

### Module Overview

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This module introduces the trainee to networks, the communication links between two or more intelligent devices or components within a computer system. The bus, or data bus, provides the communication pathway for all the devices within the network.

### Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; and *Electronic Systems Technician Level Two*.

### Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Describe the characteristics, connections, and uses for various types of data transmission media.
2. Explain the operating principles of network topologies.
3. Explain how information is transferred using different network topologies.
4. Explain device communication in an addressable network.
5. Describe the functions of routers.
6. Identify the protocols used with networks.
7. Explain power line carrier communications.

### Performance Tasks

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify IP addresses of the devices on a network.
2. Demonstrate various procedures for troubleshooting media access problems to a network.
3. Design a basic network.
4. Demonstrate PC configuration of IP and serial connections.

### Materials and Equipment

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Markers/chalk	Computers networked with peripheral devices
Pencils and scratch paper	Network router
Whiteboard/chalkboard	Computer equipped with LINUX®, UNIX®, or Mac OS® (if available)
<i>EST Level Three</i> PowerPoint® Presentation Slides (ISBN 978-0-13-266251-2)	Access to a website
Multimedia projector and screen	Special receiver module for controlling lighting and appliances
Computer	POE network switch
Diagrams of various network topologies	Equipment and computers for setting up a network
RS-232 cable	Module Examination*
USB cable	Performance Profile Sheets*
Sufficient networked computers with Internet access	

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

## Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

*Computer Networks*. Upper Saddle River, NJ: Pearson Education.

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Buses and Networks*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Session I. Introduction; Data Highway; Transfer Medium; OSI Model; Relating Network Protocols to the OSI Model</b>	
A. Introduction	_____
1. History of Networking	_____
B. The Data Highway	_____
1. Serial Communication	_____
2. Parallel Communication	_____
3. Data Buses	_____
C. Transfer Medium	_____
D. OSI Reference Model	_____
1. Protocols	_____
E. Relating Network Protocols to the OSI Model	_____
1. Network-LLC Service Interface	_____
2. LLC-MAC Service Interface	_____
3. Physical Medium Functions	_____
<b>Session II. Network Topologies; Access Control; Security</b>	
A. Network Topologies	_____
1. Star Topology	_____
2. Ring Topology	_____
3. Bus Topology	_____
4. Hybrid Topologies	_____
B. Network Access Control	_____
1. Random Access	_____
2. Polling	_____
3. Dedicated Channel	_____
4. Token Passing	_____
C. Network Security	_____
1. Firewalls	_____
2. Antivirus Software	_____

**Session III. The Internet**

A. The Internet

- 1. Background
- 2. Transmission Control Protocol/Internet Protocol (TCP/IP)
- 3. Internet Application Protocols

B. Laboratory

Have trainees identify IP addresses of the devices on a network. This laboratory corresponds to Performance Task 1.

**Sessions IV and V. Ethernet**

A. Ethernet

B. Laboratory

Have trainees design a basic network. This laboratory corresponds to Performance Task 3.

**Session VI. Microcomputer-Based LANs; Routers, Bridges, and Gateways**

A. Microcomputer-Based LANs

- 1. Basic Input/Output Systems (BIOS)
- 2. Operating Systems
- 3. Networking Software; Network Operating Systems
- 4. Real-Time Performance Issues

B. Routers, Bridges, and Gateways

- 1. Routers
- 2. Bridges
- 3. Gateways
- 4. Repeaters

**Session VII. Addressable Systems**

A. Addressable Systems

- 1. Analog Addressable Systems

B. Laboratory

Have trainees demonstrate PC configuration of IP and serial connections. This laboratory corresponds to Performance Task 4.

**Sessions VIII and IX. PLC Systems; POE Systems**

A. Power Line Carrier (PLC) Systems

B. Power Over Ethernet (POE) Systems

C. Laboratory

Have trainees demonstrate various procedures for troubleshooting media access problems to a network. This laboratory corresponds to Performance Task 2.

**Session X. Review and Testing**

A. Review

B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

### Module Overview

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This module introduces the trainee to the types of equipment and methods used in fiber optic cable installation.

### Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; Electronic Systems Technician Level Two; and Electronic Systems Technician Level Three; Module 33301-11.*

### Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Explain the basic principles of fiber optic systems.
2. Identify the uses of various types of fiber optic cables and devices.
3. Explain the features of fiber optic connectors and splices.
4. Describe the design, operation, and performance of a fiber optic system.
5. Explain the requirements for installation of fiber optic cabling and support equipment.
6. Perform a fiber optic termination.
7. Test a fiber optic link.

