

Snead State Community College Workforce Development

Self-Pace Online Training
Students will have six weeks to complete



\$100.00 per student, per course

Basic Math for

Advanced Manufacturing Technicians

This course introduces the student to basic math terms and concepts used in electrical systems. Students will learn basic fractions, percentages, ratios, and geometric functions used in today's advanced manufacturing systems.

- Basic Math
- Fractions, Decimals, and Percentages
- Basic Geometry
- Electrical Voltage and Current Measurement



Basic Electrical Systems

for Manufacturing Technicians

This course provides training for basic AC/DC Electrical systems used for power and control in industrial, commercial, agricultural, and residential applications. Students learn industry-relevant skills included in subject areas such as Basic Electrical Circuits, Electrical measurement, Circuit Analysis, Inductance and Capacitance, Combination Circuits, and Transformers. This course continues with an introduction to electrical wiring, motor control circuits, and related electronic sensors. The course concludes with an introduction to Control Relays and Motor Starters, and electrical safety practices.

- Basic Electrical Circuits
- Electrical Measurements
- Inductance and Capacitance
- Transformers
- Circuit Analysis
- Combination Circuits
- Electronic Sensors
- Introduction to Electrical Wiring
- Introduction to Electric Motor Control
- Introduction to Electrical Control Wiring
- Control Relays and Motor Starters
- Lockout/Tagout

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Basic Math for Advanced Manufacturing Technicians

This course introduces the student to basic math terms and concepts used in electrical systems. Students will learn basic fractions, percentages, ratios and geometric functions used in today's advanced manufacturing systems.

Outline

1. Electrical Voltage and Current Measurement

Objective 1 - Define Voltage and Give Its Units of Measurement
Objective 2 - Define Current and Give Its Units of Measurement
Objective 3 - State Kirchhoff's Circuit Laws and Give an Application
Objective 4 - Define the Basic Characteristics of Series and Parallel Circuits
Objective 5 - Describe the Function of a Voltmeter and Give Its Schematic Symbol
Objective 6 - Describe How to Use a Voltmeter to Measure Voltage
Skill 1 - Use an Analog Voltmeter to Measure the Voltage at a Point Referenced to Ground
Objective 7 - Describe How to Use a Digital Multimeter to Measure Voltage
Skill 2 - Use a DMM to Measure Voltage Drops in Series and Parallel Circuits
Objective 8 - Describe Two Types of Ammeters and Give Their Schematic Symbol
Objective 9 - Describe How to Use a DMM to Measure Current
Skill 3 - Use a DMM to Measure Current in Series and Parallel Circuits
Self Review 1

2. Basic Math

Segment 1 - Basic Math Terms and Concepts

Objective 1 - Describe Math as a Language
Objective 2 - Describe How Number Lines Are Used in Math
Objective 3 - Describe the Parts of a Math Problem
Objective 4 - Define Integers, Fractions, Decimals, and Variables
Objective 5 - Describe Math Terms Associated with Addition and Subtraction
Objective 6 - Describe Math Terms Used with Multiplication and Division
Objective 7 - Describe Commonly Used Math Terms

Segment 2 - Working with Whole Numbers

Objective 8 - Describe the Four Basic Operations with Integers
Objective 9 - Describe the Order of Operations
Objective 10 - Describe the Three Properties of Operations
Objective 11 - Define Variables and Explain How They Are Used in Equations
Objective 12 - Describe How to Solve for Inequalities

3. Fractions, Decimals and Percentages

Segment 1 - Fractions and Decimals

Objective 1 - Define a Fraction and Describe Its Components
Objective 2 - Describe How to Reduce a Fraction
Objective 3 - Explain How to Add and Subtract Fractions
Objective 4 - Explain How to Multiply and Divide Fractions
Objective 5 - Describe the Decimal System
Objective 6 - Explain How to Add, Subtract, Multiply and Divide Decimals

Objective 7 - Describe How to Estimate and Round Decimals
Objective 8 - Describe How to Convert Decimals and Fractions

Segment 2 - Percentage, Average, and Ratio

Objective 9 - Define Percentages and Provide Examples of Where They Are Used
Objective 10 - Describe Three Ways to Find Percentages
Objective 11 - Define Averages and Describe Three Types
Objective 12 - Define Ratios and Describe How They Are Expressed

