Electronics Systems I

8417 18 weeks

8416 36 weeks

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Acknowledgments

The components of this instruction framework were developed by the following business panelists:

Ralph Albrecht, partner, ATFirm PLLC, Washington, D.C.
Ron Baer, Senior System Engineer, U.S. Department of the Army, Fairfax, VA
Eddie Craig, Senior Mechanical Engineer, Simplimatic Automation, Forest, VA
Sokhom Kith, Engineer, Naval Research Labs, Washington, D.C.
Paul Nussbaum, Professor, East Coast Polytechnic Institute University, Richmond, VA
Deepak Patil, Chief Operating Officer, Mind Sensors, Richmond, VA

Michael Slater, AV Technical Leader, Chesterfield County Public Schools, Chesterfield, VA
Gary Yohe, Technical Leader, GE Power Conversion, Roanoke, VA

The following educators served on the curriculum development panel:

Karen Christopherson, Glasgow Middle School, Fairfax County Public Schools
Michele Gagliardi, Frank W. Cox High School, Virginia Beach City Public Schools
Emily Loving, Career and Technical Center @Hull, Chesterfield County Public Schools
Matthew Rupe, Indian River High School, Chesapeake City Public Schools
Alexander Witowski, Rosement Middle School, Norfolk City Public Schools

Correlations to the Virginia Standards of Learning were reviewed and updated by:

Leslie R. Bowers, English Teacher (ret.), Newport News Public Schools
Vickie L. Inge, Mathematics Committee Member, Virginia Mathematics and Science Coalition
Anne F. Markwith, New Teacher Mentor (Science), Gloucester County Public Schools
Cathy Nichols-Cocke, PhD, Social Studies Teacher, Fairfax High School, Fairfax County Public Schools

The framework was edited and produced by the CTE Resource Center:

Leanne Forbes-Tipton, Curriculum Designer
Kevin P. Reilly, Administrative Coordinator

Tricia S. Jacobs, PhD, CTE Coordinator of Curriculum and Instruction
Office of Career, Technical, and Adult Education
Virginia Department of Education

Course Description

Suggested Grade Level: 9 or 10 or 11 or 12

Electronic devices are everywhere in modern life and business and, as a result, opportunities abound for any who should master the knowledge and skills to design, alter, repair, and construct them. This course allows students to explore principles of electricity, apply knowledge in mathematics and science, and conduct experiments with electronics. Students solve problems using simple electrical devices and circuits and build electronic projects using DC and AC devices and circuits.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

Task Number	8416	8417	Tasks/Competencies
Introducing the Field of Electronics			
39	⊕	⊕	Demonstrate the safe and proper use of electronic lab equipment.
40	⊕	⊕	Describe techniques and methods for use of and care for soldering equipment.
41	⊕	⊕	Identify number systems used in electronics designs.
Introducing Properties of Electricity			
42	⊕	⊕	Describe methods of generating electricity.
43	⊕	⊕	Describe atomic structure as it relates to electricity.
44	⊕	⊕	Describe the law of charges.
45	⊕	⊕	Describe the effects of magnetism on electricity.
46	⊕	⊕	Describe the operation of electromagnetic devices.
47	⊕	⊕	Describe the differences between conductors and insulators.
48	⊕	⊕	Describe current, including its unit of measurement and symbol.
49	⊕	⊕	Describe voltage, including its unit of measurement and symbol(s).
50	⊕	○	Compare potential and electromotive forces.
51	⊕	⊕	Describe resistance, including its unit of measurement and symbol(s).
52	⊕	⊕	Describe the interrelationship among current, voltage, and resistance.

53	⊕	⊕	Define Ohm's law.
54	⊕	⊕	Compute current, voltage, resistance, and power, using Ohm's law and Watt's law.
55	⊕	⊕	Describe a circuit as a system.
56	⊕	⊕	Describe direct current in circuits.
57	⊕	⊕	Determine the direction of current flow in DC circuits.
Introducing Circuit Components			
58	⊕	⊕	Describe batteries as voltage sources.
59	⊕	⊕	Describe the role of conductors in a circuit.
60	⊕	⊕	Describe the role of insulators in a circuit.
61	⊕	⊕	Explain how common electrical and electronic devices work.
62	⊕	⊕	Identify control devices of electrical and electronic devices.
63	⊕	⊕	Describe resistors by type and value.
64	⊕	⊕	Describe the purpose and components of protected circuits.
65	⊕	○	Describe the operation of variable resistors.
66	⊕	⊕	Identify different types of transistors and terminals of transistors.
Exploring Circuits as Systems			
67	⊕	⊕	Construct simple electronic circuits from a schematic.
68	⊕	⊕	Describe series circuits, using modeling components.
69	⊕	⊕	Describe the flow of current in series circuits, using the systems model.
70	⊕	⊕	Construct parallel circuits, using modeling components.
71	⊕	⊕	Describe the flow of current in parallel circuits, using the systems model.
72	⊕	○	Construct series-parallel circuits, using modeling components.