### Performance Tasks

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Perform a fiber optic termination.
2. Test a fiber optic link.

### Materials and Equipment

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Markers/chalk  
Pencils and scratch paper  
Whiteboard/chalkboard  
*EST Level Three PowerPoint® Presentation Slides*  
(ISBN 978-0-13-266251-2)  
Multimedia projector and screen  
Computer  
100- to 200-power microscope  
Several pieces of optical fiber with the buffer removed from the ends  
Selection of typical cables  
Selection of different cables, including simplex, duplex, and multi-fiber  
Ribbon cable  
Several fibers with different color-coded coatings and buffers  
LEDs  
Several types of laser beams  
One or more VCSELs

Examples of spliced or connected fibers  
Examples of passive splitter configurations  
Manufacturers' spec sheets for fiber optic cables  
Standard and duplex fiber optic cable samples  
Selection of distribution hardware:  
    Rack box  
    Patch panel  
    Junction box  
Parts and tools to terminate fiber optic cables  
Fiber optic patch cable with connectors and pigtails  
Selection of common connectors  
Selection of older types of connectors  
Samples of the most common connectors, including PCs, APCs, UPCs, and SPCs  
Fiber optic stripping tools  
Fiber optic strands  
OTDR  
Fiber cleavers

*continued*

Polishing paper and other supplies as required  
Splicing tools  
Mechanical splicing kit, if available  
Optical power meter

Module Examination\*  
Performance Profile Sheets\*

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

## Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working with fiber optic cable. Emphasize the importance of proper housekeeping.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

*Fiber Optic Reference Guide*. David R Goff. Woburn, MA: Focal Press.

*The Cabling Handbook*. 2nd Edition, 2001. John R. Vacca. Upper Saddle River, NJ: Prentice Hall PTR.

The Fiber Optic Association website ([www.thefoa.org](http://www.thefoa.org)) contains a variety of information and links for fiber optic equipment, cables, and termination procedures.

OSHA guidelines on laser hazards can be found at: [www.osha.gov](http://www.osha.gov).

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Fiber Optics*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Session I. Introduction; Fiber Optics Theory</b>	
A. Introduction	_____
1. Benefits	_____
2. Applications	_____
B. Fiber Optics Theory	_____
1. Light Generation and Coupling	_____
2. Light Transmission	_____
3. Operational Considerations	_____



**Session IX. Splicing; Fiber Optic Testing**

A. Splicing

- 1. Applications of Fiber Splices
- 2. Types of Splicing
- 3. Splicing Issues

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B. Fiber Optic Testing

- 1. Optical Power Meter
- 2. Insertion Loss Testing and Mode Control
- 3. Fiber Loss Measurements
- 4. Time and Frequency Domains
- 5. Optical Time-Domain Reflectometry

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C. Laboratory

Have the trainees perform a light-loss test on a fiber optic link.  
This laboratory corresponds to Performance Task 2.

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**Session X. Review and Testing**

A. Review

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B. Module Examination

- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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C. Performance Testing

- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

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### Module Overview

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This module introduces the trainee to wireless communications, in which voice and data signals are carried through the air. Examples of wireless communications include radio, cell phones, wireless Internet, and television sets that receive signals through antennas.

### Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Electronic Systems Technician Level One*; *Electronic Systems Technician Level Two*; and *Electronic Systems Technician Level Three*; Modules 33301-11 and 33302-11.

### Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Describe the different types of wireless communication.
2. Describe the limitations of wireless communication.
3. Identify the basic components used in wireless systems and explain the function of each.
4. Identify the equipment used when testing and troubleshooting wireless communication systems.
5. Identify interfering factors in wireless communication systems.
6. Describe the placement and function of an antenna.

### Performance Tasks

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This is a knowledge-based module; there are no performance tasks.

### Materials and Equipment

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Markers/chalk	Selection of diodes, including a laser diode and an IR LED
Pencils and scratch paper	IR remote audio and video system
Whiteboard/chalkboard	Microwave oven and a working wireless LAN device
<i>EST Level Three</i> PowerPoint® Presentation Slides (ISBN 978-0-13-266251-2)	Field-strength analyzer
Multimedia projector and screen	RF analyzer
Computer	Several NEC® handbooks
Antenna manufacturer's installation instructions	Antenna manufacturer's installation instructions
A piece of waveguide	Module Examination*
A transmitter and a receiver	

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

### Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.



## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

*The Essential Guide to RF and Wireless.* Upper Saddle River, NJ: Prentice Hall.