4. Basic Geometry

Objective 1 - Describe Geometry and Explain Dimensions
Objective 2 - Describe the Four Building Blocks of Geometry
Objective 3 - Describe Endpoints, Rays, Line Segments, and Angles
Objective 4 - Describe Polygons
Objective 5 - Describe Solid Figures
Objective 6 - Describe How to Measure Geometric Shapes
Objective 7 - Describe the Cartesian Coordinate System



Basic Electrical Systems for Manufacturing Technicians

This course provides training for basic AC/DC Electrical systems used for power and control in industrial, commercial, agricultural, and residential applications. Students learn industry-relevant skills included in subject areas such as Basic Electrical Circuits, Electrical measurement, Circuit Analysis, Inductance and Capacitance, Combination Circuits, and Transformers. This course continues with an introduction to electrical wiring, motor control circuits, and related electronic sensors. The course concludes with an introduction to Control Relays and Motor Starters, and electrical safety practices.

Outline

1. Basic Electrical Circuits

Segment 1 - Fundamentals of Electricity

Objective 1 - Define Electricity and Give an Application

Objective 2 - Describe the Two Types of Electrical Current and Give an Application of Each

Objective 3 - Describe the Function and Operation of a Circuit Tester

Skill 1 - Use an AC Tester to Check a Wall Outlet for Electricity

Self Review 1

Segment 2 - Electrical Circuit Components

Objective 4 - Describe the Function of the Four Basic Components of an Electrical Circuit

Objective 5 - Describe the Operation of Two Types of Power Supplies and Give Their Schematic Symbols

Objective 6 - Describe the Function of an Electrical Schematic

Skill 2 - Connect and Operate a Power Supply

Self Review 2

Segment 3 - Manual Input Devices

Objective 7 - Describe the Operation of a Manual Switch

Objective 8 - Describe the Operation of N.O. and N.C. Contacts and Give Their Schematic Symbols

Objective 9 - Describe the Function of Three Types of Manual Switch Operators and Give an Application of Each

Objective 10 - Describe the Operation of Three Types of Manual Switch Operators and Give Their Schematic Symbols

Skill 3 - Connect and Operate a Circuit Using Three Types of Manual Switches

Self Review 3

Segment 4 - Output Devices

Objective 11 - Describe the Function of Five Types of Electrical Output Devices and Give an Application of Each

Objective 12 - Describe the Operation of Five Types of Electrical Output Devices and Give Their Schematic Symbols

Skill 4 - Connect and Operate an Electrical Circuit with a Resistor

Skill 5 - Connect and Operate an Electrical Circuit with a Buzzer

Skill 6 - Connect and Operate an Electrical Circuit with a Solenoid

Skill 7 - Connect and Operate an Electrical Circuit with a Motor

Self Review 4

2. Electrical Measurements

Segment 1 - Voltage Measurement

Objective 1 - Define Voltage and Give Its Units of Measurement
Objective 2 - Describe the Function of a Voltmeter and Give Its Schematic Symbol
Objective 3 - Describe How to Use a Voltmeter to Measure Voltage
Skill 1 - Use an Analog Voltmeter to Measure the Voltage at a Point Referenced to Ground
Objective 4 - Describe the Function of Two Multimeters: Analog and Digital
Activity 1 - Identification of Digital Multimeter Components
Skill 2 - Use a DMM to Measure the Voltage of a Point Referenced to Ground
Self Review 1

Segment 2 - Introduction to Series and Parallel Circuits

Objective 5 - Define Series and Parallel Circuits
Objective 6 - Describe the Voltage Characteristics in Series and Parallel Circuits
Activity 2 - Voltage Characteristics of Series and Parallel Circuits
Skill 3 - Use a DMM to Measure Voltage Drops in Series and Parallel Circuits
Self Review 2

Segment 3 - Current Measurement

Objective 7 - Define Current and Give Its Units of Measurement
Objective 8 - Describe the Function of Two Types of Ammeters and Give Their Schematic Symbol
Objective 9 - Describe How to Use an Ammeter to Measure Current
Skill 4 - Use a DMM to Measure the Electrical Current
Skill 5 - Use a DMM to Measure Current in Series and Parallel Circuits
Objective 10 - Describe the Current Characteristics in Series and Parallel Circuits
Activity 3 - Characteristics in Series and Parallel Circuits
Self Review 3

