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AC/AC Circuits Printer-Friendly View:

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DC/AC Instructional Materials List
Last Update: August 7, 2008

Right click and "Save Link As" to save each document to your desktop.

1. An Electronic System Power Supply Presentation (Powerpoint)
   * An Electronic System Power Supply Assessment (PDF)

2. Semiconductor Devices Presentation (Powerpoint)
   * Semiconductor Devices Assessment (PDF)

3. Semiconductor Materials Presentation (Powerpoint)
   * Semiconductor Materials Assessment (PDF)

4. Capacitors and Electronic Systems Lab
   & Capacitor Charge Process Spreadsheet (PDF)

5. System Amp Meter Lab (PDF)

6. System Volt Meter Lab (PDF)

7. System Solar Lab (PDF)

8. System Temperature Lab (PDF)

9. System Wire and Cable Characteristics Lab
   & Wire and Cable Spreadsheet (PDF)

   * Instructors should contact Tom McGlew, eSyst Project Manager, for an answer key.

Student Learning Outcomes
New student learning outcomes (SLOs) are listed below in red.

DC Circuits or Circuit Analysis I

1. Name the four major segments of the electronics industry, explain the organization and operation of the electronics industry and identify career opportunities for technicians in industry.

2. Define systems as it applies to electronics, list and explain the operation of the main building blocks and circuits of electronics systems.

3. Define basic electrical quantities and terms including current, voltage, power, resistance, and efficiency.

4. Define conductor, insulator and semiconductor materials

5. Determine resistance from color code and surface mount component codes and labels.

6. Apply Ohm’s and Kirchhoff’s laws to solve series, parallel, and series-parallel circuit problems as well as loaded and unloaded voltage divider problems.
7. Identify and calculate a bridge circuit.
8. Describe the properties of magnetic fields and materials, explain electromagnetism, electromagnetic induction and relate to the operation of common magnetic devices.
9. Make common circuit measurements such as voltage, current and resistance with a multimeter.
10. Explain meter loading and define precision and accuracy, and calculate accuracy and error.

AC Circuits or Circuit Analysis II

1. Define and identify a sine wave and determine frequency, period, peak, peak-to-peak (pp) and root mean square (rms) values of a sine wave.
2. Define capacitance and capacitance units, identify capacitors, calculate series and parallel combinations of capacitors.
3. Explain the operation of a capacitor with both DC and AC.
4. Define inductance, inductive units, identify inductors, calculate series and parallel combinations of inductors.
5. Analyze, explain and calculate the DC transient behavior of resistor-capacitor (RC) and resistor-inductor (RL) circuits.
6. Define, calculate and explain the effect of capacitive and inductive reactance.
7. Define and calculate impedance in series and parallel RL, RC and RLC circuits.
8. Define phase shift and calculate voltages, currents, impedance and phase angle in RC, RL and RLC circuits using phasors.
9. Define and calculate resonance, Q and bandwidth in series and parallel RLC circuits.
10. Name the four basic kinds of filters, show their response curves and make basic calculations of cut-off frequency with RC and LC filters.
11. Explain the construction and operation of a transformer and make transformer calculations of voltage step-up/down and impedance.
12. Explain the operation of a diode and state its most common applications.
13. Draw a block diagram of a basic linear power supply identifying each major section or component and explaining its need and operation.
14. Measure AC voltage, current, impedance, frequency, period, duty cycle, rise/fall time, pulse width and phase angle with an oscilloscope and function generator.
15. Name the most common types of wire and cable, state where each is used, and make basic wire/cable tests and measurements.
16. State a basic method and procedure to troubleshooting and perform troubleshooting on basic DC and AC circuits.

Detailed Course Outline
New topics are listed below in red.

DC Circuits or Circuit Analysis I

1. Introduction to the Electronics Industry and careers
   a. Segments of the electronics industry
   b. How the industry works
   c. Jobs and careers

2. Introduction to systems
   a. Systems defined
   b. Elements of a system
   c. System examples

3. Introduction to Electricity (Voltage, Current, and Resistance)
   a. Atomic Structure
   b. Electrical Charge
   c. Current
   d. Voltage
   e. Resistance
   f. Electrical Circuits
   g. Basic Circuit Measurements

4. Ohm's Law
   a. Current Calculations
   b. Voltage Calculations
   c. Resistance Calculations
   d. The Current, Voltage, Resistance Relations

5. Power and Energy
   a. Power in Electric Circuits
   b. Resistor Power Ratings
   c. Energy Loss and Voltage Drop in Resistance

6. DC Series Resistive Circuits
   a. Resistors in Series
   b. Rules and Laws for Series Circuits
   c. Voltage Dividers
   d. Ground
   e. Troubleshooting Series Circuits

7. DC Parallel Resistive Circuits
   a. Resistors in Parallel
   b. Rules and Laws for Parallel Circuits
   c. Current Sources
   d. Current Dividers and Applications
   e. Troubleshooting Parallel Circuits

8. DC Series Parallel Circuits
   a. Series-parallel Relationships
   b. Analysis of Series-Parallel Circuits
   c. Loaded Voltage Dividers
   d. Ladder Networks and the Wheatstone Bridge
   e. Troubleshooting

9. Magnetism and Electromagnetism
   a. Magnetic Fields
   b. Electromagnetism
   c. Hysteresis
   d. Induction
   e. Applications of Electromagnetism and Induction