*Handbook of Radio and Wireless Technology.* New York, NY: McGraw-Hill.

*Wireless Personal Communication Systems.* Reading, MA: Addison-Wesley.

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Wireless Communication*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
<b>Session I. Introduction; Wireless Communication Principles; Radio Frequency (RF) Systems</b>	
A. Introduction	_____
B. Wireless Communication Principles	_____
1. Modulation	_____
2. Analog and Digital Signals	_____
3. Multiplexing	_____
C. Radio Frequency (RF) Systems	_____
1. Transmitters	_____
2. Receivers	_____
3. Transceivers	_____
4. Repeaters	_____
5. Waveguide	_____
6. Antennas	_____
7. Voltage Standing Wave Ratio (VSWR)	_____
<b>Session II. Infrared (IR) Systems; Wireless Computer Networks; Satellite Communications</b>	
A. Infrared (IR) Systems	_____
1. Basic IR Components	_____
2. Remote Control Circuits	_____
3. Remote Control Distribution Systems	_____
4. RS-232 Data Transmission Interface Systems	_____
B. Wireless Computer Networks	_____
1. Background	_____
2. Wireless LAN Equipment	_____
3. Wireless Network Security	_____
C. Satellite Communications	_____
1. Satellite Communication System Overview	_____
2. Areas of Service	_____
3. Satellite Orbits	_____



## Module Overview

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This module covers the tasks involved in planning a job from start to finish, including how to perform site surveys for both new and retrofit construction projects. The different kinds of drawings, specifications, and other documents commonly used while performing these tasks are also covered.

## Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; Electronic Systems Technician Level Two; and Electronic Systems Technician Level Three; Modules 33301-11 through 33303-11.*

## Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Describe the general procedure or steps involved when estimating a job for the purpose of submitting a bid.
2. Describe the general procedure or steps required to properly plan and complete a job once a contract for the job has been awarded.
3. Interpret contractual documents, working drawings, and specifications pertaining to a job to determine the requirements and scope of the work.
4. Perform a site survey in order to establish or confirm the installed locations of new and/or existing equipment and the routing of the related cabling.
5. Develop a schedule for completing a job or task from start to finish that efficiently accomplishes the work and is also compatible with the work performed by other trades.
6. Recognize and interpret the various types of forms and other documentation used when estimating and planning a project.

## Performance Tasks

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Interpret contract documents in order to determine the requirements for a selected job.
2. Perform a survey in order to accomplish the following:
  - Compare the working drawings for the site against the actual building structure to identify specific locations and the work to be performed there.
  - Confirm the installed locations of new and/or existing equipment and the routing of the related cabling.
  - Measure the routing and length of selected cable pathways and raceways to verify measurements shown on floor plans and/or estimate takeoff sheets.
3. Use task and labor hours data recorded on estimating forms and/or takeoff sheets for a selected job to develop a detailed schedule for accomplishing the job.

## Materials and Equipment

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Markers/chalk  
Pencils and scratch paper  
Whiteboard/chalkboard  
*EST Level Three PowerPoint® Presentation Slides*  
(ISBN 978-0-13-266251-2)  
Multimedia projector and screen  
Computer  
Appropriate personal protective equipment  
Complete set of construction drawings  
Examples of as-built drawings

Examples of CSI-formatted specifications  
Copy of a typical scope of work  
Examples of typical contract documents:  
Addenda  
Liens  
Stop-work orders  
RFIs  
Change orders  
Project logs  
Punch list

*continued*

Support equipment for site survey:  
 Ladders  
 Flashlight  
 Measuring device (wheel/50' tape/laser)  
 Handheld tape recorder  
 Still or video camera  
 Architect's rule  
 Examples of graphic-type and text-type project schedules  
 Examples of typical purchase orders  
 Examples of typical material safety data sheets  
 Personal computer with project scheduling software (optional)

Examples of tasks and labor estimates takeoff sheets/estimating forms  
 Graph paper for making schedules  
 Examples of materials estimates takeoff sheets/estimating forms  
 Certificates of completion  
 Activation/deactivation reports, wiring certification diagrams and lists  
 Set of operation and maintenance (O&M) manuals for installed equipment  
 Module Examinations\*  
 Performance Profile Sheets\*

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

## Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

*Construction Supervision: Project Supervision.* Gainesville, FL: The National Center for Construction Education and Research.

*Mike's Basic Guide to Cabling Computers and Telephones.* Prairie Wind Communications.