73	⊕	○	Describe the flow of current in series-parallel circuits, using the systems model.
74	⊕	⊕	Compute electrical power in circuits.
Examining Current, Voltage, and Resistance			
75	⊕	⊕	Measure current in series and parallel circuits, using a multimeter.
76	⊕	⊕	Compare computed values of circuits to the measured value of circuits.
Constructing DC Analog Circuits			
77	⊕	⊕	Design series circuits.
78	⊕	⊕	Construct series circuits.
79	⊕	⊕	Design parallel circuits.
80	⊕	⊕	Construct parallel circuits.
81	⊕	○	Design series-parallel circuits.
82	⊕	○	Construct series-parallel circuits.
83	⊕	⊕	Construct circuits that satisfy design briefs, using solderless circuit boards/breadboards.
84	⊕	⊕	Design a circuit to be soldered on a circuit board.
Exploring AC Circuits			
85	⊕	⊕	Describe the process and application of troubleshooting procedures.

Legend: ⊕Essential ○Non-essential ⊖Omitted

Curriculum Framework

Introducing the Field of Electronics

Task Number 39

Demonstrate the safe and proper use of electronic lab equipment.

Definition

Demonstration should include

- acceptable training and performance with all tools, machines, equipment, and supplies (including care and maintenance of all items)
- monitored/supervised performance during each activity
- ability to locate posted safety rules, precautions, and first aid and emergency instructions
- willingness to wear personal protective equipment (PPE), when necessary, and to adhere to injury-reporting protocols
- definition of *alternating current* (AC as that which flows first in one direction and then in the opposite direction).

Process/Skill Questions

- Why is safety important in the lab and in the workplace?
- What safety precautions should be taken when using hand tools, machines, equipment, and chemicals in a lab?
- What safety precautions and responsibilities should be considered for various electronics?
- What safety precautions are used when operating an AC generator?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

TSA Competitive Events

Principles of Technology (Virginia only)

Task Number 40

Describe techniques and methods for use of and care for soldering equipment.

Definition

Description should include

- preparing/conditioning new equipment for use
- maintaining and caring for used equipment
- applying heat and solder on circuit boards and other conductors
- desoldering components on circuit boards
- opening circuits for testing and replacing components.

Process/Skill Questions

- What is the primary tool used for installing a component on a printed circuit board (PCB)?
- What wattage should be used for PCB work?
- What tools are required for desoldering a component on a PCB?
- How is the tip of a soldering iron tinned?

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Task Number 41

Identify number systems used in electronics designs.

Definition

Identification should include

- metric system prefixes (e.g., milli, micro, nano, pico, kilo, mega, giga, tera, peta, exa)
- analog numbers that assign value to amps, ohms, volts, and watts
- basic units of information used in computing and digital communication.

Process/Skill Questions

- What is a *number system*? What is its relationship to logic circuitry?
- How are conversions made from one code system to another?
- What are the base-10 and base-2 systems? What are their synonyms?

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Engineering Design

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System Control Technology

Introducing Properties of Electricity

Task Number 42

Describe methods of generating electricity.

Definition

Description should include the following methods:

- Chemical and photochemical
  - photovoltaic cells
  - hydrogen cells
  - batteries
- Friction
  - wind turbines
  - water turbines
  - generators (manual and motorized)
- Atomic and sub-atomic interaction
  - piezoelectric effect in ceramic crystals and metals
  - nuclear reactions, including fusion and fission
  - electromagnetic field effect.

Process/Skill Questions

- What methods are used to generate electricity?
- What are the mathematical and scientific principles related to the generation of electricity?
- What are the advantages and disadvantages of the various methods to generate and use electricity?
- How is the production of electricity stored, distributed, and measured?
- What are the environmental effects of electricity production?
- What emerging technologies are being used to optimize electricity production?
- What is the purpose of an AC generator?
- How does an alternator generate AC voltage?
- What is the *left-hand rule*?

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Task Number 43

Describe atomic structure as it relates to electricity.

Definition

Description should include

- identifying the parts of an atom
- understanding the relationship between electrons, protons, and neutrons
- identifying the potential for materials to conduct electricity.