10. Introduction to semiconductors and basic systems
    a. Semiconductors defined
    b. Diodes and how they work
    c. Rectifiers
    d. Introduction to transistors and ICs
    e. The basic power supply as a system

AC Circuits or Circuit Analysis II

1. Introduction to Alternating Current and Voltage
   a. Sine waves
   b. Non-sinusoidal Waveforms
   c. Voltage measures, frequency, period.
2. Capacitance and Inductance
   a. Definition, units of measure and physical properties
   b. Circuit configurations, total capacitance and inductance
   c. DC and transient analysis of RC and RL circuits
   d. Capacitance and inductance in AC Circuits
3. Transformers
   a. Step up/step down
   b. Loading and Reflected Load
   c. Impedance Matching
4. RC Circuits
   a. Typical Circuit Configurations and Total Impedance
   b. Power in RC Circuits
5. RL Circuits
   a. Circuit Configurations and Total Impedance
   b. Power in RL Circuits
6. RLC Circuits
   a. Circuit Configurations and Total Impedance
   b. Power in RLC Circuits
   c. Resonance
   d. Filters
7. Circuit Theorems
   a. Voltage and Current Sources
   b. Thevenin's Theorem
   c. Maximum Power Theorem
8. Wire and cable
   a. Types and sizes of wire
   b. Types of cable
   c. Cable characteristics
   d. Introduction to transmission lines
9. Test equipment
   a. Operation and use of the oscilloscope
   b. Operation and use of the function generator
10. Troubleshooting
   a. An approach to troubleshooting
   b. Troubleshooting methods for DC/AC circuits

New Systems Topics

Topic	**Related Materials**
1. Define systems and the concept of signal flow, in block diagrams of equipment and systems.	Work-Ready Electronics (WRE) modules: • Introduction to Electronic • Electronic Circuits

2. Define the function of the most common electronic circuits and assemblies (amplifiers, power supplies, filters, oscillators, embedded controllers, etc.).	WRE module: • Systems View of Electronics **eSyst Presentation:** • An Electronic System Power Supply Example ***eSyst Assessment:** • An Electronic System Power Supply Assessment
3. Define and explain semiconductors.	**eSyst Presentation:** • Semiconductor Materials • Semiconductor Devices ***eSyst Assessments:** • Semiconductor Materials Assessment • Semiconductor Devices Assessment
4. Include a greater emphasis on the higher frequencies (through GHz) and their effect on components and circuits (residuals in components and stray/distributed inductance and capacitance).	**eSyst Lab:** • System Wiring and Cabling Characteristics Lab & Spreadsheet
5. Emphasize surface mount components over the older traditional components.	Use current textbook for this material.
6. Teach the operational principles of diodes and their basic applications, including basic linear power supplies.	**eSyst Presentation:** • Semiconductor Devices ***eSyst Assessments:** • Semiconductor Materials Assessment • Semiconductor Devices Assessment
7. Stress more testing, measurement principles, and applications.	**eSyst Labs**: • System Amp Meter Lab • System Volt Meter Lab • System Solar Power Lab • System Temperature Lab • System Wiring and Cabling Characteristics Lab & Spreadsheet

8. Add coverage of wiring and cables.	WRE module: • Wiring and Cabling **eSyst Lab:** • System Wiring and Cabling Characteristics Lab & Spreadsheet
9. Explain the make-up of the electronic industry and industries that employ electronics technicians. Describe the flow of materials through the industry. Name the most commonly available jobs.	WRE module: • Electronic Careers

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Traditional View

Courses in DC and AC circuits, alternately called Circuit Analysis I and II, are traditionally the first courses that a student in an AAS degree electronics technology program takes. What is typically missing in such courses is some perspective with regard as to why this theory is being taught and how it fits in with every-day electronic applications. The relevance commonly escapes students thereby leaving them wondering about the context of the material.

Most electronic technology degree programs were established in the 1970 and 1980s and targeted towards filling engineering technician jobs. Such jobs are no longer widely available because of the major changes that have occurred in electronic design and how equipment is implemented today. Electronics technicians' no longer design and prototype electrical components, engineers now develop computer simulations, which serve that purpose. Hence, the heavy math analysis and design approach of most DC/AC Circuit courses today is less relevant and out of touch with current industry needs.

Systems View

Most modern electronics technician work involves one or more of the following: installation, testing, manufacturing, operation, maintenance, service, troubleshooting, and repair, of the equipment making up a system. While there are some discrete transistor, resistor, capacitor, diode circuits in use, ICs are used predominately. It is not possible to access individual components or even circuits within the larger ICs. Further, most ICs are far too large and complex for even the most experienced engineer to understand.

It has become more economical and faster for technicians to discard defective circuits and modules, replacing them with new ones. Since the technician has only access to IC or module inputs, outputs, and DC power, rarely is troubleshooting and repair to the component level even attempted. As a result, technicians no longer need to know about intimate circuit details. It is more important for technicians to know systems specifications, operation, interfaces, and the input/output signals involved.

The modern technician works with a wide variety of electronic interfaces used to connect one circuit or piece of equipment to another. It is essential that they know how to test and measure a unit's operation and specifications correctly, according to the systems' standards. The systems approach recommends additions to and deletions from traditional DC/AC courses in order to bring them more in line with current industry requirements. The emphasis should be on testing, measuring and troubleshooting, as it applies to a wide range of industries making and using electronics.