Segment 4 - Resistance Measurement

Objective 11 - Define Resistance and Give Its Units of Measurement
Objective 12 - Describe the Function of Two Types of Ohmmeters and Give Their Schematic Symbol
Objective 13 - Describe How to Use an Ohmmeter to Measure Resistance
Skill 6 - Use a DMM to Measure the Resistance of a Component
Objective 14 - Describe the Resistance Characteristics in Series and Parallel Circuits
Skill 7 - Measure the Resistance in Series and Parallel Circuits
Objective 15 - Describe Two Methods of Measuring Continuity
Skill 8 - Test the Continuity of Wires Using a DMM
Self Review 4

3. Inductance and Capacitance

Segment 1 - Electromagnetism

Objective 1 - Define Electromagnetism and Give an Application
Activity 1 - Test an Electromagnetic Field
Objective 2 - Describe the Function of Four Electromagnetic Devices
Activity 2 - Electromagnetic Device Operation
Skill 1 - Connect and Operate a Relay in a Circuit
Self Review 1

Segment 2 - Inductance

Objective 3 - Define Inductance and Give Its Unit of Measurement
Objective 4 - Describe the Operation of an Inductor and Give Its Schematic Symbol
Objective 5 - Describe the Effect of an Inductor in a DC Circuit and Give an Application
Activity 3 - Effect of Inductance in a DC Circuit
Objective 6 - Describe the Effect of an Inductor in an AC Circuit and Give an Application
Activity 4 - Effect of Inductive Reactance in an AC Circuit
Objective 7 - State the Formulas for Calculating Total Series Inductance and Inductive Reactance
Objective 8 - State the Formulas for Calculating Total Parallel Inductance and Inductive Reactance
Skill 2 - Calculate the Total Load on an AC Circuit with Inductors
Self Review 2

Segment 3 - Capacitance

Objective 9 - Define Capacitance and Give Its Units of Measurement
Objective 10 - Describe the Operation of a Capacitor and Give Its Schematic Symbol
Objective 11 - Describe the Functions of Three Types of Capacitors
Skill 3 - Discharge a Capacitor
Skill 4 - Test a Capacitor with a DMM
Self Review 3

Segment 4 - Characteristics of Capacitance

Objective 12 - Describe the Effect of a Capacitor in a DC Circuit and Give an Application
Skill 5 - Measure the Voltage across a Charged Capacitor
Activity 5 - Effect of a Capacitor in a DC Circuit
Objective 13 - Describe the Effect of a Capacitor in an AC Circuit and Give an Application
Activity 6 - Effect of a Capacitor in an AC Circuit
Objective 14 - State the Formulas for Calculating Total Series Capacitance and Capacitive Reactance
Objective 15 - State the Formulas for Calculating Total Parallel Capacitance and Capacitive Reactance
Skill 6 - Calculate the Total Load on an AC Circuit with Capacitors
Self Review 4

Segment 5 - Inductor and Capacitor Applications

Objective 16 - Describe the Function of a Fluorescent Light Fixture
Objective 17 - Describe the Function of an RC Timing Circuit in a Time-Delay Relay
Skill 7 - Calculate the Time to Charge and Discharge a Capacitor
Objective 18 - Describe the Function of Capacitors and Inductors in an Electric Power Supply
Self Review 5

4. Transformers

Segment 1 - Introduction to Transformers

Objective 1 - Describe the Function of a Transformer and Give an Application
Objective 2 - Describe the Operation of a Transformer and Give Its Schematic Symbol
Skill 1 - Connect and Operate a Transformer
Objective 3 - Describe How to Calculate the Output Voltage of a Transformer
Skill 2 - Calculate the Secondary Coil Voltage of a Transformer
Objective 4 - Describe How to Troubleshoot a Transformer
Skill 3 - Troubleshoot a Transformer by Measuring Continuity
Self Review 1

Segment 2 - Sizing a Transformer

Objective 5 - Describe How to Size a Transformer
Skill 4 - Size a Transformer
Objective 6 - Describe a Transformer's Input and Output Power Relationship and Explain Its Importance
Activity 1 - Transformer Power Loss
Objective 7 - Describe How to Calculate the Current Load of a Transformer
Skill 5 - Calculate the Current Load on a Transformer
Self Review 2

