Career Readiness Indicator Questionnaire

This questionnaire is designed to help guide the process for review of a Career Readiness Indicator (CRI). It is the responsibility of the local education agency proposing the addition of the CRI to gather the information and submit it to Josh Laney, Assistant Director for Workforce Development. Answers should be as concise as possible. Information should be submitted as a completed packet, not piecemeal. Additional information may be included at the discretion of the applying agency if it might be pertinent to the evaluation process.

Contact information for person filling out questionnaire
Agency: C-Tech Associates Inc Email: mikeb@c-techtraining.com
Phone number: 973-726-9000 Date of submittal: 9-8-15

Why do we want this CRI?
1. What industry is asking for the CRI?
   a. Construction
   b. A/V Technology & Communications
   c. Information Technology
   d. Manufacturing
2. What companies within the in industry are requesting this CRI?
   a. Dish Network
   b. Leviton
   c. Radiall-Jerrik
   d. Verizon
3. What entity, company, or testing agency is the "owner" of the CRI?
   a. C-Tech Associates Inc
      50 Station Road, Sparta NJ 07871
      973-726-9000
      Michael Brady mikeb@c-techtraining.com
      www.c-techtraining.com
4. For what career technical program(s) is the CRI being requested?
   a. Information Tech Fundamentals
   b. Networking I & II
   c. IT Program

How does one actually get the CRI?
5. How long does it take for a student to earn this CRI? 30-40 classroom hours per CRI
6. How does the student earn the CRI? Module Tests, 3 part written and hands on exam
7. Is there a minimum age requirement for gaining the CRI? No
8. Are students required to be graduates before earning the CRI? No
9. Are there minimum pre-requisite course requirements for earning the CRI? No

Rev: 7/27/15
10. What equipment is required to train for this CRI? C-Tech’s Interactive Training Workstations, Student Certification Kits

11. Does the earning of the CRI require the student to have computer access for the testing? No

How much does it cost and what resources are required?

12. What is the cost of the exam for earning this CRI? No cost for exams, student certification kits must be purchased which include a copy of the C-Tech curriculum, building materials, and a voucher for certifications, avg. cost $70 per student.

13. Is there a practice test available from the CRI issuer or from other parties? No
   a. If yes, does the practice test have a cost in addition to the actual exam and if so, how much? N/A
   b. Can rights to the practice material be purchased once or is there a recurring fee? N/A

14. Who can administer the exam? The C-Tech programs are taught and the exams are administered by a Certified C-Tech Instructor.

15. Is special certification or licensure required for a teacher to administer the CRI? YES
   a. If yes, what is the cost for gaining the appropriate licensure?
   b. Is this a one-time or recurring fee? $650 per program, one-time fee.

16. Is site, facility, or equipment certification required for administering the CRI? YES
   a. If yes, what costs are included? Varies based on programs chosen and total class size
   b. Is this a one-time or recurring fee? Equipment is a one-time fee, Student Certification Kits are a recurring fee.
August 21, 2015

Mr. Kyle Pinckard
Opelika City Schools
300 Simmons Street
Opelika, AL 36801

RE: Opelika City Schools IT Program

Mr. Pinckard:

I wanted to let you know that I am very excited to have been a part the substantial growth in your Information Technology program over the past few years. I am very proud to be involved in such an impressive program that is fully equipping students, at a high school level, for careers in IT-related fields. After reviewing the direction the program is heading, I wanted to make a few comments.

With the 15+ years of experience that I have in this field, as well as a PhD in the subject matter, I can tell you that training students in copper cabling is going to be extremely beneficial to their futures. Out of the hundreds of businesses I have been in, working with their IT and equipment, every one of them had copper cable in the walls in the form of Cat5 or Cat6. If they did not, we were probably there to install it.

Many of my college students at Auburn University do not have any knowledge of cabling or how it works. They seem to believe that somehow the information/data “magically” arrives at their computer. Students who understand the structure of business networks which, at their core, are based on copper wire, possess an extremely marketable skill in my opinion.

In terms of the fiber optic cabling, I believe Opelika is in a unique position. Opelika is the first and only city in the state that currently has FTTC and offers fiber internet to their residents as well as businesses. While I do see fiber cabling at some clients offices, it is rare. As it stands now, based purely on required speeds and infrastructure, copper cable is still king. Because most areas do not have/offer the speeds Opelika offers, fiber would be a wasted effort because it is expensive and does not benefit the business; they would still be bottlenecked by the speeds of their network equipment.

Fiber is typically used as backhauls to connect remote offices, city infrastructure, or provide a backbone for services such as telephone or WAN over a much longer distance. It is also very hard to work with as compared to copper cable. As I mentioned, having access to fiber is fairly rare at this time in small to medium businesses, which makes up a large majority of Alabama’s business environment, so we, as an IT support company, rely heavily on individuals who are familiar with copper cable and consider it more of an expertise that would be outsourced if we were to need fiber cable run.

I am certainly by no means saying that fiber should not be taught or is not used in the industry. I am saying that in a practical sense, you typically have an expertise or experience in one or the other. Individuals who had an expertise or experience with fiber wire would be more likely to be working more at the “higher” level on at network – such as for internet providers, cities, etc., building infrastructure outside of the premises.

A person with an expertise in copper cabling would likely find themselves more in a position to work within buildings and run wire between offices or back to network cores. We are seeing such a growth in the copper industry that it is likely that the next generation of Ethernet wiring schemes (copper) may rival speeds offered by fiber. I have included a table from a class I teach at the University which shows
the various connections and their speeds (or proposed speeds). You can see that Gigabit Ethernet, which is copper based, is capable of speeds greater than fiber and can also be mixed with fiber wiring. Most fiber is also still terminated to copper cabling for the business or individual.

We also see huge leaps occurring in both research and practice in the wireless industry. While wireless is growing much faster than the cable industry, there is no comparison in terms of the reliability and security of a wired connection. All modern computers come with two common connections: 802.11 wireless AND copper-based Ethernet RJ-45 jacks. I do not see a trend to indicate that this will be changing anytime soon.

Thank you again for what you are doing for our industry. If I can be of any help, please let me know. I look forward to continue to work with you and see the great things that Opelika City Schools are doing for our industry.

Dr. Heath Landrum
Owner

<table>
<thead>
<tr>
<th></th>
<th>Fast Ethernet</th>
<th>Gigabit Ethernet</th>
<th>Fibre Channel</th>
<th>Wireless LAN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Rate</strong></td>
<td>100 Mbps</td>
<td>1 Gbps, 10 Gbps, 100 Gbps</td>
<td>100 Mbps to 3.2 Gbps</td>
<td>1 Mbps to 54 Mbps</td>
</tr>
<tr>
<td><strong>Transmission Media</strong></td>
<td>UTP, STP, optical fiber</td>
<td>UTP, shielded cable, optical fiber</td>
<td>Optical fiber, coaxial cable, STP</td>
<td>2.4-GHz, 5-GHz microwave</td>
</tr>
<tr>
<td><strong>Access Method</strong></td>
<td>CSMA/CD</td>
<td>Switched</td>
<td>Switched</td>
<td>CSMA/Polling</td>
</tr>
<tr>
<td><strong>Supporting Standard</strong></td>
<td>IEEE 802.3</td>
<td>IEEE 802.3</td>
<td>Fibre Channel Association</td>
<td>IEEE 802.11</td>
</tr>
</tbody>
</table>
To Whom It May Concern:

This letter is to verify that the curriculum taught in the C-Tech programs is applicable and useful to our company. Verizon supports Broadband FiOS network infrastructure for our customers. In order to accomplish our mission, we employ technicians with the skills taught in C-Tech's programs. Connectivity has expanded and will continue to expand; as expansion continues the need for trained technicians in the area of telecommunications will increase. While working with our customers and subcontractors, we have seen the need for trained technicians nationally. Implementing the C-Tech program would be beneficial for not only Verizon but also other telecommunications companies.