*Information Transport Systems Installation Methods Manual.* Tampa, FL: BICSI.

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Site Survey, Project Planning, and Documentation*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Session I. Introduction; The Job Estimating and Bidding Process;</b>	
<b>Review of Job Requirements; Job Planning After the Contract Award</b>	
A. Introduction	_____
B. The Job Estimating and Bidding Process	_____
C. Review of Job Requirements	_____
1. Construction Drawings	_____
2. Specifications	_____
3. Scope of Work	_____
4. Exclusions	_____
D. Laboratory	_____
Have trainees interpret contract documents to determine the requirements for a selected job. This laboratory corresponds to Performance Task 1.	
E. Job Planning After the Contract Award	_____

**Sessions II and III. New Construction Site Survey, Planning, and Documentation**

A. New Construction Site Survey, Planning, and Documentation \_\_\_\_\_

B. Laboratory \_\_\_\_\_

Have trainees perform a site survey. This laboratory corresponds to Performance Task 2.

**Session IV. Scheduling the Work; Acquiring the Needed Materials/Equipment; Assigning the Installation Crew**

A. Scheduling the Work \_\_\_\_\_

B. Acquiring the Needed Materials/Equipment \_\_\_\_\_

C. Assigning the Installation Crew \_\_\_\_\_

D. Laboratory \_\_\_\_\_

Have trainees use task and labor hours data recorded on estimating forms and/or takeoff sheets for a selected job to develop a detailed schedule for accomplishing the job. This laboratory corresponds to Performance Task 3.

**Session V. Completing the Installation; Incorporating Quality Control/Acceptance Tests; Completing the Punch List; Completing the Job; Retrofitting Installations; Additional Documentation**

A. Completing the Installation \_\_\_\_\_

B. Incorporating Quality Control/Acceptance Tests \_\_\_\_\_

C. Completing the Punch List \_\_\_\_\_

D. Completing the Job \_\_\_\_\_

E. Retrofitting Installations \_\_\_\_\_

F. Additional Documentation \_\_\_\_\_

**Session VI. Review and Testing**

A. Review \_\_\_\_\_

B. Module Examination \_\_\_\_\_

1. Trainees must score 70% or higher to receive recognition from NCCER.

2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing \_\_\_\_\_

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.

2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

### Module Overview

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Today's leaders face a complex and challenging workforce, and having a capable leader is essential to the success of any team. This module introduces the trainee to the principles of leadership. Trainees will learn about:

- The construction industry today
- Business organizations
- Team building
- Gender and minority issues
- Communication
- Motivation
- Problem solving
- Decision making
- Safety
- Project control

### Prerequisites

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There are no prerequisites for this course.

### Objectives

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Upon completion of this course, the trainee will be able to:

1. Discuss current issues and organizational structure in industry today.
2. Understand and incorporate leadership skills into work habits, including communications, motivation, team building, problem solving, and decision-making skills.
3. Demonstrate an awareness of safety issues, including the cost of accidents and safety regulations.
4. Identify a crew leader's typical safety responsibilities.
5. Show a basic understanding of the planning process, scheduling, and cost and resource control.

### Performance Tasks

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Develop an estimate for a given work activity.
2. Develop and present a look-ahead schedule.

### Note to Instructors

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If you are training under an Accredited NCCER Sponsor, note that you may be eligible for dual credentials for successful completion of *Fundamentals of Crew Leadership*. When submitting the Form 200, indicate completion of the two module numbers that apply to *Fundamentals of Crew Leadership – 46101-11* (from NCCER's Contren<sup>®</sup> Management Series) and the applicable craft module (if used as part of a craft training program) and transcripts will be issued to you accordingly.

## Materials and Equipment

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Markers/chalk  
Pencils and scratch paper  
Whiteboard/chalkboard  
*Fundamentals of Crew Leadership* PowerPoint®  
Presentation Slides (ISBN 978-0-13-257329-0)  
Multimedia projector and screen  
Computer  
Several construction job descriptions, including one that is very vague and one that is overly detailed  
Several MSDSs appropriate to the craft  
Original and as-built drawings of the same project  
A redline drawing  
Sufficient copies of a roofing formwork detail drawing  
Sufficient copies of the worksheet with entries

Examples of schedules:\*

- Bar chart
- Network schedule
- Short-term or look-ahead schedule

Two or three typical job schedules  
Two job plans and pictures of each site  
Construction drawings of a work platform with a concrete footing, including specifications, to be built on site:  
Materials cost list including lumber, concrete, and hardware  
Labor cost list including concrete finishers, carpenters, and masonry workers  
Photographs of the planned site  
Set of construction drawings  
Module Examinations\*  
Performance Profile Sheets\*

\* Because this module may be used for different industries, materials such as project schedules should be appropriate to the craft where possible.

