
4	Determine resonant frequency in a series circuit
5	Construct a phasor diagram of an RLC circuit
6	Construct an R.L.C. circuit
7	Perform R.L.C. circuit calculations
8	Calculate Bandwidth of an R.L.C. circuit
9	Measure Bandwidth of an R.L.C. circuit
10	Measure A.C. phase shift of an R.L.C. circuit with a 'scope
11	Analyze series resonant filters
12	Analyze parallel RLC circuits
13	Analyze a circuit for parallel resonance
14	Analyze the operation of parallel resonant filters
15	Discuss half-power frequencies
16	Discuss some system applications of resonant circuits

	21.00 - Pulse Response of Reactive Circuits
1	Analyze operation of RC and RL low-pass filters
2	Analyze operation of RC and RL high-pass filters
3	Analyze operation of RC and RL band pass filters
4	Analyze operation of RC and RL band reject filters
5	Explain the operation of an RC integrator
6	Analyze an RC integrator with a single input pulse
7	Analyze an RC integrator with repetitive input pulses
8	Analyze an RC differentiator with a single input pulse
9	Analyze an RC differentiator with repetitive input pulses
10	Analyze the operation of an RL integrator
11	Analyze the operation of an RL differentiator
12	Discuss some basic applications of integrators and differentiators

13	Troubleshoot integrators and differentiators

	22.00 - Printed Circuit Boards (soldering and desoldering)
1	State the advantages of using printed circuit boards.
2	Describe the different ways in which a PCB is constructed.
3	Build circuits from schematics
4	Explain the photographic and print-and-etch processes.
5	Make a neat, clean, strong, and electrically solid solder connection
6	Remove components from electronic circuits without damaging the circuit or leaving excess solder behind
7	Properly mount and solder components to a PCB.
8	Properly desolder and replace components on a PCB.

	23.00 - Transformers
1	Explain mutual inductance
2	Describe how a transformer is constructed and how it works
3	Tesla's AC theory vs. Edison's DC theory
4	Describe the Construction of a Tesla Coil
5	Explain how a step-up transformer works
6	Explain how a step-down transformer works
7	Perform Transformer (ratio and voltage) calculations
8	Discuss the effect of a resistive load across the secondary winding
9	Discuss the concept of a reflective load in a transformer
10	Discuss impedance matching with transformers
11	Explain how the transformer acts as an isolation device
12	Describe a practical transformer
13	Residential uses for transformers
14	Describe several types of transformers
15	Troubleshoot transformers

	24.00 - Circuit Protection Devices
1	Define the terms overload and short circuit.
2	Compare the basic principle of operation of a fuse and a circuit breaker.
3	State how fuses and circuit breakers are rated.
4	Identify basic fuse types and typical applications.
5	Test fuses and circuit breakers in and out of circuits.
6	Explain how lightning rods and arresters protect electrical equipment.

	25.00 - Residential Wiring Requirements and Devices
1	Outline the purpose of the National Electrical Code (NEC) and the method of code enforcement.
2	Identify the components of an incoming service.
3	Draw the schematic for a three-wire distribution system.
4	State common NEC requirements that pertain to residential wiring.
5	Explain the purpose and process involved in grounding and overcurrent protection.

	26.00 - Residential Branch Circuit Wiring
1	Define the term branch circuit as it applies to the NEC.
2	Outline NEC branch circuit requirements for different areas of a home.
3	Describe the physical features of a split receptacle.

4	Complete typical branch circuit schematic and wiring diagrams.
5	Wire typical branch circuits in accordance with the guidelines of the NEC.

	27.00 - Appliance Cords and Connections
1	Identify and select the proper cord for common applications.
2	Properly connect a two-prong plug cap.
3	Properly connect a three-prong plug cap.
4	Explain the purpose and method of grounding appliances.
5	Distinguish between the live, neutral, and grounding conductors of an appliance circuit.
6	Explain the operation of ground-fault circuit interrupter (GFCI).

	28.00 - Lighting Equipment
1	Describe the operating principle of an incandescent lamp.
2	Repair a table lamp.
3	Install a light fixture.
4	Describe the operating principle of a fluorescent light fixture.
5	Describe the operating principles of high-intensity discharge lamps.
6	Install security lighting devices.