Process/Skill Questions

- How is atomic structure used in the manufacture of conductors and insulators?
- How are the electrical properties of conductors and insulators developed?
- How are conductors and insulators manufactured?
- What common products or tools use conductor and insulator materials?
- What is the *law of charges*?

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System Control Technology

Technology Bowl

Task Number 44

Describe the law of charges.

Definition

Description should include

- explaining that between magnetic objects, those with like charges repel and those with unlike charges attract

- knowing that the size of the charge and the amount of force produced have a direct relationship
- understanding that force is applied in a direct line between objects
- identifying that the inverse square law of the electrostatic follows the force of attraction
- explaining that the electrostatic force of attraction between two-point charges are proportional to the product of the magnitudes.

Process/Skill Questions

- Who is credited with discovering the law of charges?
- How should objects with similar charges behave with each other, according to the law of charges?
- What are some everyday examples of the law of charges?
- How does the size of a magnetic field relate to charge?

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Technology Bowl

Task Number 45

Describe the effects of magnetism on electricity.

Definition

Description should include

- creation of a magnetic field around two conductors
- the method of determining flux lines
- Faraday's law
- induction-generating electricity
- electromagnetism.

Process/Skill Questions

- What is the *law of magnetic poles*?
- How do relays and solenoids work?
- How is a speaker tested?
- How is the voltage of AC current with magnetism changed?
- How does a transformer work?
- How does AC current coexist with electromagnetism?

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Task Number 46

Describe the operation of electromagnetic devices.

Definition

Description should include the

- characteristics of electromagnetic devices
- process of operation in electromagnetic devices
- application of electromagnetic devices, including current examples.

Process/Skill Questions

- What is the advantage of using a breadboard before creating a PCB?
- How do the Hall effect, Faraday's law, and Lenz's law relate to electromagnetic devices?
- What are the common units of measurement associated with the characteristics of magnetism, magnetic fields, and electromagnetic devices?
- What are the mathematical and scientific concepts related to magnetism, magnetic fields, and electromagnetic devices?
- What are the characteristics and applications of electromagnetic devices?
- How are electronic circuit applications optimized by electromagnetic devices?

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Task Number 47

Describe the differences between conductors and insulators.

Definition

Description should include an analysis of conductors and insulators.

Process/Skill Questions

- How does the size of the conductor relate to resistance?
- What is the difference between a conductor and an insulator?
- What are the factors that determine the resistance of a conductor?

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Technology Bowl

Task Number 48

Describe current, including its unit of measurement and symbol.

Definition

Description should include

- differentiating between direct current (DC), alternating current, and pulsating direct current (PDC), including symbols and units of measurement

- explaining that current is measured in amperes (amps)
- identifying the symbol for current (I)
- defining *electrical current* as the motion of free electrons
- explaining the usual sine waveform and periodic changes in direction of alternating current.

Process/Skill Questions

- What is the unit of measurement for current?
- What letter symbol is used to represent current?
- In which direction does current flow? Why?

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Technology Bowl

Task Number 49

Describe voltage, including its unit of measurement and symbol(s).

Definition

Description should include

- defining *voltage* as the potential difference in charge between two points in an electrical field used to push the electrons through the circuit
- identifying that voltage is always expressed between two points in an electrical field
- providing examples for voltage produced by alternative methods
- identifying that the unit of voltage is measured in volts (Volts)
- identifying the symbols for voltage (V) and (E).

Process/Skill Questions

- What is the unit of measurement for voltage?
- What letter symbol is used to represent voltage?
- What are some alternative voltage sources?

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Technology Bowl

Task Number 50

Compare potential and electromotive forces.

Definition

Comparison should include

- potential energy—the difference between the energy of an object in a given position and its energy at a reference position
- electromotive force (EMF)—considered a potential difference of a source when no current is flowing and refers to voltage generated by a battery or by a magnetic force, according to Faraday's law.

Process/Skill Questions

- How is potential energy measured?
- What is the difference between EMF and voltage?
- What factors affect potential energy?

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Task Number 51

Describe resistance, including its unit of measurement and symbol(s).

Definition

Description should include

- defining *resistance* as free electrons moving through conductors with some degree of friction or opposition to motion
- identifying the unit of measurement of resistance in ohms and the symbol for resistance (Ω – Greek letter omega) and (R)
- explaining that resistance is measured between two points and can also be referred to as impedance
- explaining that a resistor is a passive device used to implement electrical resistance.

