



## Technical Diagnostic Services Training Institute

### Basic Electricity

**Who should attend?** Designed for field and plant personnel, supervisors and others with the need to learn the practical application of electricity. This course is excellent for new electrical personnel and cross-training.

**Course Description:** Basic Electricity is an introductory course designed to present the basic concepts of electricity from a practical point of view. The student will understand the use of the devices that are discussed and gain a sense of how they work. The course assumes a solid working knowledge of mathematics including fractions, power of ten, solving simple equations, basic geometry, and elementary trigonometric functions.

The course is a combination of the ideas and views expressed in many standard textbooks, however, it was developed from a practical background of more than 30 years of working, and teaching in electrical and electronics fields. Basic Electricity is not intended as a troubleshooting course; however, students will become familiar with some troubleshooting basics by understanding and answering questions given at the end.

Presentations will be focused on the needs of the participants, rather than a strict outline. Participants are asked to ask questions regarding electrical systems and their operation and components and practical examples are used to broaden their understanding. Each student receives a course text and a copy of Ugly's Electrical References.

**Lab vs. Lecture Time:** Approximately 50% hands-on lab time vs. 50% lecture. This will vary with the actual class.

## TDSTI

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## I. INTRODUCTION

### A. FUNDAMENTALS OF ELECTRICITY

#### NATURE OF MATTER

- Electrostatics
- The Atom
- The Ionized Atom

#### CURRENT FLOW AND VALENCE

#### ELECTRONS

- Valence Electrons
- Current Flow
- The Coulomb
- The Ampere

#### ELECTRICAL FORCE

- Electromotive Force (EMF)
- Potential Difference
- Voltage

### B. MAGNETISM

#### NATURAL MAGNETS

#### ARTIFICIAL MAGNETS

#### MAGNETIC LAWS

- Magnetic Poles
- Law of Attraction and Repulsion
- Magnetic Lines of Force

#### MODERN THEORY OF

#### MAGNETISM (DOMAIN)

#### ELECTROMAGNETISM

- Magnetic Field of a Straight Conductor
- Magnetic Field of a Coil

### C. PRODUCING AN ELECTROMOTIVE FORCE

#### PRODUCING AN EMF

- Chemical
- Magnetic
- Friction
- Pressure
- Light
- Heat

#### ELECTRIC CIRCUIT

- Source Battery Connections
- Conductors
- Load

## II. DC THEORY

### A. RESISTANCE

#### THE OHM

#### RESISTIVITY

- Factors that Determine Resistance

#### RESISTORS

- Fixed Resistors
- Variable Resistors

### B. OHM'S LAW

#### OHM'S LAW

- Solving for Voltage
- Solving for Resistance
- Solving for Power

### C. SERIES CIRCUITS

#### CHARACTERISTICS

#### SOLVING SERIES CIRCUITS

#### VOLTAGE RISES AND DROPS

### D. PARALLEL CIRCUITS

#### CHARACTERISTICS

#### KIRCHHOFF'S CURRENT LAW

#### RESISTORS IN PARALLEL

#### CALCULATING CIRCUIT VALUES

### E. SOLVING SERIES-PARALLEL CIRCUITS

#### RESISTORS IN SERIES-PARALLEL

#### CONNECTIONS

- Calculating Circuit Values

#### SOLVING DC CIRCUITS USING

#### KIRCHHOFF'S VOLTAGE LAW

#### SOLVING SERIES CIRCUIT USING

#### KIRCHHOFF'S VOLTAGE LAW

#### SOLVING COMPLEX SERIES-PARALLEL

#### CIRCUIT USING KIRCHHOFF'S LAW

#### CIRCUIT APPLICATION

- The Operation of the Bridge

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### III. AC THEORY

#### A. AC FUNDAMENTALS

##### WAVEFORMS

##### BASIC AC GENERATION

- Cycle
- Frequency
- Period

##### GENERATED VOLTAGE

##### VECTORS AND PHASORS

##### DEFINED

##### EQUATIONS OF SINE WAVE OF VOLTAGE

##### SINE WAVE CHARACTERISTICS

##### MEASURED

- Peak Amplitudes
- Instantaneous Amplitude
- Effective or RMS Value
- Average Value