	29.00 - Electric Motors
1	Explain the basic motor operating principle.
2	Describe the construction, connection, and operating characteristics of dc motors.
3	Describe the construction, connection, and operating characteristics of the universal motor.
4	Describe the construction, connection, and operating characteristics of ac single-phase and polyphase motors.
5	Explain the relationship between motor power, speed, and torque.
6	Diagnose common motor problems.

	30.00 - Relays
1	Compare electromagnetic and solid-state relays.
2	Identify relay symbols used on schematic diagrams.
3	Describe the different ways in which relays are used.
4	Explain how relays are rated.
5	Describe the operation of ON-delay and OFF-delay timer relays.

	31.00 - Motor Controls
1	Explain the principles and connections of motor protection circuits.
2	List and describe the methods by which a motor may be started.
3	Describe the operation of reversing and jogging motor-control circuits.
4	List the methods of stopping a motor.
5	Explain the operating principles of variable-speed motor drives.
6	Describe the operation of motor pilot-devices.

	32.00 - Power Transmission (Pulleys, Gears & Electric Motors)
1	Using two pulleys of different size calculate ratio's and R.P.M.
2	Using two pulleys of different size calculate Belt sizes
3	Using two gears of different sizes calculate ratio's and R.P.M.
4	Calculating Horsepower and Wattages in electric motors

	33.00 - Introduction to Semiconductors
1	Identify and define what is meant by majority and minority carrier in P and N type semiconductors
2	Discuss the basic structure of semiconductors
3	Discuss covalent bonding in silicon
4	Explain basic atomic theory as it relates to the behavior of electrons in conductors, semiconductors and insulators
5	Explain how the depletion region of a PN junction is produced and how bias changes the width of the depletion region
6	Explain how current occurs in a semiconductor
7	Discuss the characteristics of doped semiconductors
8	Describe the characteristics of a pn junction
9	Explain how to bias a pn junction
10	Explain the effects of forward and reverse bias on a PN junction relating the voltage versus current characteristics
11	Graphically illustrate & label the forward and reverse bias characteristics for si and ge PN junctions
12	Give typical values of barrier potential for silicon and germanium PN junctions
13	Test semiconductor diodes
14	Describe the basic diode characteristics

	34.00 - Diodes and Applications
1	Analyze the operation of a half-wave rectifier
2	Analyze the operation of a full-wave rectifier
3	Describe the operation of power supply filters
4	Calculate the average DC volt. & current of three common rectifier circuits given RMS input voltage and load resist.
5	Given the AC RMS source voltage, predict the peak DC output voltage of a rectifier circuit with a capacitor filter
6	Calculate the required size of a filter capacitor needed to reduce ripple from a rectifier circuit
7	Analyze the operation of diode limiters and clampers
8	Interpret a typical data sheet and ECG Data Manual
9	Construct and operate a half-wave rectifier circuit
10	Construct and operate a full-wave bridge rectifier circuit
11	Construct and operate a, full-wave, CT transformer, rectifier circuit
12	Apply LC filtration to half-wave and full-wave rectifier circuits
13	Troubleshoot rectifier circuits

	35.00 - Special-Purpose Diodes
1	Describe the characteristics of a zener diode and analyze its operation
2	Explain how a zener is used in voltage regulation and limiting and analyze zener circuits
3	Describe the variable-capacitance characteristics of a varactor diode and analyze its operation in a typical circuit
4	Discuss the operation and characteristics of LEDs and photodiodes
5	Explain the characteristics and applications of a zener diode
6	Explain the avalanche and zener reverse breakdown modes of a PN junction
7	Describe the basic operation of a varactor diode
8	Discuss the operation and application of LEDs and photodiodes
9	Troubleshoot zener diode regulators

	36.00 - Transistors and Thyristors
1	Describe the basic structure and operation of bipolar junction transistors and NPN / PNP transistors
2	Explain with a schematic symbol for an NPN and a PNP transistor how the device is normally biased
3	Analyze a transistor circuit with voltage-divider bias
4	Explain how a transistor is biased and discuss the transistor currents and their relationships
5	Relate the emitter, base and collector currents of a bipolar transistor. Define beta (HFE)