Process/Skill Questions

- What is the unit of measurement for resistance?
- What letter symbol is used to represent resistance?
- What factors determine how much resistance is in a conductor?

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Task Number 52

Describe the interrelationship among current, voltage, and resistance.

Definition

Description should include

- explaining how current in a circuit depends on the amount of voltage available to move electrons while resistance opposes electron flow
- explaining why the amount of electrical current through a metal conductor in a circuit is directly proportional to the voltage impressed across it for any given temperature.

Process/Skill Questions

- How are current, voltage, and resistance related?
- How does resistance affect the movement of free electrons?
- What are the standard units of measurement for current, voltage, and resistance?

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Task Number 53

Define Ohm's law.

Definition

Definition should include

- providing the equation of Ohm’s law
    - voltage (VE) is equal to current (I) multiplied by resistance (R)
- describing Ohm’s law, attributed to Georg S. Ohm, as a simple and useful tool for analyzing electric circuits.

Process/Skill Questions

- What is Ohm’s law?
- What are the mathematical relationships of Ohm’s law?
- How can Ohm’s law be used to evaluate circuit characteristics?
- What are the units of measurement involved in Ohm’s law, and how do they relate to one another?
- In which circuit configurations do the basic principles of Ohm’s law not apply?

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Task Number 54

Compute current, voltage, resistance, and power, using Ohm's law and Watt's law.

Definition

Computation requires an understanding of the mathematical and scientific concepts related to Watt's law and power and should include

- defining the terms of the equation for Ohm's law and Watt's law:
  - Ohm's law: V = IR; I = V/R; R = V/I
  - Watt's law: P = VI; I = P/V; V = P/I
- describing the basic scientific principle that
  - if resistance to current flow stays the same and the voltage pressure increases, the current flow rate must also increase.

Process/Skill Questions

- What is *Watt's law*?
- What are the mathematical relationships of Watt's law?
- How can Watt's law be used to evaluate circuit characteristics?
- What are the units of measurement involved in Watt's law, and what is their relationship to one another?

- How do Ohm's law and Watt's law relate to each other in the analysis of electronic circuits?

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System Control Technology

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Task Number 55

Describe a circuit as a system.

Definition

Description should include identifying

- open, closed, and short circuits
- the fundamental components of a circuit (voltage source, switch, load, connecting wires).

Process/Skill Questions

- What are the characteristics of a system?
- What might cause a short circuit?
- Why are switches used?

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Task Number 56

Describe direct current in circuits.

Definition

Description should include

- defining DC as having one direction of current flow
- identifying the amp as the unit of measurement of current
- naming common applications for DC.

Process/Skill Questions

- What does DC stand for?
- How does DC flow?
- What is the difference between DC and AC?

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Technology Bowl

Task Number 57

Determine the direction of current flow in DC circuits.

Definition

Determination should include an understanding of the characteristics, operation, and application of simple direct-current circuits and theory.

Process/Skill Questions

- What is *direct current*? What are the characteristics of DC circuits?
- What types of voltage and power sources are associated with DC circuits?
- What are examples of DC circuits and applications?
- What mathematical concepts can be applied to better understand the characteristics of DC circuits?

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Introducing Circuit Components

Task Number 58

Describe batteries as voltage sources.

Definition

Description should include

- identifying the process of current flow inside a battery
- identifying the three components necessary for current flow
    - voltage source
    - conductor
    - load
- identifying the battery schematic symbol
- measuring DC voltage with a voltmeter.

Process/Skill Questions

- What is the difference between the cathode and anode terminals?
- How does current flow inside a battery?
- Which three components are necessary for current to flow?

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TSA Competitive Events

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Technology Bowl

Task Number 59

Describe the role of conductors in a circuit.

Definition

Description should include

- providing examples of conductive material
- identifying the role and function of the conductor in a complete circuit.

Process/Skill Questions

- What are examples of conductors?

- What role does a conductor play inside a circuit?
- How does a conductor differ from an insulator?

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TSA Competitive Events

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Technology Bowl

Task Number 60

Describe the role of insulators in a circuit.

Definition

Description should include

- providing examples of insulated material
- explaining how an insulator protects a circuit and circuit components.

Process/Skill Questions

- What are examples of insulators?
- What role does an insulator play inside a circuit?
- How does an insulator differ from a conductor?

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Task Number 61

Explain how common electrical and electronic devices work.

Definition

Explanation should include identifying the following devices:

- Lamps
- Motors
- Light-emitting diodes (LED)
- Speakers

It also includes identifying common schematic symbols as noted.

See electronic symbols and diagrams.