C-Tech graduates have the skills to install, test and troubleshoot proactive green copper and fiber optic cabling systems in accordance to national standards. They also have the ability to install, test and program telephone and audio/video entertainment systems, then troubleshoot and correct problems as necessary to insure proper system operation. These skills along with the soft skills such as customer service taught in all the C-Tech programs are vital to the success of our business and all other related technology entertainment companies.

Verizon and our network of subcontractors would consider C-Tech graduates for employment if there are positions available within our company and the applicants meet our initial company guidelines and expectations.

Sincerely,

[Signature]

Brian Pinkstaff
Manager Global Talent Development
Verizon
Basking Ridge, NJ 07920
To: Whom it may concern

Ref: C-Tech’s Network Cabling Specialist & Voice Communications Professional Certifications

C-Tech is a developer and manufacturer of innovative training aids and curriculum in Communications Networking that they market to educational institutions and job training providers. These programs provide students with a strong knowledge of Copper and Fiber Optic Network Cabling as well as Key Telephone Systems. C-Tech has established a network of over 350 Certified Training Facilities in 36 states.

Leviton Voice & Data Division has reviewed the C-Tech curriculum for content and applicability and recommends that you consider C-Tech certified Network Cabling Specialists and Voice Communications Professionals as candidates for entry-level technician positions.

C-Tech can help you 1) develop relationships with local training facilities, 2) gain access to new hires as well as 3) provide a location for existing employees to “brush up” on their skills. These programs carry BICSI CE credits. The C-Tech training provides basic skill sets and knowledge bases that prepare students to participate in our training programs.

C-Tech has issued NCS and VCP certifications to over 3,000 individuals annually for the past few years. According to C-Tech, 95% of those people are looking for a career in our industry and that 72% would consider the possibility of relocating. C-Tech trained individuals are proven to have better retention rates and can be hired as “entry-level” technicians who 1) have the skills, 2) are familiar with the industry and 3) are eager and ready to work.

You may not need a technician, but you may need support with your sales or customer service staff. It would be a great benefit to hire someone with a background in the technology. C-Tech graduates have that background and again will be better prepared to participate in our training programs than someone hired “off the street.”

Leviton Voice & Data Division believes strongly in the value of continuing education and views C-Tech’s programs as a compliment to our training. To learn more about C-Tech directly, please call William McGurgen, Director of Programs and Training, at 973.726.9000 ext. 35 or e-mail Bill at billm@c-techtraining.com to find out how your company can get involved today.

Best Regards,

Brian S. Ensign, RCDD/LAN/OSP Specialist
Senior Project Scientist
800-877-0190, ext. 57322
Leviton Premier Contractors in Alabama

1. Goss Electric Inc
   137 Woodall Rd
   Decatur, AL 35601
   Phone: (256) 353-8751

2. Channell Communications, Inc
   6950 Hargrove Rd E
   Tuscaloosa, AL 35456
   Phone: (205) 345-7477

3. Southern Technologies Services
   25253 Friendship Rd, Ste A
   Daphne, AL 36526
   Phone: (251) 621-6787
Introduction to Network Cabling – Copper-based systems version 3.3.1

Course Objectives

TOTAL HOURS: 40

Course Description: This course is a hands-on, short-term program that provides the skills and knowledge desired universally by industry professionals for entry-level employment in the telecommunications connectivity field. Graduates will be versed in all phases of installation and maintenance of copper networking systems to include data, voice and video for both commercial and residential applications. Students work with actual cabling and connectivity devices as they terminate, test and troubleshoot copper-based data, voice and video systems as found in Business and Smart Homes. Also covered in the course are commercial and residential cabling standards, cable routing and placement.

Certification: Network Cabling Specialist

Module 1 The ACT with DAVE-3™ Training Aid

Goal: After completion of this module, students will be able to set up the ACT and DAVE-3 units for operation.

Objectives:
1.1 Identify all components of the ACT panel
1.2 Identify all aspects of the Banner Board
1.3 Identify elements in the Cable Supply
1.4 Identify the different functions of the DAVE-3 Transmitter and Receiver
1.5 Identify all of the cables and test adapters in the ACT with the DAVE-3 Training Aid
1.6 Identify the types of tools located in the training aid and their function to include:
   1.6.1 Punch-down tool
   1.6.2 Cable Strippers
   1.6.3 Coaxial Cable Crimpers
   1.6.4 RJ-45 Crimpers
   1.6.5 Cable Cutter
1.7 Identify the contents of the student consumable kit
1.8 Identify the contents of the optional tool kit
Module 2 Twisted Pair Cabling Systems

Goal: After completion of this module, students will be able to identify and describe the characteristics, application and configuration of various cables and terminations.

Objectives:

2.1 Identify the characteristics of Twisted Pair Cables to include:
   2.1.1 Twist Length
   2.1.2 Gauge
   2.1.3 Solid and Stranded Cabling Systems
   2.1.4 Tip and Ring

2.2 Define Plenum and Riser with regard to Copper Cabling

2.3 Given a cabling substitution chart, recommend a correct cable substitution

2.4 Define bandwidth and bits-per second as it pertains to twisted pair cabling systems

2.5 Identify the color code for 4-pair UTP cabling

2.6 Identify the following Modular Plug and Jack pair to pin configurations:
   2.6.1 T568A
   2.6.2 T568B
   2.6.3 USOC

2.7 Identify cabling configurations and uses in regards to:
   2.7.1 Straight Through Cable
   2.7.2 Roll Over Cable
   2.7.3 Cross Over Cable

2.8 Complete a wire map of a 4 Pair UTP cable terminated in different configurations

2.9 Define IDC as Insulations Displacement Connection

2.10 Identify four types of IDC termination devices

2.11 Identify IDC termination procedures using a 66 block

2.12 Identify IDC termination procedures using a 110 Block

2.13 Identify IDC termination procedures using a Krone (LSA) Block

2.14 Identify IDC termination procedures using a BIX Block

2.15 Identify modular patch panel configurations

2.16 Define MAC as Moves, Adds, and Changes

2.17 Identify Screened 4-pair (ScTP) cable

2.18 Identify Modular Jacks and Plugs

2.19 Define termination procedures of ScTP cable on a 66 Connecting Block

2.20 Define termination procedures 25-pair cable of a 66 Connecting Block

2.21 Define termination procedures 25-pair cable on a 110 Connecting Block
Module 3 Safety

Goal: At the completion of this module, students will be able to identify and explain the safety precautions, installation techniques and tools used to install copper-based cabling systems.

Objectives:

3.1 Define Safety as it applies to the Network Cabling Specialist
3.2 Define OSHA and its role in workplace safety
3.3 Identify and explain the safety procedures to be followed for personal protection to protect:
   3.3.1 Head and Scalp
   3.3.2 Eyes and Ears
   3.3.3 Hands and Feet
   3.3.4 Respiratory
   3.3.5 Skin (Hazardous Substances and Poisonous Plants)
   3.3.6 Back
3.4 Identify and explain the safety procedures to be followed at the work site to include:
   3.4.1 Special Instructions
   3.4.2 Special Training
   3.4.3 Restrictions
   3.4.4 Permits
   3.4.5 Work Permits
   3.4.6 Lock-Out procedures
   3.4.7 Access Routes
   3.4.8 Locations of Safety Equipment
3.5 Identify and explain the safety procedures to be followed to prevent electrical hazards to include:
   3.5.1 Function and use of Ground Fault Circuit Interrupter (G.F.C.I.)
   3.5.2 Extension Cords
   3.5.3 Proximity and Hot Work
   3.5.4 Insulated Tools
3.6 Define the importance of Bonding and Grounding electrical circuits and telecommunications devices
3.7 Distinguish between Alternating Current and Direct Current
3.8 Define the purpose of Material Safety Data Sheets when working with hazardous materials
3.9 Identify and explain the safety procedures to be followed when working with tools to include
   3.9.1 Hand Tools
   3.9.2 Power Tools
3.10 Define workspace safety to include:
   3.10.1 Stability Control
   3.10.2 Fall Prevention and Protection
   3.10.3 Ladder Safety
   3.10.4 Scaffolding
   3.10.5 Scissor Lifts
   3.10.6 Barricades
   3.10.7 Crawl Spaces
3.11 Identify and explain the safety procedures and precautions that should be followed for fire prevention and safety to include:
   3.11.1 Location and Access to Fire Alarms
   3.11.2 Emergency
Module 4 Constructing/Testing 4-Pair Cabling Systems

(6.5 hours)

Goal: At the completion of this module, students will be able to construct, test, and troubleshoot 4-pair twisted pair cabling systems. Students use the ACT with DAVE-3™ unit to test cabling systems for shorts, opens, transposals, split pairs, dual lighting LED's, reversals, and map pair to pin configurations.