6	Perform Alpha and Beta Calculations
7	Discuss transistor parameters and characteristics and use these to analyze a transistor circuit
8	Perform voltage-divider bias transistor calculations
9	Explain the operation of a bipolar transistor as an amplifier
10	Analyze a transistor switching circuit
11	Discuss important transistor parameters and maximum ratings
12	Describe the basic structure and operation of a JFET
13	Explain the operation of a JFET in terms of its characteristics
14	Explain the basic structure and operation of MOSFET
15	Analyze several biasing arrangements for JFETs and MOSFETs
16	Discuss the operation and application of he UJT
17	Explain the basic structure and operation of the SCR, the triac, and the diac
18	Construct a switch Unijuction Transistor (UJT) circuit
19	Construct a timing circuit using a Unijuction Transistor (UJT)
20	Construct a power control circuit using a Silicon Controlled Rectifier (SCR)
21	Construct a power control circuit using a Triac
22	Construct a power control circuit using a Diac
23	Recognize transistor packages and identify the terminals
24	Troubleshoot various faults in transistor circuits

	37.00 - Transistor Bias Circuits
1	Discuss the concept of dc bias in a linear amplifier
2	Analyze a voltage-divider bias circuit
3	Analyze a base bias circuit, an emitter bias circuit, and a collector-feedback bias circuit
4	Troubleshoot various faults in transistor bias circuits

	38.00 - BJT Amplifiers
1	Understand the amplifier concept
2	Identify and apply internal transistor parameters
3	Calculate the Q-point for a voltage -divider transistor circuit
4	Construct a Bipolar transistor amp
5	Calculate Gain for the bipolar transistor amp
6	Understand and analyze the operation of common-emitter amplifiers
7	Understand and analyze the operation of common-collector amplifiers
8	Understand and analyze the operation of common-base amplifiers
9	Construct a CB amp (common base)
10	Construct a CC amp (common collector)
11	Construct a CE amp (common emitter)
12	Discuss multistage amplifiers and analyze their operation
13	Troubleshoot amplifier circuits

	39.00 - Field-Effect Transistors (FETs)
1	Explain the operation of JFETs
2	Define, discuss, and apply important JFET parameters
3	Discuss and analyze JFET bias circuits
4	Explain the operation of MOSFETs
5	Define, discuss, and apply important MOSFET parameters
6	Discuss and analyze MOSFET bias circuits

7	Construct and operate a D-MOSFET transistor circuit
8	Construct and operate a E-MOSFET transistor circuit
9	Troubleshoot FET circuits

	40.00 - FET Amplifiers
1	Describe the amplification properties of a FET
2	Explain and analyze the operation of common-source FET amplifiers
3	Explain and analyze the operation of common-drain FET amplifiers
4	Explain and analyze the operation of common-gate FET amplifiers
5	Construct a CD amp (common drain)
6	Construct a CG amp (common gate)
7	Construct a CS amp (common source)
8	Construct a MOSFET amp
9	Construct multiple multi-stage amp circuits using all previous amp circuits
10	Troubleshoot FET amplifiers

	41.00 - Amplifiers and Oscillators
1	Analyze a multistage amplifier
2	Construct an operate and Tank circuit as an oscillator
3	Explain class A amplifier operation
4	Analyze a class B amplifier
5	Explain the basic operation of a class C amplifier
6	Discuss the theory and analyze the operation of several types of oscillators
7	Calculate Gain for the 741 OP-amp
8	Construct a 741 opamp circuit
9	Construct a closed loop 741 opamp circuit
10	Troubleshoot amplifier circuits

	42.00 - Operational Amplifiers (Op-Amps)
1	Discuss the basic op-amp
2	Explain the basic operation of a differential amplifier
3	Interpret op-amp data sheets
4	Analyze the noninverting, voltage-follower, and inverting op-amp configurations
5	Analyze the effects of negative feedback on the three basic op-amp configurations
6	Troubleshoot op-amp circuits