Segment 3 - Transformer Types

Objective 8 - Describe the Function of Two Basic Categories of Transformers
Objective 9 - Describe the Function of a Control Transformer
Skill 6 - Design a Control Transformer Circuit to Provide a Given Output Voltage
Objective 10 - Describe the Function of a Tap on the Secondary of a Transformer and Give an Application
Activity 2 - The Distribution Transformer
Self Review 3

5. Circuit Analysis

Segment 1 - Power in Series Circuits

Objective 1 - State the Formula for Calculating Series Resistance and Give an Application
Skill 1 - Calculate Series Resistance Given Each Load's Resistance
Objective 2 - State Ohm's Law, Explain Its Importance, and Give an Application
Skill 2 - Use Ohm's Law to Calculate Voltage, Current, and Resistance in a Series Circuit

Objective 3 - State Kirchhoff's Voltage Law for a Series Circuit and Give an Application

Activity 1 - Verification of Kirchhoff's Voltage Law

Objective 4 - Define Power and Give Its Units of Measurement

Objective 5 - State a Formula for Calculating the Total Power Used in an Electrical Circuit

Skill 3 - Calculate the Total Power Used by a Series Circuit

Self Review 1

Segment 2 - Power in Parallel Circuits

Objective 6 - State Kirchhoff's Current Law and Give an Application

Skill 4 - Calculate the Main Line Current in a Parallel Circuit

Objective 7 - State a Formula for Calculating Total Parallel Resistance

Skill 5 - Calculate the Total Parallel Resistance

Skill 6 - Calculate the Total Power Used in a Parallel Circuit

Self Review 2

Segment 3 - Circuit Protection Devices

Objective 8 - Describe the Function of Two Types of Circuit Protection and Give an Application of Each

Objective 9 - Describe the Operation of a Fuse and Give Its Schematic Symbol

Skill 7 - Operate a Circuit Using a Fuse

Skill 8 - Test and Replace a Fuse

Objective 10 - Describe the Operation of Two Types of Circuit Breakers and Give Their Schematic Symbols

Skill 9 - Operate a Circuit Using a Circuit Breaker

Skill 10 - Test and Reset a Circuit Breaker

Self Review 3

6. Combination Circuits

Segment 1 - Characteristics

Objective 1 - Define a Series-Parallel Circuit

Objective 2 - Describe a Method for Identifying the Series and Parallel Sections of a Circuit

Skill 1 - Trace the Current Path in a Combination Circuit

Objective 3 - List the Seven Steps for Solving a Combination Circuit

Skill 2 - Solve a Combination Circuit

Self Review 1

Segment 2 - Lighting Circuits

Objective 4 - Describe How Switches Are Used in Combination Circuits and Give an Application

Skill 3 - Connect and Operate a Basic Lighting Circuit

Skill 4 - Connect and Operate a Ceiling Fan Circuit

Objective 5 - Describe the Function of a Variable Resistor and Give an Application

Activity 1 - Rheostat Operation

Skill 5 - Connect and Operate a Rheostat as a Light Dimmer

Self Review 2

Segment 3 - Voltage Dividers

Objective 6 - Describe the Function of a Voltage Divider and Give an Application

Objective 7 - Describe the Operation of Three Types of Voltage Dividers

Skill 6 - Design a Voltage Divider Network

Skill 7 - Connect and Operate a Voltage Divider Network

Self Review 3

Segment 4 - Troubleshooting

Objective 8 - Explain the Effect of a Short Circuit

Objective 9 - Describe the Four Steps for Troubleshooting a Short Circuit

Skill 8 - Locate a Short Circuit

Objective 10 - Describe the Three Basic Steps for Troubleshooting an Open Circuit

Skill 9 - Locate an Open Circuit

Self Review 4

7. Electronic Sensors

Segment 1 - Inductive Proximity Sensors

Objective 1 - Describe the Function of Three Types of Electronic Sensors and Give an Application of Each
Objective 2 - Describe the Operation of an Inductive Proximity Sensor and Give Its Schematic Symbol
Skill 1 - Connect and Operate an Inductive Proximity Sensor
Objective 3 - Describe Five Characteristics That Affect Inductive Sensor Operation
Skill 2 - Measure and Analyze Inductive Proximity Sensor Performance
Skill 3 - Design a Drill Motor Control Circuit Which Uses an Inductive Proximity Sensor
Self Review 1