Objectives:

4.1 Identify the ACT with Dave units
4.2 Identify and define the pair layout and pin assignment illustrated on the ACT with DAVE Banner Board
4.3 Define and correctly interpret DAVE-3 Receiver responses for the following conditions:
   4.3.1 Normal configured cable
   4.3.2 Cable with Reversals
   4.3.3 Cable with an Open
   4.3.4 Cable with a Short
   4.3.5 Cable with Split Pair
   4.3.6 Cable that causes Dual lighting of a DAVE-3 LED
   4.3.7 Cable with Transposals
4.4 Test a ScTP cable using the DAVE-3 test set
4.5 Diagram a wire map for a terminated UTP cabling system
4.6 Define, set up, and use procedures for the 3 blade cable stripper and cable jacket stripper
4.7 Define how to use the 8P8C Crimper
4.8 Given UTP cable, plugs and tools correctly terminate and test a UTP cabling system
4.9 Given ScTP cable, shielded plugs and tools correctly terminate and test a ScTP cable system
4.10 Define Foreign Voltage and how it applies to cabling systems
4.11 Using the ACT panel and the DAVE-3 test set, observe a foreign voltage indication
4.12 Using the ACT panel, configure the jumpers and anticipate and record responses for the following
   4.12.1 Open
   4.12.2 Short
   4.12.3 Reversal
   4.12.4 Transposals
   4.12.5 Transposals with Reversal
   4.12.6 Split Pairs, Dual lighting LED's
Module 5 Troubleshooting/Punching Down of Four-Pair Cabling Systems

Goal: At the completion of this module, students will be able to terminate, punch down and test on 66 and 110 Connecting Blocks, and complete the construction of jacks. Students use the ACT with DAVE™ unit to test and troubleshoot cabling systems and map pair to pin configurations. Students also perform a Tone and Trace of a UTP cabling system.

Objectives:
5.1 Interpret and wire map the DAVE-3 responses for multiple UTP cabling faults
5.2 Using the ACT panel, a 66 Block adapter and bridging clips test a 4-pair UTP cable between a modular jack and a 66 Block
5.3 Using the ACT panel, test a 4-Pair UTP cable between a modular jack and a 110 Block
5.4 Using the ACT patch panel, test a 4-Pair UTP cable between a modular jack and a patch panel
5.5 Using the ACT panel terminate and test a 4-Pair UTP cable on a 66 Connecting Block
5.6 Using the ACT panel terminate and test a 4-Pair UTP cable on a 110 Connecting Block
5.7 Terminate and test a 4-Pair UTP cable on a modular jack
5.8 Using the ACT panel and the DAVE-3 test set, Tone and Trace a 4-Pair UTP cable

Module 6 Coaxial Cable

Goal: At the completion of this module, students will be able to identify, terminate and test coaxial cabling systems that are used in Networking and Telecommunications, and understand their applications.

Objectives:
6.1 Define common coaxial cabling applications in regards to:
   6.1.1 Cable Television Systems
   6.1.2 Cable Modems
   6.1.3 Digital Satellite Systems
   6.1.4 Local Area Networks
6.2 Identify the component parts of a typical Coaxial Cable
6.3 Identify the three most common types of Coaxial Cable connectors as:
   6.3.1 BNC
   6.3.2 F-Type
   6.3.3 N-Type
6.4 Identify the tools used for installing connectors on coaxial cable
6.5 Demonstrate the ability to set the 3 blade stripper to terminate a coaxial cable
6.6 Identify the crimp procedure used to terminate coaxial cable
6.7 Identify the compression procedure used to terminate coaxial cable
6.8 Identify what the crimpers eccentric adjustment is used for
6.9 Identify the steps in coaxial cabling termination process
6.10 Terminate and test an RG-59 coaxial cable system using F-Type connectors
6.11 Test and troubleshoot constructed coaxial cables using the DAVE-3 test set
6.12 Terminate an RG-59 coaxial cable system using BNC connectors
6.13 Identify the steps to terminate quad shield Coaxial Cable with F-Type connectors
6.14 Identify the component parts of a quad shield Coaxial Cable
Module 7 Commercial Cabling Topologies & Standards (2 hours)

Goal: At the completion of this module, students will be able to explain the role of codes and standards and commercial cabling topologies. Students will be able to identify commercial cabling subsystems. Students will also be familiarized with cabling labeling and equipment color code practices. They will be able to distinguish between mandatory and advisory language in codes and standards.

Objectives:
7.1 Define the role of codes and standards in dealing with copper cabling systems
7.2 Identify the standards that pertain to copper cabling in the commercial environment
7.3 Identify the topologies used in commercial cable installation
7.4 Identify the six subsystems of a commercial cabling system as: Entrance facility, backbone cabling, Horizontal Cabling, Telecommunications Room, Equipment Room and work area
7.5 Identify the functions of a telecommunications room.
7.6 Define maximum cable lengths for the various telecommunications link
7.7 Identify the types of cable recommended for commercial applications.
7.8 Identify the main environmental hazards of copper cabling as Mechanical, Ingress, Climate, and Electromagnetic (MICE)
7.9 Given a diagram of a commercial cabling system, identify the backbone cable, main cross connect, intermediate cross connect, horizontal cross connect, first and second level backbone cable and the work area
7.10 Define the role of the National Electric Code as it pertains to copper cabling systems
7.11 Identify mandatory and advisory term in regards to codes and standards
7.12 Given blueprint symbols, identify common copper components in a commercial building
7.13 Define how cables should be labeled
Module 8 Residential Cabling Topologies & Standards

Goal: In this module students are familiarized with the standards that apply to residential copper network cabling in accordance with the EIA/TIA570 standard for both single residences and multi-tenant residences. Students will be familiarized with residential system components and topologies. Students will identify the different grades of residential cabling as set forth in residential standards, as well as structured cabling systems. Students also calculate the cost of parts for a residential installation.

Objectives:
8.1 Identify that the ANSI/EIA/TIA570 is the standard that applies to residential cabling
8.2 Identify the copper cabling types used in residential applications
8.3 Define structured cable
8.4 Identify Smart Home technology systems
8.5 Identify the elements of a single residential cabling system to include:
   8.5.1 Gateway
   8.5.2 Auxiliary Disconnect Outlet
   8.5.3 Outlet Cabling
   8.5.4 Outlets
8.6 Identify the recommended cabling topology used in a residence per TIA/EIA standards
8.7 Define maximum cabling distances recommended for residential applications per EIA/TIA standards
8.8 Given a cabling diagram of a Single Family residence correctly label the copper cabling components
8.9 Identify the elements of a Multi-Dwelling residence to include:
   8.9.1 Entrance Facility
   8.9.2 Main Terminal Space
   8.9.3 Backbone cabling
   8.9.4 Floor serving terminal
   8.9.5 Distribution Devices
   8.9.6 Auxiliary Disconnect Outlets
   8.9.7 Outlet Cabling
   8.9.8 Outlets
8.10 Given a diagram of a Multi-Tenant Residence, correctly label the copper cabling systems components
8.11 Given a cabling and connector price list and a diagram of a home, calculate the cost of materials to complete a cabling job
Module 9 Placement of Copper Cable Systems

Goal: At the completion of this module students will be able to identify cable placement methods and procedures. Students will be able to identify the steps to a successful cable pull as well as the tools and devices required.

