

# RESOURCE 3

## Electrical and Electronics Curricula

### Electrical Maintenance/ Plant Electrician Apprentice

The *Electrical Maintenance Apprentice/Career Skills* curriculum provides trainees with the courseware materials required to enable them to perform the tasks associated with a Plant Electrician. This print-based curriculum has been developed to meet the subject requirements set forth in the standards established by the Bureau of Apprenticeship and Training (BAT). When combined with on-the-job training, this program will provide apprentices/trainees with the comprehensive skills and knowledge they will need to perform in this trade area.

The recommended Electrical Maintenance curriculum starts with pre-technical foundation skills courses. It progresses through electrical principles, electrical equipment and components, electrical motors and motor controllers, and the skills needed by a Plant Electrician. Operations, maintenance, and troubleshooting procedures are emphasized.

Upon completion of this curriculum, students will be able to:

- Perform arithmetic calculations and work with fractions, decimals, ratios, and conversion factors.
- Explain how voltage, current, and resistance are related by Ohm's Law.
- Identify basic schematic symbols and read electrical drawings.
- Use electrical measuring instruments for troubleshooting.
- Explain the construction and operation of motors, generators, and transformers.
- Perform the important steps for general maintenance and troubleshooting techniques using the required tools.
- Use the National Electrical Code Handbook effectively.

#### Base Curriculum

| Course Title                                       | Course Number |
|--|---------------|
| <i>Pre-Technical Foundation Skills</i>             |               |
| Basic Industrial Math.....                         | Block X21     |
| Addition and Subtraction .....                     | 186008        |
| Multiplication and Division .....                  | 186009        |
| Fractions, Percents, Proportions, and Angles ..... | 186010        |
| Metric System .....                                | 186011        |
| Formulas .....                                     | 186012        |
| Introduction to Algebra.....                       | 186013        |
| Practical Measurements .....                       | Block X22     |
| Linear and Distance Measurement .....              | 186021        |
| Bulk Measurement.....                              | 186022        |
| Temperature Measurement .....                      | 186023        |
| Energy, Force, and Power .....                     | 186024        |
| Fluid Measurement .....                            | 186025        |
| Problem Solving and Troubleshooting .....          | 186073        |
| Trades Safety: Getting Started .....               | 186001        |
| Working Safely with Chemicals .....                | 186002        |
| Fire Safety.....                                   | 186003        |
| Material Handling Safety .....                     | 186006        |
| Working Safely with Electricity .....              | 4400          |

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|---|-----------|
| Hand and Power Tools .....                    | Block X24 |
| Common Hand Tools, Part 1 .....               | 186052    |
| Common Hand Tools, Part 2 .....               | 186053    |
| Precision Measuring Instruments, Part 1 ..... | 186068    |
| Electric Drilling and Grinding Tools .....    | 186054    |
| Power Cutting Tools .....                     | 186055    |
| Pneumatic Hand Tools .....                    | 186056    |
| Plumbing and Pipefitting Tools.....           | 286042    |
| Electricians' Tools .....                     | 006026    |
| Tool Grinding and Sharpening .....            | 186057    |
| Woodworking Hand Tools .....                  | 186058    |
| Routers, Power Planers, and Sanders .....     | 186059    |
| Jacks, Hoists, and Pullers.....               | 186060    |
| Applied Geometry .....                        | 186085    |
| Practical Trigonometry .....                  | 186086    |
| Reading Prints and Schematics .....           | Block X25 |
| Introduction to Print Reading.....            | 186080    |
| Print Reading Symbols and Abbreviations.....  | 186081    |
| Dimensioning and Tolerancing .....            | 186082    |
| Print Reading Applications .....              | 186083    |
| Building Drawings.....                        | 186043    |
| Electrical Drawings and Circuits .....        | 186044    |
| Electronic Drawings .....                     | 186045    |
| Hydraulic and Pneumatic Drawings .....        | 186046    |
| Piping: Drawings, Materials, and Parts .....  | 186047    |
| Welding Symbols.....                          | 186048    |
| Sheet Metal Basics .....                      | 186049    |
| Sketching.....                                | 186050    |

#### AC/DC and Electrical Fundamentals

|   |           |
|---|-----------|
| DC Principles .....                         | Block A21 |
| Nature of Electricity .....                 | 086096    |
| Circuit Analysis and Ohm's Law .....        | 086002    |
| Capacitors and Inductors.....               | 086003    |
| Magnetism and Electromagnetism .....        | 086004    |
| Conductors, Insulators, and Batteries ..... | 086005    |
| DC Motors and Generator Theory .....        | 086006    |