\*\*Use your access code to download this exam from the IRC.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

Aging Workforce News, [www.agingworkforcenews.com](http://www.agingworkforcenews.com).

American Society for Training and Development (ASTD), [www.astd.org](http://www.astd.org).

Architecture, Engineering, and Construction Industry (AEC), [www.aecinfo.com](http://www.aecinfo.com).

CIT Group, [www.citgroup.com](http://www.citgroup.com).

Equal Employment Opportunity Commission (EEOC), [www.eeoc.gov](http://www.eeoc.gov).

National Association of Women in Construction (NAWIC), [www.nawic.org](http://www.nawic.org).

National Census of Fatal Occupational Injuries (NCFOD), [www.bls.gov](http://www.bls.gov).

National Center for Construction Education and Research, [www.nccer.org](http://www.nccer.org).

National Institute of Occupational Safety and Health (NIOSH), [www.cdc.gov/niosh](http://www.cdc.gov/niosh).

National Safety Council, [www.nsc.org](http://www.nsc.org).

NCCER Publications:

- *Your Role in the Green Environment*
- *Sustainable Construction Supervisor*

Occupational Safety and Health Administration (OSHA), [www.osha.gov](http://www.osha.gov).

Society for Human Resources Management (SHRM), [www.shrm.org](http://www.shrm.org).

United States Census Bureau, [www.census.gov](http://www.census.gov).

United States Department of Labor, [www.dol.gov](http://www.dol.gov).

USA Today, [www.usatoday.com](http://www.usatoday.com).

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. This course is designed to be taught in one of two formats: two 8-hour sessions (such as all-day workshops) or eight 2-hour sessions (such as after-work training seminars). Because of this, each session below has a suggested time period of two hours. If leading 8-hour sessions, simply teach four of these 2-hour sessions both times your class meets. All instructors will need to adjust the time required for participant activities and testing based on class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Session I. Section One – The Basics</b>	
A. Industry Today	_____
1. The Need for Training	_____
2. Impact of Technology	_____
B. Gender and Cultural Issues	_____
1. Communication Styles of Men and Women	_____
2. Language Barriers	_____
3. Cultural Differences	_____
4. Sexual Harassment	_____
5. Gender and Minority Discrimination	_____
C. Business Organizations	_____
1. Division of Responsibility	_____
2. Authority, Responsibility, and Accountability	_____
3. Job Descriptions	_____
4. Policies and Procedures	_____
<b>Session II. Section Two – Leadership Skills, Part One</b>	
A. Introduction to Leadership	_____
B. The Shift in Work Activities	_____
C. Becoming a Leader	_____
1. Characteristics of a Leader	_____
2. Functions of a Leader	_____
3. Leadership Styles	_____
4. Ethics in Leadership	_____
D. Communication	_____
1. Verbal Communication	_____
2. Nonverbal Communication	_____
3. Written or Visual Communication	_____
4. Communication Issues	_____
E. Motivation	_____
1. Employee Motivators	_____
2. Motivating Employees	_____
F. Team Building	_____
1. Successful Teams	_____
2. Building Successful Teams	_____





**Session VI. Section Four – Project Control, Part Two**

A. Planning

1. Why Plan?

2. Stages of Planning

B. Laboratory

Have the trainees develop and present a look-ahead schedule based on one of the plans. This laboratory corresponds to Performance Task 2.

C. The Planning Process

1. Establish a Goal

2. Identify the Work to Be Done

3. Identify Tasks to Be Performed

4. Communicating Responsibilities

5. Follow-Up Activities

D. Planning Resources

1. Safety Planning

2. Materials Planning

3. Site Planning

4. Equipment Planning

5. Tool Planning

6. Labor Planning

**Session VII. Section Four – Project Control, Part Three**

A. Scheduling

1. The Scheduling Process

2. Bar Chart Schedule

3. Network Schedule

4. Short-Term Scheduling

5. Updating a Schedule

B. Cost Control

1. Assessing Cost Performance

2. Field Reporting System

3. Crew Leader's Role in Cost Control

C. Resource Control

1. Materials Control

2. Equipment Control

3. Tool Control

4. Labor Control

D. Production and Productivity

**Session VIII. Review; Testing**

A. Module Review

B. Module Examination

1. Trainees must score 70 percent or higher to receive recognition from NCCER.

2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainee must perform each task to the satisfaction of the instructor to receive recognition from NCCER.