Objectives:
9.1 Identify the cable pulling process as Planning, Preparation, Terminating and Testing
9.2 Define how to use a pull string to begin a cable pull
9.3 Identify distance considerations between network cables and power sources when dealing with:
   9.3.1 Transformers
   9.3.2 Electrical service entrances
   9.3.3 High voltage wiring and fixtures
   9.3.4 110 volt wiring
   9.3.5 Conduits
9.4 Describe how to label cabling systems
9.5 Identify types of cable support systems
9.6 Identify the tools used in the placement of Copper cable to include:
   9.6.1 Fish tapes
   9.6.2 Rods
   9.6.3 De-Reelers
9.7 Define minimum bend radius for cable placement
9.8 Define how to pull cable from spools and reels
9.9 Describe the process of pulling four or five UTP or ScTP cables at once
9.10 Define how to pull cable from cartons
9.11 Identify the safety precautions relative to cable pulling
9.12 Describe the process of attaching a pulling cable to a copper cable
9.13 Describe the process of pulling 25 pair
9.14 Describe the process used to complete an installation through a vertical pull
9.15 Describe the process used to complete an installation through a horizontal pull
9.16 Describe the steps to pull a copper cable into a pathway
9.17 Describe how to pull a cable through a conduit
9.18 Describe the usage of raceways
9.19 Describe the limitations for cabling in a conduit
9.20 Describe how to dress an outlet panel or closure
9.21 Describe the importance of Fire Stopping
9.22 Identify the technician’s responsibility concerning fire-stopping materials
9.23 Identify the minimum amount of cable needed to be in place after the cable has been placed in a closure or outlet
9.24 Define how to remove an abandoned cabling system
Module 10 Testing and Troubleshooting Copper-Based Cabling Systems  
(2.5 hours) 

Goal: At the completion of this module students will be able to define cabling system performance parameters and have an understanding of Copper-Based systems testing. Students will be familiarized with copper cabling troubleshooting methods and they will identify solutions to copper cabling faults.

Objectives:
10.1 Define Attenuation
10.2 Identify the signal characteristics of both an analog and a digital system
10.3 Define Insertion Loss and Return Loss
10.4 Identify that noise in a cabling system can be either internally or externally generated
10.5 Define that twisted cable, differential amplifiers, and good installation practices minimize the effects of noise in a cabling system
10.6 Define that signal to noise ratio S/N is the ratio of the signal amplitude to the amplitude of the noise
10.7 Distinguish between Near End Cross Talk (NEXT) and Far End Cross Talk (FEXT)
10.8 Define Wire Map
10.9 Define Cable Length, Propagation Delay and Delay Skew as system features to be tested
10.10 Identify system testing as a three step process that includes:
    10.10.1 Inspection
    10.10.2 Testing
    10.10.3 Documentation
10.11 Define consolidation point and describe what it is used for
10.12 Describe how to test a cable channel and a permanent link
10.13 Given a diagram of an overall copper cabling channel, define the cabling segments and devices
10.14 Describe the Split Half troubleshooting method
10.15 Define that Copper Cabling system performance is based on the following:
    10.15.1 Cable Characteristics
    10.15.2 Installation Techniques
    10.15.3 Connections
    10.15.4 Connecting Hardware
10.16 Define safety requirements in regards to testing a cabling system
10.17 Given a blueprint and price figures, cost out a typical installation
Module 11 Local Area Network Overview (2 hours)

Goal: During this module students are familiarized with workings of Ethernets and Token Ring local area network systems, and review the OSI model. Students also examine the role of media conversion in a network. The standards and practices of wireless networks are also covered.

Objectives:
11.1 Describe how to install a NIC card in a personal computer
11.2 Identify a Local Area Network (LAN), a Wide Area Network (WAN), and a Metropolitan Area Network (MAN)
11.3 Given an example of a network topology, determine if it is a Bus, Star, or Token Ring
11.4 Define Collision as it pertains to networking
11.5 Define Ethernet and Ethernet terms to include:
   11.5.1 Medium
   11.5.2 Node
   11.5.3 Segment
   11.5.4 Frame
   11.5.5 Protocol
11.6 Define Media Access Control (MAC) as it pertains to Ethernet protocol
11.7 Identify the three different parts of a standard Ethernet naming convention
11.8 Define a hybrid network as one that uses both copper and fiber optic media
11.9 Identify the four main reasons that hybrid networks are used as Distance, Interference, Security, and Expense
11.10 Identify that the media used in a network is the first layer of the Open System Interconnect model
11.11 Define wireless work
11.12 Identify that wireless LAN’s solve problems of mobility and installation
11.13 Given a wireless network setup, identify the purpose and function of Ad Hoc or Peer to Peer arrangements and Access points
11.14 Identify the 802.11 standard as the wireless networking standard
11.15 Define the term Wi-Fi
11.16 Identify that Bluetooth is not part of the 802.11 standard
11.17 Identify that most wireless LAN systems use Frequency Hopping or Direct Sequence Spread Spectrum technologies
11.18 Identify that security is a concern associated with wireless network
11.19 Define 3 ways a technician can increase the security of a wireless network

Three part final exam (4 hours)
Introduction to Network Cabling – Fiber Optic-based systems version 3.3

Course Objectives

TOTAL HOURS: 30 hours

Course Description
This course is a short-term but hands-on program that will provide students with the skills and understanding necessary to land employment positions involving fiber optic connectivity as found in commercial and residential applications. Knowledge gained from this program is highly sought-after by professionals in the industry looking to hire entry-level technicians. Students will learn the theory behind fiber optic transmission systems as well as practice sharpening skills required for effective fiber cable termination and splicing. Other topics touched upon throughout the course are cabling standards, cable routing and placement, and the testing and troubleshooting of fiber optic cabling systems.

Certification: Network Cabling Specialist

Module 1 Introduction to Fiber Optic-Based Systems and Safety (2 Hours)
In this module students are familiarized with a course overview and the tools and equipment used to connectorize and splice fiber optic cables. Students are familiarized with the anaerobic method of connectorization. Students will identify the contents of the student consumable kit and will also learn safety concepts concerning personal protection when dealing with Fiber Optics.

Objectives:
1.1 Observe the process for installing Fiber Optic connectors using the anaerobic method and identify key points in the process and the tools used.
1.2 Identify the tools and equipment found in your Fiber Optic Termination Kit to include:
   1.2.1 The termination tray, for left or right hand use, cable management Velcro and pads
   1.2.2 Three fiber optic patch cords
   1.2.3 Buffer tube stripper
   1.2.4 Cable jacket stripper for patch cord
   1.2.5 Cable jacket stripper for building cable
   1.2.6 Crimp tool
   1.2.7 Scribe
   1.2.8 ST/SC polishing bucks
   1.2.9 Scissors
   1.2.10 Screwdriver
   1.2.11 Cable pulling jigs
   1.2.12 Fiber cleaving puck
   1.2.13 Microscope
   1.2.14 SPOT
1.3 Identify applicable safety precautions that pertain to the use of the Fiber Optic Termination
1.4 Given a SPOT (Student Personal Optical Tester) and a Fiber Optic patch cord, determine the continuity of a Fiber Optic cable

1.5 Use a microscope and inspect a fiber connector - record your results

1.6 Identify the contents of the Student Consumable Kit:
   1.6.1 Student manual with CD
   1.6.2 ST connectors
   1.6.3 SC connectors
   1.6.4 Building cable
   1.6.5 Patch cordage
   1.6.6 Mechanical splices
   1.6.7 Polishing films
   1.6.8 Safety glasses
   1.6.9 Alcohol wipes (Small and Large)
   1.6.10 Applicator tips
   1.6.11 Fiber optics disposal disks
   1.6.12 Safety Glasses
   1.6.13 Information Card