Process/Skill Questions

- How does a lamp emit light?
- How does a motor work?
- How does an LED work?
- How do speakers work?

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16. Energy and Power Technologies

Task Number 62

Identify control devices of electrical and electronic devices.

Definition

Identification should include the following devices:

- Resistors
- Switches
- Diodes
- Thermistor

See electronic symbols and diagrams.

Process/Skill Questions

- What are the sensing and control devices and circuits commonly used in electronics?
- What are characteristics and applications of control devices in electronic circuits?
- How can control devices affect circuit operations?

ITEEA National Standards

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Task Number 63

Describe resistors by type and value.

Definition

Description should include

- identifying types of resistors
- identifying notation (μ, n, p, K, M, G)
- interpreting a color-coded chart that correlates colors to type and value
- determining resistance values using color or color-recognizing mobile apps
- identifying the band system to represent values, multiplier, and tolerance.

Sources of assistance:
Providing help for those who are colorblind.
Optical recognition of resistor codes.
Resistor Vision.

Process/Skill Questions

- What are the types of resistors and their characteristics, applications, and advantages?
- What are the units of measurement for resistive components?
- How are resistive components labeled?
- What is the resistor color code, and how is it used to determine values and tolerances?

- How is a resistor's power rating determined and measured?
- Does component size affect resistor values? Explain.

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Technology Bowl

Task Number 64

Describe the purpose and components of protected circuits.

Definition

Description should include

- identifying fuses and circuit breakers
- explaining the purpose of circuit-protection devices
- discussing surge protectors and ground fault interrupter (GFI) circuits.

Process/Skill Questions

- What are the methods for protecting electronic circuits?
- What are safety precautions for working with electronic circuits?
- What are the units of measurement for circuit protection?
- How is circuit protection evaluated and maintained?

ITEEA National Standards

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TSA Competitive Events

Animatronics

Principles of Technology (Virginia only)

Technology Bowl

Task Number 65

Describe the operation of variable resistors.

Definition

Description should include

- explaining the process and function of variable resistors
- identifying examples of variable resistors, such as potentiometer, rheostat, and digital resistor
- using ohm meter to measure the value of variable resistors
- identifying the unit of measurement for variable resistors.

Process/Skill Questions

- How would a variable resistor be used in a circuit?
- What is the advantage of using a variable resistor inside a circuit?
- How does one determine whether a variable resistor is working as intended?

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TSA Competitive Events

Principles of Technology (Virginia only)

Technology Bowl

Task Number 66

Identify different types of transistors and terminals of transistors.

Definition

Identification should include the following components:

- Transistor
- Emitter
- Base
- Collector
- Schematic symbol for a transistor

Process/Skill Questions

- What are some types of transistors?
- How does one determine what type of transistor is needed in a circuit?
- What are the different transistor circuit configurations?

ITEEA National Standards

16. Energy and Power Technologies

Exploring Circuits as Systems

Task Number 67

Construct simple electronic circuits from a schematic.

Definition

Construction should include

- placing components on a breadboard

- making connections to build a functioning circuit
- matching a given schematic
- simulating a functioning circuit in computer software.

Process/Skill Questions

- What are the parts of a circuit?
- How are circuits constructed from schematics using connections?
- How do schematics use computer software simulations? What are the advantages of doing so?
- How are soldering techniques used in the construction of circuits?
- How are circuits manufactured in large quantities?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

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TSA Competitive Events

Animatronics

System Control Technology

Task Number 68

Describe series circuits, using modeling components.

Definition

Description should include identifying the

- source, load, path, and control of the circuit
- input, process, and output of the circuit
- specific components and their functions in the circuit.

Process/Skill Questions

- What is a short circuit?
- What is the path for current flow in a circuit?
- What happens when a series circuit is opened?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

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TSA Competitive Events

System Control Technology

Task Number 69

Describe the flow of current in series circuits, using the systems model.

Definition

Description should include

- identifying the one current path
- describing the direction of current flow in the circuit
- determining input, process, output, and feedback.

Process/Skill Questions

- What could potentially fault a series circuit?
- How can a series circuit be tested for proper voltage?
- How is current measured in a series circuit?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

System Control Technology

Task Number 70

Construct parallel circuits, using modeling components.

Definition

Construction should include

- placing components in a parallel circuit
- prototyping a functioning parallel circuit on a breadboard
- soldering components on a circuit board to make a functioning parallel circuit.

Process/Skill Questions

- What faults are associated with parallel circuits?
- What are the advantages of using parallel circuits?
- Where are parallel circuits typically used/found?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

Animatronics

System Control Technology

Task Number 71

Describe the flow of current in parallel circuits, using the systems model.

