# BASIC ELECTRICITY AND ELECTRONICS 2

### JIM PYTEL

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This course is the 2nd in a three part series intended to support the flipped classroom approach for traditional basic electronics classes. Basic Electronics 2 covers capacitors and the transient capacitor charge and discharge process, inductors and the transient inductor storage and release process, sinusoidal properties, complex numbers and complex impedance, phasors, AC Ohm's Law, series AC circuit analysis, parallel AC circuit analysis, and series-parallel AC circuit analysis. The text includes discussions of Kirchhoff's Voltage Law, the AC Voltage Divider Rule, Kirchhoff's Current Law, and the AC Current Divider Rule. Additionally the text covers use of AC voltmeters, AC ammeters, function generators, and oscilloscopes. These resources are meant to accompany a hands on lab with the guidance of an instructor.

# **UNIT 1: CAPACITORS**

**Objective:** Demonstrate understanding of exponential functions, capacitor construction, capacitor charge process, capacitor discharge process, capacitor charging with initial conditions, partial charging and partial discharging scenarios, capacitor charging scenarios necessitating the use of Thevenin's Theorem, and electrical properties of capacitors in series and parallel.

### **EXPONENTIAL FUNCTIONS**



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Exponential Functions Study Guide

### CAPACITORS



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#### **Capacitors Study Guide**

### **CAPACITOR CHARGING**



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#### Capacitor Charging Study Guide

### **CAPACITOR DISCHARGING**



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Capacitor Discharging Study Guide



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# CAPACITOR CHARGING WITH INITIAL CONDITIONS



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Capacitor Charging With Initial Conditions Study Guide

# CAPACITOR PARTIAL CHARGING AND DISCHARGING



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Capacitor Partial Charging and Discharging Study Guide

# CAPACITOR CHARGING FEATURING THEVENIN'S THEOREM



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Capacitor Charging Featuring Thevenins Theorem Study Guide Capacitors in Series and Parallel Study Guide

## CAPACITORS IN SERIES AND PARALLEL



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Capacitors in Series and Parallel Study Guide

# **UNIT 2: INDUCTORS**

**Objective:** Demonstrate understanding of inductor construction, electromagnetic interaction, inductor storage process, inductor process, inductor storage with initial conditions, partial storage and partial release scenarios, inductor storage scenarios necessitating the use of Thevenin's Theorem, and electrical properties of inductors in series and parallel.

### INDUCTORS



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Inductors Study Guide

# INDUCTOR STORAGE PROCESS



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Inductor Storage Process Study Guide

## INDUCTOR RELEASE PROCESS



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Inductor Release Process Study Guide

# UNIT 3: SINUSOIDAL PROPERTIES

**Objective:** Demonstrate understanding of sinusoidal properties including peak value, peak to peak value, RMS or effective value, period, frequency, and phase shift. Convert between radians and degrees. Calculate instantaneous sinusoidal properties and determine the time sinusoidal properties satisfy specific conditions. Learn to use an AC voltmeter, an AC ammeter, function generator, and oscilloscope. Learn to interpret and measure sinusoidal properties on an oscilloscope.

# INTRODUCTION TO AC CIRCUIT ANALYSIS



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Introduction to AC Circuit Analysis Study Guide

#### **SINE WAVES**



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#### Sine Waves Study Guide

# PEAK AND EFFECTIVE VALUES



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Peak and Effective Values Study Guide

### **PERIOD AND FREQUENCY**



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Period and Frequency Study Guide

#### **PHASE SHIFT**



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#### Phase Shift Study Guide
#### 1/SQRT(2)?



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#### 1 Over SQRT 2 Study Guide

### AC VOLTMETERS: B&K PRECISION 2831E



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AC Voltmeters Study Guide

#### **Basic Electricity and Electronics 2**

BK Precision 2831E Manual

#### FUNCTION GENERATORS: B&K PRECISION 4010A



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Function Generators STUDENT Study Guide

#### **Basic Electricity and Electronics 2**

BK Precision 4010A Manual

### AC AMMETERS: B&K PRECISION 2831E



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AC Ammeters Study Guide

### INTRODUCTION TO OSCILLOSCOPES



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Oscilloscopes Study Guide

Tektronix 1032B Oscilloscope Manual

# OSCILLOSCOPE MEASUREMENT TECHNIQUES



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#### Oscilloscope Measurement Techniques Study Guide

# UNIT 4: COMPLEX NUMBERS AND COMPLEX IMPEDANCE

**Objective:** Demonstrate understanding of complex numbers expressed in both rectangular format and polar format, convert from rectangular format to polar format, and convert from polar format to rectangular format. Add, subtract, multiply, divide, exponentiate, disassociate, negate, and form the complex conjugate of complex numbers. Use complex numbers on a scientific calculator. Calculate complex impedance of resistive, capacitive, and inductive elements. Calculate total impedance of series and parallel arrangements of complex impedances.