##### SINE WAVE IN-PHASE

##### SINE WAVES OUT-OF-PHASE

##### COMBINING AC VOLTAGE

#### B. PRINCIPLES OF INDUCTANCE

##### INDUCTANCE

- Self-Inductance  
Generation of Counter-EMF
- Mutual Inductance
- Factors Affecting Mutual Inductance
- RL Series Circuit
- L/R Time Constant

#### C. CAPACITANCE

##### CAPACITANCE

- Electrostatics
- Capacitor
- Dielectric Materials
- Unit of Capacitance
- Factors Affecting the Value of Capacitance
- Voltage Rating
- Charging and Discharging a Capacitor
- Charge and Discharge of an RC Series Circuit

##### RC TIME CONSTANT

##### UNIVERSAL TIME CONSTANT

##### CHART

- Capacitor in Series and Parallel

#### D. INDUCTIVE AND CAPACITIVE REACTANCE

##### INDUCTIVE REACTANCE

- Calculating for Inductive Reactance
- Impedance
- Power

##### SOLVING SERIES RL CIRCUITS

##### SOLVING PARALLEL RL CIRCUITS

##### CAPACITORS IN AC

##### CAPACITIVE REACTANCE

- Calculating for Capacitive Reactance
- Capacitors in Series
- Capacitors in Parallel

##### SOLVING SERIES AND

##### PARALLEL RC CIRCUITS

#### F. RLC SERIES AND PARALLEL CIRCUITS

##### SERIES RLC CIRCUITS

##### PARALLEL RLC CIRCUITS

##### POWER FACTOR CORRECTION

#### G. THREE-PHASE CIRCUITS

##### GENERATING THREE-PHASE VOLTAGES

- Wye-Connected Alternators
- Delta-Connected Alternators

##### POWER MEASUREMENT

- Three-Wattmeter Method
- Two-Wattmeter Method

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## **H. TRANSFORMER FUNDAMENTALS**

DEFINITION

PRINCIPLE OF OPERATION

- No-Load Operation
- Operation Under Load

TRANSFORMER

CONSTRUCTION LOSSES

- Core Losses
- Copper Losses

EFFICIENCY

TRANSFORMER POLARITY

CONNECTIONS: SINGLE-PHASE

CONNECTIONS: THREE-PHASE

- Delta Characteristics
- Wye Characteristics
- Connection Combinations

INSTRUMENT TRANSFORMERS

AUTOTRANSFORMERS

POWER TRANSFORMERS

- Polarity Marking

## **I. GENERATING FUNDAMENTALS**

ELECTRO-MAGNETIC INDUCTION

- Magnets and Magnetism
- Electromagnets
- Magnetic Circuits
- Magnetomotive Force
- Flux
- Reluctance
- Permeability
- Saturation
- Retentivity and Residual Magnetism

INDUCTION-ELECTRICITY FROM MAGNETISM

- Induction
- Left-Hand Rule for Generators
- Strength of Induced EMF
- Lenz's Law and the Operation of Generators

AC GENERATORS

- Principle of Operation
- Generator Field and Armature

CONSTRUCTION OF AC GENERATORS

- Small Generators
- Large Generators
- Turbo-Type (Cylindrical) Rotor
- Salient-Pole Type Rotor

TYPES OF AC GENERATORS

- Single-Phase Alternators

- Multi-Phase Alternators
- Delta Connection

## **J. DC GENERATORS**

DC GENERATORS

- Principle of Commutation
- Commutation Problems
- Generator Ripple

CONSTRUCTION OF DC GENERATORS

- Frame (Yoke)
- Field Windings
- Pole Pieces
- Armature
- Commutator
- Brushes and Brush Holders

TYPES OF DC GENERATORS

- Separately Excited Generators
- Self-Excited Generators
- Series Generator
- Shunt Generator
- Compound Generator

## **K. DC MOTORS**

DC MOTORS

- Right-Hand Motor Rule
- Motor Torque
- Lenz's Law in Electric Motors - Counter-EMF
- Motor Output and Efficiency

TYPES OF DC MOTORS

- Series
- Shunt
- Compound
- Speed Control and Starting
- Rotating Field

## **L. AC MACHINERY**

AC MOTORS

- Induction Motors
- Squirrel-Cage Motors
- Wound-Rotor Motors
- Single-Phase Motors
- Synchronous Motors
- Stator
- Rotor
- Rotor Windings
- Starting
- Power Factor Adjustment

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