Definition

Description should include

- determining the input, process, output, and feedback
- identifying the direction of current flow in the circuit
- using a multimeter to show electron flow.

Process/Skill Questions

- What is the behavior of current in a parallel circuit?
- How is a meter used to test current in a parallel circuit?
- What determines voltage in a parallel circuit?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

System Control Technology

Task Number 72

Construct series-parallel circuits, using modeling components.

Definition

Construction should include

- identifying current flow in the circuit
- locating the portion of the circuit that is in a series
- determining the parallel portion of the circuit.

Process/Skill Questions

- How is current behavior determined in series-parallel circuits?
- How is voltage determined throughout the circuit?
- What is the path of least resistance?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

Animatronics

System Control Technology

Task Number 73

Describe the flow of current in series-parallel circuits, using the systems model.

Definition

Description should include

- identifying the input(s)
- determining the process and path
- analyzing the output and feedback.

Process/Skill Questions

- How can feedback be used to control a circuit?
- How is the process and path determined?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

System Control Technology

Task Number 74

Compute electrical power in circuits.

Definition

Computation should include

- using the same value components that are physically installed in the circuit
- retaining at least three significant figures (i.e., decimal places) on all measurements
- reconciling differences between computed and measured values (often attributable to rounding errors).

Process/Skill Questions

- Why might computed values differ from measured values?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

8. The Attributes of Design

TSA Competitive Events

Animatronics

System Control Technology

Examining Current, Voltage, and Resistance

Task Number 75

Measure current in series and parallel circuits, using a multimeter.

Definition

Measurement should include determining current, voltage, and resistance.

When working with a circuit

- connecting the meter to the circuit should be done in the power-off condition
- resistance measurements should always be made in the power-off condition to avoid blowing a fuse in the meter or damaging internal components
- negative reading(s) in a DC circuit means the leads are reversed.

Note: Black will always be placed in the ground position, while red will be in VΩmA for low-value measurements of up to 1-2 amperes and will be moved to the 10 ampere (maximum) position for higher readings.

Process/Skill Questions

- What is a multimeter?
- How do analog and digital multi-meters compare in use, accuracy, and performance?
- How can multimeters and similar test equipment be used to measure circuit characteristics?
- How do actual and virtual test equipment values compare?
- How can multimeters be used to measure circuit characteristics of voltage and current?

- How do series and parallel measurements of current differ?

ITEEA National Standards

1. The Characteristics and Scope of Technology

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

Principles of Technology (Virginia only)

Technology Problem Solving

Task Number 76

Compare computed values of circuits to the measured value of circuits.

Definition

Comparison should include

- using the same value components that are physically installed in the circuit
- retaining at least three significant figures (i.e., decimal places) on all measurements
- reconciling differences between computed and measured values (often attributable to rounding errors).

Process/Skill Questions

- Why might computed values differ from measured values?

ITEEA National Standards

1. The Characteristics and Scope of Technology

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

TSA Competitive Events

Principles of Technology (Virginia only)

Technology Problem Solving

Constructing DC Analog Circuits

Task Number 77

Design series circuits.

Definition

Design should include

- designating one path for current to flow
- using a conductor, a load, and a voltage source
- placing load and path
- simulating and testing for virtual output.

Process/Skill Questions

- How can virtual meters help with series-circuit analysis?
- What are the advantage of a simulation?
- What faults can be tested virtually?

- What is a series circuit?
- What are the minimum requirements to complete a series circuit?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

TSA Competitive Events

Animatronics

Engineering Design

System Control Technology

Task Number 78

Construct series circuits.

Definition

Construction should include

- using a breadboard
- designating a source and one path for current to flow
- using a conductor, a load, and a voltage source connecting components
- testing output for desired results.

Process/Skill Questions

- How do virtual simulations compare to real-world circuits?
- What might cause a fault in a circuit?
- How is a series circuit affected by a broken path?
- Which items in the industry or at home use series circuits?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

TSA Competitive Events

Animatronics

Engineering Design

System Control Technology

Task Number 79

Design parallel circuits.

Definition

Design should include

- designating two or more paths for current to flow
- using a conductor, a load, and a voltage source
- placing loads
- testing virtual output and branch currents for desired results.

Process/Skill Questions

- What information can virtual test equipment provide?
- How do parallel circuits differ from series circuits?
- How is a parallel circuit affected by a broken path?
- What is a parallel circuit?
- What are the minimum requirements to complete a parallel circuit?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

TSA Competitive Events

Animatronics

Engineering Design

System Control Technology

Task Number 80

Construct parallel circuits.