1.7 Identify selected items in the Instructor workstation to include:
   1.7.1 Power Meter and Light Source
   1.7.2 Computer based Fiber optic microscope
   1.7.3 Visual Fault Finders
   1.7.4 Blue, Red, IR and White SPOTS
   1.7.5 Mandrel
   1.7.6 IR detector card

1.8 Identify other classroom supplies to include:
   1.8.1 Adhesive
   1.8.2 Primer
   1.8.3 Applicator Disposal Unit

1.9 Describe how to safely use the Disposal Unit

1.10 Describe safety precautions to follow when dealing with fiber optics

1.11 Describe safety precautions to follow when dealing with optical light sources

1.12 Describe personal protection measures that include:
   1.12.1 Head and Scalp
   1.12.2 Ears and Eyes
   1.12.3 Hands and Feet
   1.12.4 Respiratory

1.13 Identify fire protection including a fire extinguisher

1.14 Describe tool safety for both hand tools and power tools

1.15 Describe the safe use of ladders and fall protection

1.16 Define the following terms in regards to safety on a job site:
   1.16.1 Hot Work
   1.16.2 Proximity Work
   1.16.3 Stability Control
   1.16.4 Access
Module 2 Light and Optics

Students will have an understanding of the basics of light to include speed, wavelength, frequency, intensity and attenuation. During this module students will be working with light sensors, emitters and optical power meters in support of module objectives.

Objectives:
2.1 Define the characteristics of light to include: frequency and wavelength, speed, movement and amplitude
2.2 Identify the speed of light as 300,000kps
2.3 Identify that light slows down as it enters air or water
2.4 Identify that the metric system is used for measurements in optics
2.5 Define metric terms to include millimeter, micron, and nanometer
2.6 Identify that scientist’s use scientific notation to work with very large or very small numbers
2.7 Convert numbers using scientific notation
2.8 Given a sine wave, determine a wavelength measurement
2.9 Define the terms: frequency and wavelength
2.10 Describe that the relationship between frequency and wavelength is inversely proportional
2.11 Give examples of devices that use wavelengths and frequencies
2.12 Define the Greek symbol, Lambda, and what it represents
2.13 Define that energy in the Electromagnetic Spectrum is measured by frequency or wavelength
2.14 Identify the parts of the Electromagnetic Spectrum in terms of Radio, Visible, Non-Visible and Microwave
2.15 Compare wavelengths and identify which has the lower frequency
2.16 Identify that red is on one end of the visual spectrum and Violet is on another
2.17 Define the acronym ROYGBIV as the colors of the spectrum
2.18 Given a color of light, identify its wavelength
2.19 Define light as both the visible and the non-visible
2.20 Use an infrared detector and check for the presence of non-visible light
2.21 Identify that white light contains components of all visible wavelengths
2.22 Take part in an experiment and observe and record the results of SPOTs of different wavelengths
2.23 Define light movement in terms of Reflection and Refraction
2.24 Identify that most of what we see is the reflection of light
2.25 Describe how we perceive the color of an object
2.26 Identify incident angle, reflected angle and the normal line in terms of light reflection
2.27 Identify that when light refracts it changes speed and direction
2.28 Define Snell’s Law and give examples on how it applies to reflection and refraction
2.29 Diagram how light reflects off a mirror and indicate which angles provide the strongest reflections
2.30 Given an index of refraction chart, calculate the speed of light in a medium
2.31 Describe which direction a refracted light wave travels when interfacing with materials of different indexes of refraction
2.32 Describe how a Fresnel lens works to refract and focus light
2.33 Define attenuation as loss of light over distance
2.34 Define that attenuation is a ratio, a function of distance and wavelength
2.35 Define that attenuation is measured in Decibels
2.36 Define that decibels are a log expression
2.37 Describe that 3 dB is a doubling of power
2.38 Given a decibel to power conversion chart, determine what percentage of power is lost per dB
2.39 Describe the operation of the power meter and light source
2.40 Observe cautions when using a power meter and light source
2.41 Use the subtractive or zero set method to measure the attenuation of an optical system
2.42 Use a power meter and plot the light intensity of four optical sources
2.43 Take part in an experiment and observe and record the results of light with different wavelengths with an 850nm power meter

Module 3 Light Transmission

This module covers the history and the development of light wave guides. It covers how these systems work, how they are constructed and limitations of optical systems. This module also familiarizes students with cabling types as in mode, core sizes and refractive index properties. Students work with testers and experiment with light attenuation and light dispersion including modal and chromatic. Students learn the sensitivity of optical wave guide systems and the role of a technician in fine-tuning these systems for optimal effectiveness.

Objectives:
3.1 Identify optics technologies and give examples of where they are used
3.2 Given an Infrared detector card and a remote control, experiment with optical transmission and determine a data pattern
3.3 Identify early light experiments and discoveries by John Tyndall and others
3.4 Describe the operation of a fiber scope that is used in medicine and industry
3.5 Identify limitations of transmitting light through glass
3.6 Define opto-electronics and identify types of devices
3.6 Define LASER and LED
3.7 Identify two of the obstacles to fiber optic development as limitations of purer glass and opto-electronics.
3.8 Identify key historical developments in the evolution of Fiber Optics systems
3.9 Identify two of the obstacles to fiber optic development as limitations of glass and wavelengths
3.10 Identify that operational wavelengths of Fiber Optic devices are based on the light handling characteristics of the glass fiber
3.11 Describe attenuation in relation to wavelength used in optic systems
3.12 Define the wavelength of the three ideal zones for optical transmission
3.13 Identify the three parts of a Fiber Optic cable
3.14 Define the purpose of the core, the cladding and the buffer in a fiber optic cable
3.15 Identify common core sizes and give applications for 9μm, 50μm, and 62.5μm
3.16 Describe the light propagation characteristics of both single-mode and multimode cable
3.17 State typical transmission distances for single-mode and multimode Fiber Optic cable
3.18 Using a microscope examine core and cladding
3.19 Diagram and Label your observations
3.20 Define the propagation of light in Fiber Optic systems to include: reflection, total internal reflection, refraction and index of refraction and angle of acceptance
3.21 Identify the characteristics of light propagation of stepped index and graded index
3.22 Define cone of acceptance as it pertains to optical systems
3.23 Define dispersion to include modal and chromatic dispersion
3.24 Experiment, determine and report on modal dispersion
3.25 Identify plastic optical waveguides and state its uses
3.26 Define glass as having properties of a liquid
3.27 Define inside and outside vapor deposition as the way optical fiber is manufactured
Module 4 Fiber Optic Systems

At the completion of this module students will have an understanding of the operation and characteristics of optical systems including Sources and Detectors used in Fiber Optic systems. Students will be able to match systems in regards to sources, detectors and cabling systems. Students will calculate an optical loss budget.