2. Record the training results on Training Report Form 200, and submit the results to the Training Program Sponsor.

### Module Overview

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This module introduces the trainee to the various types of equipment racks used to house electronic equipment. The module also covers grounding and ventilation requirements for racks and rack-mounted equipment.

### Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; Electronic Systems Technician Level Two; and Electronic Systems Technician Level Three; Modules 33301-11 through 33304-11 and 46101-11.*

### Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Identify various types of electronic equipment racks.
2. Select the appropriate rack for a given application.
3. Establish proper grounding of racks to ensure personnel safety and minimize signal interference.
4. Explain proper ventilation techniques to avoid overheating of rack-mounted electronic equipment.
5. Describe the installation practices for rack-mounted equipment.
6. Prepare a rack layout drawing.
7. Calculate power requirements and heat dissipation requirements for a rack installation.
8. Assemble a rack, including lacing rails.
9. Populate a rack with equipment.

### Performance Tasks

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Select a rack unit for a given application.
2. Prepare a rack layout drawing.
3. Calculate power requirements and Btu dissipation for a rack installation.
4. Properly install electronic equipment in a rack.
5. Assemble a rack, including lacing rails.

### Materials and Equipment

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Markers/chalk  
Pencils and scratch paper  
Whiteboard/chalkboard  
*EST Level Three* PowerPoint® Presentation Slides  
(ISBN 978-0-13-266251-2)  
Multimedia projector and screen  
Computer  
Appropriate personal protective equipment  
Rack layout drawing  
Sample Btu calculations  
Sketches of racks containing power strips  
Equipment racks  
Examples of cable management devices  
Examples of a system installation

Examples of rack accessories, including:

Rack support base  
Casters  
Mounting hardware  
Rack ears  
Power strips  
Hair dryer  
Lightweight plastic bags  
Rack-mount equipment, including:  
Blank panels  
Ventilating fans  
Cable/wire management devices  
Sufficient racks  
Module Examinations\*  
Performance Profile Sheets\*

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

## Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

*Audio Systems Design and Installation*. Philip Giddings. Boston, MA: Focal Press.  
Middle Atlantic Products, Inc., [www.middleatlantic.com](http://www.middleatlantic.com).

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 17½ hours are suggested to cover *Rack Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Sessions I and II. Introduction; Types of Racks; Rack Dimensions; Power and Grounding</b>	
A. Introduction	_____
B. Types of Racks	_____
C. Laboratory	_____
Have the trainees select a rack unit for a given application. This laboratory corresponds to Performance Task 1.	
D. Rack Dimensions	_____
E. Power and Grounding	_____
1. Power	_____
2. Grounding	_____
<b>Session III. Rack Ventilation and Cooling</b>	
A. Rack Ventilation and Cooling	_____
1. Heat Load Calculation	_____
2. Laboratory	_____
Have trainees calculate power requirements and Btu dissipation for a rack installation. This laboratory corresponds to Performance Task 3.	
3. Rack Ventilation	_____
4. Heat Exchangers and Air Conditioners	_____

**Sessions IV–VI. Installation Practices**

A. Installation Practices

1. Installation Hardware and Accessories

2. Laboratory

Have trainees prepare rack layout drawings. This laboratory corresponds to Performance Task 2.

3. Cable Management

4. Earthquake Protection

5. Laboratory

Have the trainees assemble a rack, including lacing rails, and install electronic equipment. This laboratory corresponds to Performance Tasks 4 and 5.

**Session VII. Review and Testing**

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.

2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.

2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

### Module Overview

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This module explains the commissioning process used to verify the correct operation of a system following installation. The module also provides guidance to technicians who must train user personnel in the operation of the system.

### Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; Electronic Systems Technician Level Two; and Electronic Systems Technician Level Three; Modules 33301-11 through 33304-11, 46101-11, and 33305-11.*

### Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Describe the phases of the system commissioning process and explain how they apply to the commissioning of specific types of electronic systems.
2. Explain how to develop a user training course.
3. Demonstrate or describe how to prepare for and conduct user training.

### Performance Task

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Prepare and conduct a user training session.

### Materials and Equipment

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Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

*EST Level Three* PowerPoint® Presentation Slides  
(ISBN 978-0-13-266251-2)

Multimedia projector and screen

Computer

Commissioning report

Module Examination\*

Performance Profile Sheets\*

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

### Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

*Procedural Standards for Whole Building Systems Commissioning of New Construction.* Gaithersburg, MD: National Environmental Balancing Bureau.