Definition

Construction should include

- using breadboard
- determining two or more paths for current to flow
- using a conductor, a load, and a voltage source
- connecting components
- testing output for desired results.

Process/Skill Questions

- Which items in the industry or at home use series circuits?
- How does virtual circuit compare to real-world model?
- What may fault the circuit?
- What happens to current flow in parallel circuits?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

TSA Competitive Events

Animatronics

Engineering Design

Task Number 81

Design series-parallel circuits.

Definition

Design should include

- determining two or more paths for current to flow (at least one path should have additional pathways)
- using a conductor, a load, and a voltage source
- placing loads
- testing virtual output and branch currents for desired results.

Process/Skill Questions

- How can a virtual meter be used to test branch current?
- What are the advantages of simulating a circuit prior to its construction?
- What are some advantages of series-parallel combination circuits?
- What is a series-parallel circuit?
- What are the minimum requirements to complete a series-parallel circuit?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

TSA Competitive Events

Animatronics

Engineering Design

System Control Technology

Task Number 82

Construct series-parallel circuits.

Definition

Construction should include

- using a conductor, a load, and a voltage source
- connecting components
- testing output for desired results.

Process/Skill Questions

- How does the model compare to the simulation?
- Why is circuit behavior predictable in a series-parallel circuit?
- What methods may be employed to test the circuit?
- What are examples of series-parallel circuits used in industry or households?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

TSA Competitive Events

Animatronics

Engineering Design

System Control Technology

Task Number 83

Construct circuits that satisfy design briefs, using solderless circuit boards/breadboards.

Definition

Construction should include

- determining source and paths
- using a conductor, a load, and a voltage source
- connecting components
- testing output for desired results.

Process/Skill Questions

- How does the circuit design satisfy the design brief?
- What changes may be made to optimize the design?
- What troubleshooting methods should be used when the circuit does not behave as expected?
- What is the benefit of using solderless breadboards?
- What is the advantage in using a breadboard before creating a printed circuit board (PCB)?

ITEEA National Standards

11. Apply the Design Processes

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

8. The Attributes of Design

9. Engineering Design

TSA Competitive Events

Animatronics

Computer Integrated Manufacturing (CIM)

Engineering Design

Scientific Visualization (SciVis)

Task Number 84

Design a circuit to be soldered on a circuit board.

Definition

Design should include

- determining the proper source and paths
- configuring the optimum layout
- using a conductor, a load, and a voltage source
- constructing the circuit
- testing output for desired results.

Process/Skill Questions

- How are components protected while soldering?
- How is optimum layout determined?
- When can the layout affect circuit behavior?
- What is a PCB?
- How is a PCB created?

ITEEA National Standards

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

2. The Core Concepts of Technology

9. Engineering Design

TSA Competitive Events

Animatronics

Engineering Design

System Control Technology

Exploring AC Circuits

Task Number 85

Describe the process and application of troubleshooting procedures.

Definition

Description should include

- conducting a visual inspection
- using diagnostic tools and techniques
- inspecting components
- identifying current specifications.

Process/Skill Questions

- Why might one need to troubleshoot a circuit?
- What are some questions one should ask one's self when troubleshooting?
- How does one determine whether components are functional?

ITEEA National Standards

10. The Role of Troubleshooting, Research and Development, Invention and Innovation, and Experimentation in Problem Solving

12. Use and Maintain Technological Products and Systems

16. Energy and Power Technologies

19. Manufacturing Technologies

2. The Core Concepts of Technology

8. The Attributes of Design

SOL Correlation by Task

39	Demonstrate the safe and proper use of electronic lab equipment.	History and Social Science: GOVT.14 Science: CH.1, PH.1
40	Describe techniques and methods for use of and care for soldering equipment.	
41	Identify number systems used in electronics designs.	English: 9.3, 10.3, 11.3, 12.3 Mathematics: COM.15
42	Describe methods of generating electricity.	English: 9.5, 10.5, 11.5, 12.5 Science: CH.5, ES.6, PH.11
43	Describe atomic structure as it relates to electricity.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: VUS.8 Science: CH.2
44	Describe the law of charges.	Mathematics: A.4, A.8, AII.3, AII.10 Science: PH.6
45	Describe the effects of magnetism on electricity.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.7
46	Describe the operation of electromagnetic devices.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.7
47	Describe the differences between conductors and insulators.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
48	Describe current, including its unit of measurement and symbol.	English: 9.5, 10.5, 11.5, 12.5 History and Social Science: VUS.8