	43.00 - Applications of Op-Amps
1	Explain the basic operation of a comparator circuit
2	Analyze summing amplifiers, averaging amplifiers, and scaling amplifiers
3	Explain the operation of op-amp integrators and differentiators
4	Discuss the operation of several types of op-amp oscillators
5	Recognize and evaluate basic op-amp filters
6	Describe the operation of basic series and shunt voltage regulators

	44.00 - Introductory Digital Concepts
1	Explain the basic differences between digital and analog quantities
2	Show how voltage levels are used to represent digital quantities

3	Describe various parameters of a pulse waveform such as rise time, fall time, pulse width, frequency, period, and duty cycle
4	Explain the basic logic operations of NOT, AND, and OR
5	Describe the logic functions of the comparator, adder, code converter, encoder, decoder, multiplexer, demultiplexer, counter, and register
6	Identify fixed-function digital integrated circuits according to their complexity and the type of circuit packaging
7	Identify pin numbers on integrated circuit packages
8	Describe the PLD, discuss the various types, and state how PLDs are programmed
9	Recognize digital instruments and understand how they are used in troubleshooting digital circuits and systems
10	Show how a complete digital system is formed from the basic functions in a practical application

	45.00 - Number Systems, Operations, and Codes
1	Review the decimal number system
2	Count in the binary number system
3	Convert from decimal to binary and from binary to decimal
4	Apply arithmetic operations to binary numbers
5	Determine the 1's and 2's complements of a binary number
6	Express signed binary numbers in sign-magnitude, 1's complement, 2's complement, and floating-point format
7	Carry out arithmetic operations with signed binary numbers
8	Convert between the binary and hexadecimal number systems
9	Add numbers in hexadecimal form
10	Convert between the binary and octal number systems
11	Express decimal numbers in binary coded decimal (BCD) form
12	Add BCD numbers
13	Convert between the binary system and the Gray code
14	Interpret the American Standard Code for Information Interchange (ASCII)
15	Use binary numbers and codes in a system application

	46.00 - Logic Gates
1	Describe the operation of the inverter, the AND gate, and the OR gate
2	Describe the operation of the NAND gate and the NOR gate
3	Express the operation of the NOT, AND, OR, NAND, and NOR gates with Boolean algebra
4	Describe the operation of the exclusive-OR and exclusive-NOR gates
5	Demonstrate ability to extract and analyze pertinent date from TTL data manuals
6	Recognize and use both the distinctive shape logic gate symbols and the rectangular outline logic gate symbols of ANSI/IEEE Standard 91-1984
7	Construct timing diagrams showing the proper time relationships of inputs and outputs for the various logic gates
8	Make basic comparisons between the major IC technologies - CMOS and TTL
9	Explain how the different series within the CMOS and TTL families differ from each other
10	Define propagation, delay time, power dissipation, speed-power product, and fan-out in relation to logic gates
11	List specific fixed-function integrated circuit devices that contain the various logic gates
12	Use each logic gate in simple applications
13	Troubleshoot logic gates for opens and shorts by using the logic pulser and probe or the oscilloscope
14	Describe the basic concepts of programmable logic

	47.00 - Boolean Algebra and Logic Simplification
1	Apply the basic laws and rules of Boolean algebra
2	Apply DeMorgan's theorems to Boolean expressions

3	Describe gate networks with Boolean expressions
4	Evaluate Boolean expressions
5	Simplify expressions by using the laws and rules of Boolean algebra
6	Convert any Boolean expression into a sum-of-products (SOP) form
7	Convert any Boolean expression into a product-of-sums (POS) form
8	Use a Karnaugh map to simplify Boolean expressions
9	Use a Karnaugh map to simplify truth table functions
10	Describe how a PAL works and explain how the part number defines its configuration
11	Apply Boolean algebra and the Karnaugh map method to a system application

	48.00 - Combinational Logic
1	Analyze basic combinational logic circuits, such as AND-OR, AND-OR-Invert, exclusive-OR, exclusive-NOR, and other general combinational networks
2	Write the Boolean output expressions for any combinational logic circuit
3	Develop a truth table from the output expression for a combinational logic circuit
4	Design a combinational logic circuit for a given Boolean output expression
5	Design a combinational logic circuit for a given truth table
6	Simplify a combinational logic circuit to its minimum form
7	Use NAND gates to implement any combinational logic function
8	Use NOR gates to implement any combinational logic function
9	Troubleshoot faulty logic circuits
10	Troubleshoot logic circuits by using signal tracing and waveform analysis
11	Describe a GAL and how it differs from a PAL
12	Apply combinational logic to a system application