### COMPLEX NUMBERS: RECTANGULAR FORMAT



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Complex Numbers Rectangular Format Study Guide

#### COMPLEX NUMBERS: POLAR FORMAT



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Complex Numbers Polar Format Study Guide

## COMPLEX NUMBERS: RECTANGULAR TO POLAR CONVERSION



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#### Complex Numbers Rectangular to Polar Study Guide

## COMPLEX NUMBERS: POLAR TO RECTANGULAR CONVERSION



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#### Complex Numbers Polar to Rectangular Study Guide

#### COMPLEX NUMBERS: COMPLEX MATH



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Complex Numbers Complex Math Study Guide

### COMPLEX NUMBERS: SCIENTIFIC CALCULATORS



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Complex Numbers Scientific Calculators Study Guide

#### RESISTIVE COMPLEX IMPEDANCE



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Resistive Complex Impedance Study Guide

#### CAPACITIVE COMPLEX IMPEDANCE



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Capacitive Complex Impedance Study Guide

#### INDUCTIVE COMPLEX IMPEDANCE



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Inductive Complex Impedance Study Guide

#### SERIES COMPLEX IMPEDANCE



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Series Complex Impedances Study Guide

#### PARALLEL COMPLEX IMPEDANCE



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Parallel Complex Impedances Study Guide

# UNIT 5: PHASORS AND AC OHM'S LAW

**Objective:** Demonstrate understanding of phasor notation and AC Ohm's Law. Convert between time domain and phasor domain. Calculate current, voltage, and impedance. Interpret properties displayed on an oscilloscope.

#### **PHASOR NOTATION**



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Phasor Notation Study Guide

#### AC OHM'S LAW



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#### AC Ohms Law Study Guide

#### **AC OHM'S LAW EXAMPLES**



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#### AC Ohms Law Examples Study Guide

### MEASURING PHASE SHIFT WITH AN OSCILLOSCOPE



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### MEASURING CURRENT WITH AN OSCILLOSCOPE



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Measuring Current with an Oscilloscope Study Guide

### OSCILLOSCOPES AND AC OHM'S LAW EXAMPLES



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Oscilloscopes and AC Ohms Law Examples Study Guide
# UNIT 6: SERIES AC CIRCUITS

**Objective:** Demonstrate understanding of series AC circuit properties including Kirchhoff's Voltage Law. Make use of the AC Voltage Divider Rule.

## SERIES AC CIRCUIT ANALYSIS



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Series AC Circuits Study Guide

#### **AC VOLTAGE DIVIDER RULE**



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AC Voltage Divider Rule Study Guide

### SERIES AC CIRCUIT EXAMPLES



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Series AC Circuits Examples Study Guide

## OSCILLOSCOPE MATH FUNCTIONS: OSCILLOSCOPES IN SERIES AC CIRCUITS



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## Oscilloscope MATH Functions Oscilloscopes in Series AC Circuits Study Guide

# UNIT 7: PARALLEL AC CIRCUITS

**Objective:** Demonstrate understanding of parallel AC circuit properties including Kirchhoff's Current Law. Make use of the AC Current Divider Rule.

### PARALLEL AC CIRCUIT ANALYSIS



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Parallel AC Circuits Study Guide

#### **AC CURRENT DIVIDER RULE**



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#### AC Current Divider Rule Study Guide

#### PARALLEL AC CIRCUIT EXAMPLES



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#### Parallel AC Circuits Examples Study Guide

# UNIT 8: SERIES-PARALLEL AC CIRCUIT ANALYSIS

**Objective:** Demonstrate understanding of series-parallel AC circuit analysis.

## SERIES-PARALLEL AC CIRCUIT ANALYSIS



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Series Parallel AC Circuits Analysis Study Guide

This is where you can add appendices or other back matter.

#### **ABOUT THE AUTHOR:**

Jim Pytel is currently an instructor at Columbia Gorge Community College's Electro-Mechanical Technology program where he teaches basic electronics, hydraulics and pneumatics, motor control, PLCs, digital logic, and power generation and transmission. He is a former Captain in the US Army and has worked in the semiconductor manufacturing and wind power generation industries. To see more of his online content check out his YouTube channel at: https://www.youtube.com/user/ bigbadtech