		Mathematics: A.4, A.8, T.3, AII.3, AII.10 Science: PH.11
49	Describe voltage, including its unit of measurement and symbol(s).	English: 9.5, 10.5, 11.5, 12.5 Mathematics: A.4, A.8, AII.3, AII.10 Science: PH.11
50	Compare potential and electromotive forces.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.6, PH.11
51	Describe resistance, including its unit of measurement and symbol(s).	English: 9.3, 10.3, 11.3, 12.3 Science: PH.11
52	Describe the interrelationship among current, voltage, and resistance.	English: 9.5, 10.5, 11.5, 12.5 Mathematics: A.4, A.8, AII.3, AII.10 Science: PH.11
53	Define Ohm's law.	English: 9.3, 10.3, 11.3, 12.3 Mathematics: A.4, A.8, AII.3, AII.10 Science: PH.11
54	Compute current, voltage, resistance, and power, using Ohm's law and Watt's law.	Mathematics: A.4, A.6, A.8, AII.3, AII.10 Science: PH.11
55	Describe a circuit as a system.	Science: PH.7, PH.11
56	Describe direct current in circuits.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
57	Determine the direction of current flow in DC circuits.	Science: PH.11
58	Describe batteries as voltage sources.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.6
59	Describe the role of conductors in a circuit.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.7, PH.11
60	Describe the role of insulators in a circuit.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.7, PH.11

61	Explain how common electrical and electronic devices work.	English: 9.5, 10.5, 11.5, 12.5
62	Identify control devices of electrical and electronic devices.	English: 9.5, 10.5, 11.5, 12.5
63	Describe resistors by type and value.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
64	Describe the purpose and components of protected circuits.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
65	Describe the operation of variable resistors.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
66	Identify different types of transistors and terminals of transistors.	
67	Construct simple electronic circuits from a schematic.	Science: PH.11
68	Describe series circuits, using modeling components.	Science: PH.11
69	Describe the flow of current in series circuits, using the systems model.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
70	Construct parallel circuits, using modeling components.	Science: PH.11
71	Describe the flow of current in parallel circuits, using the systems model.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
72	Construct series-parallel circuits, using modeling components.	Science: PH.11
73	Describe the flow of current in series-parallel circuits, using the systems model.	English: 9.5, 10.5, 11.5, 12.5 Science: PH.11
74	Compute electrical power in circuits.	Mathematics: A.1, A.4, AII.3 Science: PH.11
75	Measure current in series and parallel circuits, using a multimeter.	Science: PH.1, PH.11
76	Compare computed values of circuits to the measured value of circuits.	Science: PH.1, PH.11
77	Design series circuits.	Science: PH.1, PH.11
78	Construct series circuits.	Science: PH.11
69	Design parallel circuits.	Science: PH.1, PH.11
80	Construct parallel circuits.	Science: PH.11
81	Design series-parallel circuits.	Science: PH.1, PH.11
82	Construct series-parallel circuits.	Science: PH.11
83	Construct circuits that satisfy design briefs, using solderless circuit boards/breadboards.	Science: PH.11
84	Design a circuit to be soldered on a circuit board.	Science: PH.1, PH.11

85	Describe the process and application of troubleshooting procedures.	English: 9.5, 10.5, 11.5, 12.5

Cyber Security and Cyber Forensics Infusion Units

Cyber Security and Cyber Forensics Infusion Units (CYBR) were designed to be infused with designated CTE courses to help students in those programs achieve additional, focused, validated tasks/competencies in personal and professional cyber security skills. These units are not mandatory, and, as such, the tasks/competencies are marked as "optional," to be taught at the instructor's discretion.

Entrepreneurship Infusion Units

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- Electronics Technology Assessment
- National Career Readiness Certificate Assessment
- Student Electronics Technician (SET) Examination
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Electronics Systems II (8412/36 weeks)
- Electronics Systems III (8413/36 weeks)
- Energy and Power (8495/18 weeks)
- Energy and Power (8448/36 weeks)
- Power and Transportation (8444/18 weeks)
- Power and Transportation (8445/36 weeks)
- Technology of Robotic Design (8420/18 weeks)
- Technology of Robotic Design (8421/36 weeks)

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Engineering and Technology	**Aerospace Engineering Technician** **Computer Hardware Engineer** **Electrical Engineer** **Electrical Engineering Technician** **Electro-Mechanical Technician** **Electronics Engineering Technician** **Engineer** **Engineering Technician** **Industrial Engineering Technician**