*National Fire Alarm and Signaling Code Handbook, NFPA 72.* Quincy, MA: National Fire Protection Association.

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *System Commissioning and User Training*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Session I. Introduction; Commissioning Process Overview</b>	
A. Introduction	_____
B. Commissioning Process Overview	_____
1. Pre-Installation Activities	_____
2. Commissioning Plan Preparation	_____
3. Installation Activities	_____
4. Functional Performance Testing Activities	_____
5. User Training and Documentation	_____
6. System Acceptance	_____
7. Post-Acceptance Activities	_____
<b>Session II. Commissioning Demonstration</b>	
A. Commissioning Demonstration	_____
1. Perform a walk-through of a commissioning procedure for a selected system.	
<b>Session III. User Training, Part One</b>	
A. User Training	_____
1. Determining the Scope of the Training	_____
2. Instructor Preparation	_____
3. Trainee Qualifications	_____
4. Equipment/System Preparation	_____
5. Conduct the Training	_____
<b>Sessions IV through VII. User Training, Part Two</b>	
A. User Training	_____
1. On-the-Job Learning	_____
2. Course Closure	_____
B. Laboratory	_____
Have trainees prepare and conduct a user training session. This laboratory corresponds to Performance Task 1.	

## Session VIII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.



## Module Overview

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This module provides information and instructions for maintenance and repair of low-voltage systems and equipment. A systematic approach and component-level troubleshooting are covered, as well as methods of identifying common types of repairs. Information and general guidelines for various preventive maintenance tasks are also covered.

## Prerequisites

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Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Electronic Systems Technician Level One; Electronic Systems Technician Level Two; and Electronic Systems Technician Level Three; Modules 33301-11 through 33304-11, 46101-11, 33305-11, and 33306-11.*

## Objectives

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Upon completion of this module, the trainee will be able to do the following:

1. Explain the difference between maintenance and repair.
2. Identify the common causes of system and equipment failures.
3. Use electrostatic discharge (ESD) control devices and techniques when handling ESD-sensitive equipment and components.
4. Use manufacturers' troubleshooting aids to identify system problem(s).
5. Isolate computer-related problems to hardware or software.
6. Isolate common faults in wiring and equipment.
7. Identify common preventive maintenance measures.
8. Identify and explain preventive maintenance and inspection schedules.

## Performance Tasks

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Under the supervision of the instructor, the trainee should be able to do the following:

1. Use ESD control devices and techniques when handling and troubleshooting ESD-sensitive equipment or components.
2. Use manufacturers' troubleshooting aids to identify system problem(s).
3. Determine if a power supply is good or bad.
4. Determine if a printed circuit board is good or bad.
5. Isolate the cause of a computer-related problem to the hardware or software.
6. Isolate common faults in copper and fiber optic cable wired networks.

## Materials and Equipment

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Markers/chalk  
Pencils and scratch paper  
Whiteboard/chalkboard  
*EST Level Three PowerPoint® Presentation Slides*  
(ISBN 978-0-13-266251-2)  
Multimedia projector and screen  
Computer  
Appropriate personal protective equipment  
Copy of the *National Electrical Code®*  
ESD grounding wrist strap  
ESD control devices, including:  
    ESD isolation containers  
    ESD ionizer  
ESD-sensitive printed circuit boards

Test equipment, as applicable:  
Multimeter (DMM/VOM)  
Clamp-on ammeter  
Oscilloscope and probes  
Wire map tester  
Handheld cable tester  
Toner/wand  
Air-filled plastic bag  
Telephone test set  
Certification test set  
Cable tracer  
Optical light source and power meter  
Fiber optic cable  
Time-domain reflectometer (TDR)

*continued*

Optical time-domain reflectometer (OTDR)  
 Optical fiber flashlight  
 Low-intensity laser  
 Megohmmeter  
 Frequency meter/counter  
 Miscellaneous test adapters, leads, and cables  
 Examples of service manuals  
 Maintenance manuals for low-voltage systems and equipment  
 Manufacturers' troubleshooting aids  
 Several power supplies, some good and some bad  
 Several PC boards, some good and some bad

Schematic with both NO and NC contacts  
 Several computers with hardware problems in some and software problems in others  
 Computer networks, including:  
   Copper cable-wired network  
   Fiber optic cable-wired network  
 Examples of testing and inspection forms  
 Several electronic system manufacturer's manuals  
 Isopropyl alcohol and a clean, lint-free cloth  
 Module Examination\*  
 Performance Profile Sheets\*

\* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

## Safety Considerations

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Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Review safety guidelines associated with working on electrical and electronic systems. Emphasize the importance of proper housekeeping.