#### Optional Laboratory Experiments:

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|---|-----------|
| Electronic Simulation Software .....                          | 086800    |
| Experiments with Basic DC Theory – Lab Manual .....           | 086087    |
| AC Principles .....   | Block A22 |
| Alternating Current .....                                     | 086007    |
| Alternating Current Circuits .....                            | 086008    |
| Inductors in AC Circuits.....                                 | 086009    |
| Capacitors in AC Circuits .....                               | 086010    |
| Transformers .....  | 086011    |
| Alternators .....   | 086012    |
| Electrical Energy Distribution .....                          | 086013    |
| Rectification and Basic Electronic Devices .....              | 086014    |
| Experiments with Basic AC Theory – Lab Manual .....           | 086088    |
| Analog Circuit Measurement.....                               | Block A23 |
| Basic Test Equipment .....                                    | 086025    |
| Troubleshooting with<br>Volt-Ohm-Milliamp Meters (VOMs) ..... | 086026    |
| Using Basic Oscilloscopes .....                               | 086027    |
| Experiments in Electrical Measurements – Lab Manual .....     | 086089    |
| Electrical Safety for the Trades .....                        | 186005    |
| Electrical Equipment .....                                    | Block A24 |

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|---|--------|
| Conductors and Insulators in Industry .....         | 086070 |
| Working with Conduit .....                          | 086071 |
| Electrical Boxes .....                              | 086072 |
| Industrial Enclosures and Raceways .....            | 086073 |
| Connecting Electrical Equipment, Part 1 .....       | 086074 |
| Connecting Electrical Equipment, Part 2 .....       | 086075 |
| Industrial Fuses .....                              | 086076 |
| Industrial Circuit Breakers .....                   | 086077 |
| Plugs, Receptacles, and Lampholders .....           | 086078 |
| Industrial Switches .....                           | 086079 |
| Industrial Relay Ladder Logic .....                 | 086080 |
| Industrial Relays, Contractors, and Solenoids ..... | 086081 |

**Functional Skills Used by a Plant Electrician**

|   |        |
|---|--------|
| Reading Electrical Schematic Diagrams .....                     | 006022 |
| Electrical Blueprint Reading.....                               | 006036 |
| Electrical Wiring Practices .....                               | 086E02 |
| Electric Lamps, Part 1 .....                                    | 006031 |
| Electric Lamps, Part 2 .....                                    | 006032 |
| Lighting Control .....  | 006033 |
| National Electrical Code<br>(NEC Code and Textbook Course)..... | 5177EM |
| Preventive Maintenance .....                                    | 286085 |
| Preventive Maintenance Techniques.....                          | 286086 |
| Electrical Grounding .....                                      | 086E01 |
| Wiring Electrical Circuits.....                                 | 006037 |

**Electrical Components – Operations and Maintenance**

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|--|--------|
| Storage Batteries .....                      | 4343   |
| Alternators .....                            | 4031   |
| Transformers.....                            | 4040   |
| Transformer Operation.....                   | 4041   |
| Distribution and Power Transformers.....     | 4042   |
| Local Distribution of Electrical Power ..... | 006038 |
| Underground Power Systems .....              | 006039 |
| Efficiency Tests .....                       | 4342   |

**AC/DC Motors and Motor Controllers – Operations and Maintenance**

|  |         |
|--|---------|
| Industrial DC Motors .....   | 086051  |
| Industrial AC Motors.....  | 086052  |
| Controlling Industrial Motors .....  | 086053  |
| Fractional Horsepower Motors.....  | 4033    |
| Industrial Motor Applications .....  | 086093  |
| Motor Control Fundamentals (for Programmable Logic<br>Controllers) .....       | 006010  |
| Industrial Motor Control (for Programmable Logic<br>Controllers), Part 1 ..... | 006011  |
| Industrial Motor Control (for Programmable Logic<br>Controllers), Part 2 ..... | 006012  |
| Repairing DC Motors and Generators.....  | 4220A-B |
| AC Motor Repair.....   | 6631A-B |
| Repairing Fractional Horsepower Motors .....                                   | 4034    |
| Reconnecting Induction Motors .....  | 6585    |
| Electric Heating .....   | 006034  |
| Controls for Air Conditioning .....  | 006035  |

**Industrial Applications and Troubleshooting**

|   |           |
|---|-----------|
| Analog Electronic Components.....                 | Block B23 |
| Basic Semiconductor Components: Diodes.....       | 086019    |
| Basic Semiconductor Components: Transistors ..... | 086020    |
| Switching Devices .....                           | 086021    |
| Electronic Sensors .....                          | 086022    |
| Special Rectifiers:.....                          | 086023    |
| Optoelectronic and Fiber Optic Components.....    | 086024    |
| Electronics Hardware.....                         | 086040    |
| Understanding and Using Electronic Diagrams ..... | 086095    |

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| Troubleshooting Industrial Electrical,<br>Electronic, and Computer Systems ..... | Block B26 |
| Industrial Electronic Troubleshooting .....                                      | 086064    |
| Electronic Troubleshooting of Industrial Motor Controllers .....                 | 086065    |
| Troubleshooting Sensing Devices and Systems .....                                | 086066    |
| Troubleshooting Industrial Control Systems<br>and Output Devices.....            | 086067    |
| Troubleshooting Industrial Computer Systems<br>and Software .....                | 086068    |
| Industrial Computer Networks .....   | 086069    |
| Data, Voice, and Video Cabling .....   | 086E16    |
| Electronic Process Control.....  | 086E17    |

Estimated Curriculum Duration: 1036 hours  
(excluding optional lab experiments).  
Number of Exams: 148.