Objectives:

4.1 Give examples of light communication systems in the typical home or school
4.2 Define FiOS as a residential optical connectivity system
4.3 Define the parts of all communications systems
4.4 Identify the role of the transmitter, receiver, message and medium
4.5 List some of the advantages and disadvantages of fiber optic systems
4.6 Identify the three main elements of an Optic communications system and briefly explain the function of each
4.7 Define transducer and give an example
4.8 Define encoding and decoding and give examples
4.9 Define binary as it applies to encoding and decoding
4.10 Define types of data transmission to include analog and digital
4.11 Describe the following types of transmission systems and identify advantages and limitations: amplitude modulation, frequency modulation and digital
4.12 Identify sources and detectors as they apply to fiber optic transmission systems
4.13 Identify desired characteristics of sources
4.14 Describe common sources to include: LED, VCSEL and LASER diode
4.15 Compare and contrast the different types of sources as to: Application Cost and Operation
4.16 Identify cabling types used with various sources
4.17 Identify safety procedures to be followed when working with sources
4.18 Identify common detectors and their application
4.19 Define PIN diode and APD
4.20 Describe characteristics of sources and their application
4.21 Match a source to the correct cable and detector
4.22 Define an optical power budget and why it is important
4.23 Describe the term over head as it applies to a light budget
4.24 Define dynamic range
4.25 Calculate with negative and positive dBm readings and determine a dynamic range
4.26 Identify that when working with exponents and logarithmic numbers that subtracting is actually dividing
4.27 Given charts that describe attenuation values for connectors, splices and cables calculate an optical system loss
4.28 Calculate an optical light budget and determine if components will work with sufficient overhead
4.29 Define detector saturation as too much light at the detector
Module 5 Terminating Fiber Optic Cable

In this module students will terminate both SC and ST fiber optic connectors to either 900um buffered fiber or patch cordage. Students will identify the steps of termination in the construction and testing of optical patch cords. Safety procedures are reinforced in the establishment of safe laboratory procedures. Students will determine dB light loss of the systems they construct and compare their results to known good systems.

Objectives:

5.1 Identify safe practices with dealing for fiber optics in regards to personal safety measures and how to dispose of optical fibers and applicator tips

5.2 Identify the tools used in the Fiber Optic Termination Process

5.3 Demonstrate how to correctly and safely use the tools of termination to include:

5.3.1 Crimpers
5.3.2 Scissors
5.3.3 Buffer Stripper
5.3.4 Jacket Stripper
5.3.5 Cleaver
5.3.6 Termination Tray

5.4 Define anaerobic as an adhesive method that only cures where there is no air

5.5 Identify the parts of the epoxy as the adhesive and the primer

5.6 Correctly apply epoxy to connect a fiber to a fiber connector

5.7 Define the 10 steps and the sub-steps in the optical termination process

5.8 Demonstrate the correct use of eye protection while terminating fiber

5.9 Demonstrate the correct procedure for the disposal of loose fiber ends removed during cleaving

5.10 Demonstrate how to correctly dispose of an adhesive applicator tip

5.11 Identify the parts needed to construct four types of patch cords

5.12 Demonstrate the ability to measure and cut optical systems at 5, 15 and 30mm

5.13 Use a checklist and correctly terminate an ST connector to 900um buffered cable

5.14 Use a checklist and correctly terminate an ST connector to Patch Cordage

5.15 Use a checklist and correctly terminate an SC connector to 900um buffered cable

5.16 Use a checklist and correctly terminate an SC connector to Patch Cordage

5.17 State the safety procedures to follow when working with fiber optic cable

5.18 Demonstrate the ability to cleave and polish optical glass

5.19 Identify the cleaving process as scoring then breaking glass in a controlled manner

5.20 Correctly air polish a cleaved glass

5.21 Correctly use polishing films as sequence to obtain a desired result

5.22 Use a microscope to determine the quality of polishing on a 125um fiber

5.23 Perform a continuity check on a constructed cable

5.24 Correctly create an optical test station using an optical power meter and light source, adapters and 5.24 known good cables

5.25 Measure the light loss in dB of a constructed fiber optic cable using a reference or ratio method

5.26 State the standards-based attenuation values for fiber optic terminations

5.27 Compare standards dB values, known good dB values and constructed dB values to determine the quality of a constructed system
Module 6 Fiber Optic System Components

At the completion of this module, students will be able to identify and describe the purpose of the components used in Fiber Optic Cabling systems. These components include connectors, adapters, splices, enclosures and outlets. Students will define all parts of each of the components and state their applications. Activities in this module include splicing of a fiber optic cable and constructing an optical patch cord using pre-polished connectors.

Objectives:

6.1 Identify the five optic system components to include:
6.2 Connectors, Adapters, Splices, Enclosures and Outlets
6.3 Identify different types of optical connectors and their applications
6.4 Define Small Form Factor and give examples
6.5 Identify the difference between simplex and duplex connectors
6.6 Identify multi-connectors and layouts
6.7 Identify the standard connector color coding for single mode and 50/125 types of multimode and standard 62.5/125 optics
6.8 Identify the attributes of Physical Contact connections and the amount of interface reflection as measured in Decibels
6.9 Identify the attributes of Angled Physical Contact connections and the amount of interface reflection as measured in decibels
6.10 Define systems that do not require adhesives or polishing
6.11 Observe a demonstration and define how to construct a connector using the Crimp and Cleave method
6.12 Observe a demonstration and define how to construct a connector using the Thread-Lock method
6.13 Observe an instructor led demonstration for installing a pre polished connector and identify the key steps involved
6.14 Construct a patch cord using a pre polished connector
6.15 Define adapter and give examples
6.16 Define hybrid adapter and give examples
6.17 Identify the use of fan outs
6.18 Describe mechanical splicing
6.19 Describe fusion splicing
6.20 Define 60dB as a one to one-million ratio
6.21 Define the parts of an ultra-splice
6.22 Define the need for the protection of Fiber Optic Cables and splices.
6.23 Define the characteristics of splice closures
6.24 Identify commonly used splice closures
6.25 Observe an instructor led demonstration of a mechanical splice and identify the key steps involved
6.26 Demonstrate the ability to safely and correctly apply a mechanical splice to a fiber optic cable
6.27 State acceptable attenuation values for both fusion and mechanical splices.
6.28 Using a light source and power meter, test a newly constructed mechanical splice for acceptable attenuation
6.29 Identify the characteristics of fiber optic enclosures, cabinets, outlets and faceplates
Module 7 Commercial Cabling Topologies and Standards

In this module students are familiarized with the standards that apply to Fiber Optic network cabling. They will identify and define commercial LAN topologies, blueprint symbols and standard application processes. Students will be familiarized with standard terminology and accepted industry procedures.

Objectives:
7.1 Define the role of codes and standards in dealing with Fiber Optic cabling
7.2 Identify that the National Electric Code is designed to protect individuals and property
7.3 Define the difference between both mandatory and advisory terms used in standards
7.4 Identify a Fiber Optic cable as conductive, non-conductive or composite as defined by the National Electrical Code
7.5 Identify types of cables and their applications to include: Plenum, Riser, General Purpose and Restricted Application
7.6 Given a Cable Substitution chart correctly identify a substitution
7.7 Define the purpose of cable foot markers
7.8 Given the Fiber Optic color code for Fiber Optic cables identify a fiber by its number, color and bundle
7.9 Identify a Fiber Optic cable type by its labeling
7.10 Define IFC cable as intra-facility cable and state uses and construction
7.11 Define OSP cable as Outside Plant cable and state uses and construction
7.12 Identify the aspects of both loose and tight buffer fiber optic cable
7.13 Given a cable comparison chart indicate the uses and limitations of tight buffer and loose tube cabling types
7.14 Identify the cabling topology used in commercial fiber optic cabling.
7.15 Define Moves, adds, and Changes in regards to cabling.
7.16 Identify the six subsystems of a commercial cabling system as; Entrance facility, Backbone cabling, Horizontal Cabling, Telecommunications Room, Equipment room and Work area.
7.17 Given a diagram of a Fiber Optic cabling system in a commercial building identify the backbone cable, main cross connect, intermediate cross connect, horizontal cross connect, first and second level backbone cable and the work area outlet.
7.18 Identify the types of cabling recommend for commercial applications.
7.19 Identify the blue print symbols used to identify outlets, cables, and spices.
7.20 Define how cables should be labeled
7.21 Define how telecommunications equipment is color coded in an equipment room
Module 8 Residential Cabling Topologies and Standards  
(2 hours)
In this module students are familiarized with the standards that apply to residential Fiber Optic network cabling in accordance with the TIA 570 standard for both single residences and multi-tenant residences. Students will be familiarized with residential system components and topologies. Students will identify the different grades of residential cabling as set forth in residential standards as well as structured cabling systems. Students also calculate the cost of parts for a residential installation.