## Additional Resources

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This module presents thorough resources for task training. The following resource material is suggested for further study.

- Mike's Basic Guide to Cabling*. Englewood, CO: Global Engineering Documents.
- Cabling: The Complete Guide to Network Wiring*. San Francisco, CA: Sybex.

## Teaching Time for This Module

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An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Maintenance and Repair*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
<b>Sessions I and II. Introduction; Maintenance Versus Repair; Causes of Failures; Test Equipment; Common Causes of Electrical Equipment Faults</b>	
A. Introduction	_____
B. Maintenance Versus Repair	_____
C. Causes of Failure	_____
1. Environmental Conditions	_____
2. Improper Installation	_____
3. Poor Power Quality	_____
4. Electrostatic Discharge	_____
5. Laboratory	_____
Have trainees use ESD control devices and techniques when handling or troubleshooting ESD-sensitive equipment or components. This laboratory corresponds to Performance Task 1.	

- 6. Operator Error \_\_\_\_\_
- D. Test Equipment \_\_\_\_\_
- E. Common Causes of Electrical Equipment Faults \_\_\_\_\_
  - 1. Short Circuits \_\_\_\_\_
  - 2. Open Circuits \_\_\_\_\_
  - 3. Ground Faults \_\_\_\_\_
  - 4. Mechanical Failures \_\_\_\_\_

**Session III. Using a Systematic Approach to Troubleshooting; Customer Interface; Physical Examination of the System; Basic System Analysis; Use of Manufacturers' Troubleshooting Aids**

- A. Using a Systematic Approach to Troubleshooting \_\_\_\_\_
- B. Customer Interface \_\_\_\_\_
- C. Physical Examination of the System \_\_\_\_\_
- D. Basic System Analysis \_\_\_\_\_
- E. Use of Manufacturers' Troubleshooting Aids \_\_\_\_\_
  - 1. Wiring Diagrams \_\_\_\_\_
  - 2. Troubleshooting Tables and Fault Isolation Diagrams \_\_\_\_\_
  - 3. Diagnostic Equipment and Tests \_\_\_\_\_
- F. Laboratory \_\_\_\_\_
 

Have trainees use manufacturers' troubleshooting aids to identify system problem(s). This laboratory corresponds to Performance Task 2.

**Sessions IV–VII. Fault Isolation in the System/Unit Problem Area**

- A. Fault Isolation in the System/Unit Problem Area \_\_\_\_\_
  - 1. Troubleshooting Input Power and Power Supply Circuits \_\_\_\_\_
  - 2. Laboratory \_\_\_\_\_
 

Have trainees determine if a power supply is good or bad. This laboratory corresponds to Performance Task 3.
  - 3. Troubleshooting Control/Sensor Circuits \_\_\_\_\_
  - 4. Troubleshooting Central Processing Circuits \_\_\_\_\_
  - 5. Laboratory \_\_\_\_\_
 

Have trainees determine if a printed circuit board is good or bad. This laboratory corresponds to Performance Task 4.
  - 6. Troubleshooting Computer-Related Problems \_\_\_\_\_
  - 7. Laboratory \_\_\_\_\_
 

Have trainees isolate the cause of a computer-related problem to the hardware or software. This laboratory corresponds to Performance Task 5.
  - 8. Troubleshooting and Testing Copper Cable \_\_\_\_\_
  - 9. Laboratory \_\_\_\_\_
 

Have trainees isolate common faults in copper cable-wired networks. This laboratory corresponds to part of Performance Task 6.
  - 10. Troubleshooting and Testing Fiber Optic Cable \_\_\_\_\_
  - 11. Laboratory \_\_\_\_\_
 

Have trainees isolate common faults in fiber optic cable-wired networks. This laboratory corresponds to part of Performance Task 6.
  - 12. Testing After Repair \_\_\_\_\_

**Session VII. Preventive Maintenance; Inspecting and Testing Forms**

A. Preventive Maintenance

- 1. Inspection
- 2. Cleaning
- 3. Lubrication
- 4. Testing and Adjustment

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B. Inspecting and Testing Forms

**Session VIII. Review and Testing**

A. Review

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B. Module Examination

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- 1. Trainees must score 70% or higher to receive recognition from NCCER.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

C. Performance Testing

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- 1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
- 2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.