Segment 2 - Capacitive Proximity Sensors

Objective 4 - Describe the Operation of a Capacitive Proximity Sensor and Give Its Schematic Symbol
Skill 4 - Connect and Operate a Capacitive Proximity Sensor
Objective 5 - Describe Five Characteristics That Affect Capacitive Sensor Operation
Skill 5 - Measure and Analyze Capacitive Proximity Sensor Performance
Skill 6 - Design a Level Sensing Control Circuit Which Uses a Capacitive Proximity Sensor
Self Review 2

Segment 3 - Photoelectric Sensors

Objective 6 - Describe the Operation of a Photoelectric Sensor and Give an Application
Objective 7 - Describe Five Characteristics That Affect Photoelectric Sensor Performance
Skill 7 - Connect and Operate a Photoelectric Sensor
Skill 8 - Connect and Operate a Motor Control Circuit with a Photoelectric Sensor
Skill 9 - Troubleshoot a Motor Control Circuit with an Electronic Sensor
Skill 10 - Design a Motor Control Circuit That Will Sense Product Jams on a Conveyor System
Self Review 3

8. Introduction to Electrical Wiring

Segment 1 - Electrical Terms

Objective 1 - Describe Two Types of Electricity and Give an Application of Each
Objective 2 - Describe the Function of the Four Basic Components of an Electrical Circuit
Objective 3 - Define Four Common Electrical Measurements and Give an Application of Each
Objective 4 - Describe How to Use a Voltage Tester to Check a Circuit for Electricity
Skill 1 - Use a Voltage Tester to Check a Wall Outlet for Electricity
Self Review 1

Segment 2 - Electrical Safety

Objective 5 - Describe Ten Basic Electrical Safety Rules
Objective 6 - Describe the Function of the National Electric Code (NEC)
Objective 7 - Describe the Function of the Underwriters Laboratory (UL) and Canadian Standards Association (CSA)
Skill 2 - Check Electrical Components for UL and CSA Approval
Self Review 2

Segment 3 - Wire Stripping Techniques

Objective 8 - Describe the Operations of Three Tools Used to Strip Insulation from a Wire
Objective 9 - Describe How to Strip Insulation from a Wire
Skill 3 - Strip Insulation from Wires Using a Stripping Tool
Self Review 3

Segment 4 - Wire Termination Techniques

Objective 10 - Describe the Function and Construction of Two Types of Wiring Terminals
Objective 11 - Describe Two Methods to Connect Wires to Terminal Screws
Objective 12 - Describe How to Install a Spade Lug Connector on a Wire
Skill 4 - Install a Spade-Lug Connector on a Wire
Objective 13 - Describe How to Connect Wires to a Terminal Strip
Skill 5 - Connect Wires to a Terminal Strip
Self Review 4

Segment 5 - Power Cord Installation

Objective 14 - Describe the Function of a 3-Wire AC Circuit
Objective 15 - Describe the Function of an AC Electrical Plug

Objective 16 - Describe How to Connect a Plug to an Electric Cord
Skill 6 - Connect an AC Plug to an Electric Cord
Self Review 5

9. Introduction to Electric Motor Control

Segment 1 - Electrical Safety

Objective 1 - Explain the Importance of the Equipment Ground Connection
Objective 2 - Describe the Function of Five Common Standards Associated with Electrical Control
Objective 3 - Describe Ten Basic Rules of Electrical Safety
Objective 4 - Describe the Purpose of the Lockout/Tagout System Used in Industry
Activity 1 - System Familiarization
Skill 1 - Perform a Lockout/Tagout
Self Review 1

Segment 2 - Three-Phase Power

Objective 5 - Describe the Operation of Three-Phase Power
Objective 6 - Describe the Two Most Common Three-Phase Voltage Systems
Objective 7 - Explain the Function of Neutral
Skill 2 - Use a Voltmeter to Verify Supply Voltage
Objective 8 - Describe the Operation of Grounded and Ungrounded Systems
Self Review 2