	49.00 - Integrated Circuits
1	Describe the basic construction and features of integrated circuits (ICs).
2	Compare the operation of digital and analog ICs and their applications.
3	Discuss the operation of a 555 Timer and its applications.
4	Construct a 555 timer circuit
5	Vary the frequency and duty cycle on a 555 timer circuit
6	Assemble, test, and troubleshoot IC experimental circuits.

	50.00 - Computer Technologies and Applications
1	Examines the structure of the Windows filing system.
2	Compares and contrasts operating systems.
3	Identifies the concept of symptom, cause and solution.
4	Identifies common faults in computer hardware.
5	Investigates file and application compatibility issues.
6	Investigates stages in a computer troubleshooting method.
7	Explores the simulated computer problems and identifies the symptom, cause and solution.
8	Identifies symptoms, causes, solutions and implements tests on faulty computers in a simulation.
9	Identifies the hardware and software requirements of applications.
10	Describes how to approach given computer problems.
11	Investigates software and hardware compatibility issues.
12	Identifies the cause of a computer problem and its solution from a simulation.
13	Explores procedures for backing up data.
14	Identifies software, cleaning and technical tools used in computer troubleshooting and maintenance.

15	Explores computer viruses and methods to detect them.
16	Explores the tools a support technician may use.
17	Explores preventive maintenance systems and procedures.
18	Identify basic procedures for adding and removing field replaceable modules.
19	Identify proper procedures for installing and configuring IDE/EIDE devices.
20	Identify proper procedures for installing and configuring peripheral devices.
21	Identify common symptoms and problems associated with each module and how to troubleshoot and isolate the problems.
22	Interpret and replicate reported computer system problems.
23	Test a computer system to identify the faulty component.
24	Fix the computer system fault.
25	Identify basic characteristics of the popular CPU chips.
26	Identify the categories of RAM (Random Access Memory) terminology, their locations, and physical characteristics.
27	Identify the most popular type of motherboards, their components, and their architecture (bus structures and power supplies).
28	Replaces a faulty network card in a computer.
29	Builds and tests a coaxial computer network.
30	Measures the resistance of network terminators using a multimeter.
31	Observes the effect of removing and replacing terminators in a coaxial cabled network.
32	Recognizes the procedure for measuring the resistance of a terminator by listening to instructions in a video.
33	Recognizes the procedure for constructing a coaxial network cable.
34	Tests a coaxial network cable.
35	Recognizes the procedure for deconstructing a network cable by listening to instructions in a video.
36	Determines by measurement the type of UTP cable required for a direct cable connection between two computers.
37	Recognizes the characteristics and correct termination of UTP network cables.
38	Identifies different types of network cable media and their features.
39	Installs and tests a hub-based network.
40	Constructs a UTP patch cable.
41	Tests and deconstructs a UTP patch cable.
42	Identifies characteristics of UTP cable.
43	Creates a local user account.
44	Shares a local user account folder on different computers and between different users.
45	Identifies the features of Internet Protocol (IP) addresses.
46	Resolves the name or IP address of a networked computer using the ping command.
47	Recognizes the problems caused by having duplicated IP addresses and computer names on the same network.
48	Distinguishes between TCP and UDP protocols from information provided in a textbook.
49	Recognizes the layout and purpose of the OSI Reference Model.
50	Examines the network bandwidth types and methods of bandwidth enhancement.

	51.00 - Job Seeking/Keeping & Leadership Skills
1	Participate as an effective team/group member
2	Participate as a committee member
3	Chair a committee
4	Prepare a agenda for a meeting
5	Conduct a business meeting
6	Establish a long range career goal plan
7	Participate in a Vocational Organization like Skills USA or VICA
8	Complete an employment application
9	Prepare a resume

10	Write a letter expressing interest in employment
11	Interview for employment
12	Display job-keeping skills