Objectives:
8.1 Identify the two different grades of Fiber Optic cable used in residential applications.
8.2 Define structured cable.
8.3 Identify Smart Home technology systems.
8.4 Identify the elements of a single residential cabling system to include:
  8.4.1 Gateway
  8.4.2 Auxiliary Disconnect Outlet
  8.4.3 Outlet Cabling
  8.4.4 Outlets
8.5 Identify the recommended Fiber Optic cable used in residential applications.
8.6 Identify the recommended cabling topology used in a residence per TIA/EIA standards.
8.7 Given a diagram of a Single-Family residence correctly label the Fiber Optic cabling components.
8.8 Define maximum cabling distances recommended for residential applications per TIA/EIA standards.
8.9 Identify the elements of Multi-Tenant residences to include:
  8.9.1 Entrance Facility
  8.9.2 Main Terminal Space
  8.9.3 Backbone Cabling
  8.9.4 Floor Serving Terminal
  8.9.5 Distribution Devices
  8.9.6 Auxiliary Disconnect Outlets
  8.9.7 Outlet Cabling
  8.9.8 Outlets
8.10 Given a diagram of a Multi-Tenant Residence correctly label the Fiber Optic components.
8.11 Given a cabling and connector price list and a diagram of a home, calculate the cost of materials to complete a cabling job.

Module 9 Placement of Fiber Optic Cable  
(2 hours)
In this module students are familiarized with the pulling and placement of Fiber Optic cabling. Also included in this module are tool usage, cable pulling terminology, safety and considerations in Fiber Optic cable pulling. Students are also familiarized with Fire Stopping and their responsibilities concerning fire stopping when pulling Fiber Optic Cable. Students will configure a pulling jig and set it up to pull cable.

Objectives:
9.1 Identify the cable pulling process as Planning, and Preparation, Pulling, Terminating and Testing.
9.2 Define minimum bend radius for both cable storage and cable placement.
9.3 After viewing a Lab Splice demonstration identify the correct procedure for testing a Fiber Optic roll of cable using splices and a light source.
9.4 Identify the tools used in the placement of Fiber Optic cable. (Fishtapes and Rods, De-Reelers.)
9.5 Identify the safety precautions relative to cable pulling.
9.6 Given a pull string, correctly attach it to a building cable and prepare it for pulling.
9.7 Describe the process of attaching a pulling cable to a Fiber Optic cable's strength yarns.
9.8 Describe the process used to attach the mesh grip and swivel.
9.9 Describe the process used to complete an installation through a vertical pull.
9.10 Describe the process used to complete an installation through a horizontal pull.
9.11 Describe how to pull a cable through a conduit.
9.12 Describe the limitations for cabling in a conduit.
9.13 Describe the steps to pull a Fiber Optic cable into a pathway.
9.14 Describe the steps to pull a Fiber Optic cable into a ladder.
9.15 Identify types of cable support systems.
9.16 Describe how to dress an outlet panel or closure.
9.17 Describe the usage of raceways.
9.18 Describe the technician's responsibility concerning fire-stopping materials.
9.19 Describe the importance of Fire Stopping.
9.20 Identify the minimum amount of cable needed to be in place after the cable has been placed in a closure or outlet.

Module 10 Testing and Troubleshooting Fiber Optic Cabling Systems

Module 10 Testing and Troubleshooting Fiber Optic Cabling Systems (3 hours)

After completion of this module students will be able to identify the correct steps in accordance with standards in completing Fiber Optic testing using the Power Meter and Light Source and OTDR. Students will be able to identify correct procedures in testing Fiber Optic segments.

Objectives:
10.1 Identify that the key considerations that affect a Fiber Optic system are:
   10.1.1 Fiber optic cable,
   10.1.2 All connectors and Splices
   10.1.3 Strength of source signal
   10.1.4 Detector sensitivity
10.2 Identify the importance of using a Mandrel when checking short cable runs.
10.3 Define how to take a power and loss measurement using the Power Meter and Light Source.
10.4 Identify the passive and active parts of a Fiber Optic System.
10.5 Define Tier 1 is required and it uses a optical power meter and light source
10.6 Define Tier 2 testing as the use of an ODTR
10.7 Identify the 5 testable link segments in Fiber Optic systems.
10.8 Identify the considerations given when testing Centralized links, First and Second Level Backbones and Horizontal Links.
10.9 Identify testing procedures using the one, two and three cabling methods.
10.10 Read an OTDR display and determine events and distances
10.11 Identify OTDR controls and features
10.12 Describe pulse with in relation to resolution
10.13 Define the importance of keeping records when testing an optical system.
9.3 After viewing a Lab Splice demonstration identify the correct procedure for testing a Fiber Optic roll of cable using splices and a light source.
9.4 Identify the tools used in the placement of Fiber Optic cable. (Fishtapes and Rods, De-Reelers.)
9.5 Identify the safety precautions relative to cable pulling.
9.6 Given a pull string, correctly attach it to a building cable and prepare it for pulling.
9.7 Describe the process of attaching a pulling cable to a Fiber Optic cable’s strength yarns.
9.8 Describe the process used to attach the mesh grip and swivel.
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10.10 Read an OTDR display and determine events and distances
10.11 Identify OTDR controls and features
10.12 Describe pulse with in relation to resolution
10.13 Define the importance of keeping records when testing an optical system
10.14 State the rules of Optical Testing
10.15 Define the Split-Half method of troubleshooting Fiber Optic links.
10.16 Identify the things to look for when troubleshooting an optical system
10.17 Describe the effects of cabling mismatches in regard to core size, cable ellipticity and core eccentricity.
10.18 Define the importance of correct fiber alignment.
10.19 Identify the four items that account for connector insertion loss.
10.20 Define the purpose of the Visual Fault Locator.
10.21 Define the purpose of the Optical Time Domain Reflectometer (OTDR).
10.22 Identify testing and troubleshooting procedures in regards to the active components of a Fiber Optic System.
10.23 State the purpose of following Electro Static Discharge (ESD) precautions when dealing with sources and detectors.
10.24 Complete an optical troubleshooting scenario

Three part final exam

(3 hours)
Looking Beyond the Obvious for Job Creation
LOOKING BEYOND THE OBVIOUS FOR JOB CREATION: WORKFORCE DEVELOPMENT
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on them.

BAU-144
C-Tech has worked closely with New York City Schools under a professional services contract for Career and Technical Education to enhance outcomes for teachers and students.

Leviton and C-Tech collaborated on the Smart Home professional certification to address the demand for skilled workers in audio/video and energy management technologies.

C-Tech assisted in the development of the Network Cabling Training Achievement Record (TAR).

Initial industry collaboration resulted in an effective delivery system for workforce development applications.

Established standardized model for behind-the-wire training which has expanded to 29 states.

BICSI provides Continuing Education Credits on each C-Tech certification and verifies content as current on a regular basis.

C-Tech designed and manufactured network test devices for IBM under private label.

Delivered 21st century training to developing Nations including Ethiopia.

The IBEW and C-Tech designed training aids in response to the increased demand for low-voltage skilled electrical workers.

C-Tech is currently conducting a research-based project to determine the impact of alternative education for Native American populations.
C-Tech Connects
Coast to Coast

Short-Term Training for Long-Term Careers™

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C-Tech Specializes in
Telecommunications Education

We provide interactive, short-term training systems to give students the opportunity to start a career that lasts a lifetime.

Over 66,000 certificates issued
39 states
90% certification

C-Tech
“To develop training for people of all ages and backgrounds, both in and out of school or work, that provides the necessary foundation for meaningful career opportunities.”

Company Summary

Who is C-Tech?
C-Tech was established in 1992 as a designer and manufacturer of private-label telecommunications test equipment and training aids. We have developed products for AT&T, IBM, Tyco (AMP Division), and the National Joint Apprenticeship Training Committee (IBEW). In 1995, C-Tech introduced our first training system, featuring our patented Advanced Cable Trainer. Our purpose was to deliver the most advanced short term (40 hrs) technology program, incorporating an educationally sound methodology and skill based activities, addressing this need in the education market.