Segment 3 - Disconnects and Protective Devices

Objective 9 - Describe Two Devices Used to Disconnect Power to a Circuit
Skill 3 - Use a Digital Multimeter to Check the Condition of a Fuse
Objective 10 - Explain Why Time-Delay Fuses Are Used with Motor Starting Circuits
Objective 11 - Describe Three Important Factors to Consider with Overcurrent Protection Devices
Activity 2 - Size Circuit Protection
Self Review 3

Segment 4 - Three-Phase Motors

Objective 12 - Describe the Operation of a Three-Phase Motor
Objective 13 - Describe the Operating Data on a Motor's Nameplate
Objective 14 - Define Service Factor and Explain Its Importance
Skill 4 - Connect a Dual-Voltage Three-Phase Motor for Low Voltage Operation
Objective 15 - Explain Why Dual-Voltage Motors Should Be Run on the Highest Available Voltage
Skill 5 - Connect a Dual-Voltage Three-Phase Motor for High Voltage Operation
Self Review 4

10. Introduction to Electrical Control Wiring

Segment 1 - Electrical Prints

Objective 1 - Describe the Function of an Electrical Print
Objective 2 - Describe the Four Basic Parts of a Ladder Diagram
Objective 3 - Explain Six Rules for Drawing a Ladder Diagram
Objective 4 - Describe the Function of Cross-Reference Symbols and Notes on an Electrical Print
Objective 5 - Describe How to Interpret a Ladder Diagram
Skill 1 - Interpret an Electrical Print
Self Review 1

Segment 2 - Electrical Panels

Objective 6 - Describe the Function of an Electrical Panel
Objective 7 - Describe How to Arrange Panel Wiring to Terminal Blocks
Objective 8 - Describe How to Size and Install Electrical Terminal Blocks
Skill 2 - Install a Terminal Block in an Electrical Panel
Self Review 2

Segment 3 - Panel Wiring Fundamentals

Objective 9 - Describe How to Number Wires on a Ladder Diagram
Skill 3 - Label Wire Numbers on an Electrical Print
Objective 10 - Describe How to Determine the Number of Wires to Run between Panels

Skill 4 - Determine the Number of Wires to Run from a Control Panel to an Operator Station
Objective 11 - Describe How to Determine Wire Colors for Control Panel Wiring
Skill 5 - Determine the Wire Colors Needed for an Application
Self Review 3

Segment 4 - Sizing Disconnects and Overcurrent Devices

Objective 12 - Describe How to Size Overcurrent Protection Devices
Skill 6 - Select a Circuit Protection Device for an Electrical Control System
Objective 13 - Describe How to Install and Test Circuit Protection Devices
Skill 7 - Install and Test a Circuit Breaker in an Electrical Panel
Objective 14 - Describe How to Size a Safety Disconnect Switch
Skill 8 - Size a Safety Disconnect Switch
Self Review 4

11. Control Relays and Motor Starters

Segment 1 - Control Relays

Objective 1 - Describe the Function of a Control Relay and Give an Application
Objective 2 - Describe the Operation of a Control Relay and Give Its Schematic Symbol
Objective 3 - Describe the Operation of Two Types of Control Relays and Give an Application of Each
Objective 4 - Describe How Detached Symbolology Is Used to Show a Control Relay on a Ladder Diagram
Objective 5 - Describe the Operation of Memory Logic and Give an Application
Self Review 1

Segment 2 - Magnetic Motor Starters

Objective 6 - Describe the Operation of a Magnetic Motor Starter
Self Review 2

Segment 3 - Two-Wire Control

Objective 7 - Describe the Operation of a Two-Wire Motor Control Circuit and Give an Application
Self Review 3

Segment 4 - Three-Wire Start/Stop Control

Objective 8 - Describe the Operation of a Three-Wire Motor Control Circuit and Give an Application
Objective 9 - Describe the Function of a Push-to-Test Pilot Light and Give an Application
Objective 10 - Describe the Operation of a Push-to-Test Pilot Light and Give Its Schematic Symbol
Self Review 4

12. Lockout/Tagout

Objective 1 - Define Hazardous Energy and Describe Its Associated Dangers
Objective 2 - Describe Lockout/Tagout and Explain Its Importance
Objective 3 - Describe How to Use LOTO to Safeguard a Machine
Objective 4 - Describe the Requirements of a Lockout Tagout Device
Objective 5 - Describe the Requirements of an Energy-Control (ECP) Program