

## Substation Maintenance Program Outline

### // Unit 1 – Basic Mathematics & Electricity

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- Electrical System Components
- The Distribution System
- Basic Math
- Electrical Circuits
- Trigonometry & Vectors

This is the first of three self study modules. Students will receive a hard-copy workbook and test online at their own pace. This module is made up of 5 lessons covering the needed basics of math and electricity.

### // Unit 2 – Fundamentals of Alternating Current

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- Alternating Current and Circuits Containing Resistance
- Inductance in Alternating Current Circuits and Resistance and Impedance in Series Circuits
- Capacitors are not only fun, they're Important Too!
- Series Circuits: Resistance, Inductive Reactance, and Capacitive Reactance
- AC Parallel Circuits and Series-Parallel Circuits
- Three Phase Systems
- AC Instruments and Meters
- Alternating Current Generators
- Transformers
- Transformer Connections and Special Applications

This is the second of three self study modules. Students will receive a hard-copy workbook and test online at their own pace. This module is made up of 10 lessons covering the needed fundamentals of alternating currents.

## // Unit 3 – Substation Operation & Maintenance

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- Substations and Switchyards
- Safety in Substations and Switchyards
- Power Transformers
- Circuit Breakers
- Relaying and Substation Infrastructure

This substation mechanical maintenance specialist course will cover in detail typical maintenance tasks needed to keep substation equipment healthy, maximize lifespan, and minimize failures. Some examination of typical preventative maintenance programs including transformer oil testing, temperature maintenance of transformers, circuit breaker mechanisms, characteristics of gas insulated switchgear and electrical busses. There will be a data application section that shows how various types of substation data can be used to predict failures so costly failures are avoided and reliability of the grid is increased.

## // Lab A – Introductory (5 Days)

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### **DC Circuits Review**

### **AC Circuits Review**

### **Electrical Measurements Equipment**

### **Electrical Measurements**

### **P-Polyphase Vectors:**

- Real Power
- Reactive Power
- Apparent Power
- Power Factor
- Phase Sequence

### **Three Phase Connections Lab Exercises:**

- Phase Sequence Determination
- Three Phase Connections
- Phase Angle Determinations

## // Lab B – Introductory (5 Days)

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### **Insulation**

#### **Laboratory Training Exercises:**

- Insulation Resistance Tests
- Power Factor Tests
- Dielectric Strength Tests

### **Transformers**

#### **Transformer Testing:**

- Winding Resistance
- Insulation Resistance
- Polarity
- Insulation Power Factor
- Transformer Turns Ratio
- Combustible Gas
- Safety Factors

### **Tests on a Power Transformer**

#### **Circuit Breaker Tests:**

- Insulation Resistance
- Power Factor Testing
- Timing
- Contact Resistance
- Safety Factors

### **Tests on an Oil Circuit Breaker**

#### **Stand-By Batteries**

#### **Demonstration on Batteries**

#### **Lightening Arrestors**

### **Substation Maintenance Safety Techniques**

#### **Substation Drawings:**

- Substation Standard Device Numbers
- Substation Standard Device Symbols
- Single Line Diagram
- Three Line Diagram
- Schematic Diagram
- Wiring Diagrams

#### **Training Exercise:**

- Relay Logic Circuits
- Substation Drawing Exercise