What is the role of C-Tech?
C-Tech enables Institutions and their Instructors, regardless of their experience, to successfully deliver up-to-date “standardized” vocational programming to virtually any student while delivering an industry-recognized certification. C-Tech continually maintains updated curriculum content using our many industry and workforce partnerships.

What sets C-Tech apart from other programs?
C-Tech is not just a book; rather it places the student in a real-world environment fortified by a step by step approach to understanding the subject. Students work in a cooperative learning environment where they are presented authentic issues covering everything from theory to practice, as well as testing and troubleshooting problems. Administrators and Teachers benefit from a comprehensive and standardized curriculum including: lesson plans, quizzes, chapter tests, as well as the final exams. This enables the teacher to focus on teaching and assisting students. Teachers participate in a short train-the-trainer session on utilizing our programs where they are evaluated and certified. C-Tech continues supporting our programs with scheduled updates and on-going technical and curriculum support. Furthermore, our programs and training can take place in any standard classroom, eliminating the cost for special construction or dedicated classrooms.

What are C-Tech Program Results?
C-Tech has consistently maintained a 98% completion rate and a 90% certification rate. These statistics are calculated from the testing results submitted by over 500 customer sites, commencing in 1995. Both males and females, youth and adult students are included from: secondary, post-secondary, juvenile, and adult corrections, as well as community and faith based organizations. Through the delivery of these programs by our training partners, we are changing lives.

What fields of employment do the programs apply to?
A recent survey of our customers indicates that their students are utilizing these skills to obtain jobs in a broad range of fields. Connectivity stretches from Starbucks to Southwest Airlines and just about every market in between. In a relatively short time communications has gone from a telephone to an iPad and from a wired network to ‘the cloud’. All indications are that we are only at the threshold of even more explosive growth in this technology. This fact was made clear by John Chambers, CEO of CISCO Systems, who recently stated “Currently there are 10 billion connections in the USA and by 2020 this will rise to 50 billion connections”. This is the opportunity you can provide to your students by becoming a C-Tech Certified Training Facility today.
Market for Technology and Telecommunications Technicians

The world is sending and receiving data, voice, and video signals 24/7. These transmissions revolve around virtually every aspect of our lives. Transmissions cannot take place without connectivity, which is a critical aspect of telecommunications technology. The need for these transmissions creates hundreds of thousands of new jobs for the future. Networks utilize wire, light, and air as mediums to transmit data, voice, and video signals. Jobs are available in virtually every industry worldwide, supporting everyday activities.

Local Area Networks (LAN) and Wide Area Networks (WAN) support a broad range of devices including:
» PCs
» Telephones
» TVs
» Lighting
» HVAC
» Cellphones
» Tablets

New network applications, products, and services will continue to create tens of thousands of jobs and viable career paths for individuals possessing these mid-level skills, such as those offered through C-Tech training. A spike in growth will occur, as an even greater demand for these technicians is created resulting from broadband, the Smart Grid, and telemedicine.

Currently, there are 10 billion connections in the US
By 2020, this will rise to 50 billion connections
Which could result in a 400% increase in telecommunications jobs
Telecommunications accounted for 864,100 of employed persons in August 2013.

"The dirty little secret of wireless is that there's not much wireless in wireless."
—Ernie Carey, Senior Vice President-construction and engineering, AT&T

As the worldwide use of networks continues to expand, employers are in need of local technicians capable of installing, testing and servicing; copper, fiber and wireless transports, along with a host of new devices requiring connectivity. This requires a shift in our knowledge-based economy from "knowing that" to "knowing how." C-Tech's programs clearly articulate the career pathway needed for students to progress toward gainful employment.

EMPLOYMENT OUTLOOK: Industry Employment and Output Projections to 2020
Bureau of Labor Statistics - Richard Henderson
The communication equipment manufacturing industry is projected to increase its real output from $42.8 billion in 2010 to $105.7 billion in 2020. The increase of more than $42.8 billion, or 5.3% per year, makes this one of the fastest growing industries.

Median Pay (per hour):
Line Installers and Repairers - $26.10
Telecommunications Equipment Installers and Repairers (except line installers) - $26.30
Home Entertainment Equipment Installers and Repairers - $15.84
Electrical and Electronics Installers and Repairers - $23.64
The Job Market is Expanding

Electrical & Electronics Repairers
Commercial and Industrial Equipment
Repairs, tests, adjusts, or installs electronic equipment, such as industrial controls, transmitters, and antennas.

70% of electrical contractors worked in power quality, communications systems/connectivity and automation/controls, while

61% performed communication systems/connectivity work, with structured wiring and cabling mentioned most often

$26/HR* $53,250 Average Annual Salary

Electronic Entertainment Equipment Installers & Repairers
Repair, adjust, or install audio or television receivers, stereo systems, camcorders, video systems, or other electronic entertainment equipment.

$18/HR* 1,140 Projected Annual Job Openings

The #1 Job to fill in the US in 2013 was Technician

Telecommunications Equipment Installers & Repairers (except Line Installers)
Install, set-up, rearrange, or remove switching, distribution, routing and dialing equipment used in central offices or head ends. Service or repair telephone, cable television, Internet, and other communications equipment on customers' property. May install communications equipment or wiring in buildings.

3,820 Projected Annual Job Openings
$26/HR* 217,200 Currently Employed

Source: The American Job Center Occupations Information website 2014 • Average hourly income
The C-Tech Pedagogy and Certification

C-Tech programs are designed using a variation of the Smith-Regan constructionist learning model. Concepts are introduced, reinforced and mastered through the use of activities, both hands-on and written. Multiple learning styles are addressed through the use of graphics, charts and hands-on activities that help to redefine mental models in line with course requirements. Students work in collaborative teams to master key concepts, fostering life-long learning strategies through the use of authentic, technology-based learning situations, job-readiness skill preparation, career awareness and job progression overviews. C-Tech programs have also been active in attracting more females into the technology field, certifying females at almost three times the national average. Thus, the local Certified Training Facility (CTF) produces a qualified and competitive worker, possessing specific skills. CTFs also reduce the employers cost of training these technology-based workers - "The Missing Link."

C-Tech's management and development teams have met with leading telecommunications suppliers throughout the U.S. and other countries. They continue to confirm that C-Tech Training not only provides access to an in-demand labor pool, but also effectively reduces internal training by six to eight weeks. We are hearing increasing reports from CTFs that local telecommunications companies are interviewing and offering to hire entire C-Tech classes, many from technical colleges.

Conversations with top level HR staff at a number of companies, including Verizon, Cox, AT&T and Comcast, reveal that they cannot find enough applicants capable of passing their initial technology screening test, given prior to an interview. They are also stating because of increased demand along with higher costs for training, they are experiencing a 60% or higher call-back rate within their direct and 3rd party field technical operations. This is occurring at a time when installations are still increasing, re-organizations are occurring and competition is on the rise. They are in need of appropriate middle-skill level training programs that can be delivered locally to current and prospective workers.

To gain certification, candidates are required to earn an 85% (C-Tech weighted average) as an overall grade for each module test and three-part final examinations. All final exams have both a hands-on and a written component.
Technology Education Track

Master of Science
Bachelors' Degree
Associates Degree
Employability
Energy Management
Audio/Video Systems
Telephone Systems and VoIP
Fiber Optic-Based Networks
Copper Based Networks
Telecommunication Foundation
Communications Pathways Series

CTE "Hello?"
C-Tech Certified Training Occupations

Master of Science
- Network Engineer
  - 6 years
- Associates Degree
  - Network & Computer Systems Administrator
    - 2 years
  - Smart Home Professional - Energy Management
    - 230 hours
  - Voice Communications Professional - VoIP
    - 150 hours
  - Network Cabling Specialist - Copper
    - 80 hours
  - Security & Fire Alarm Systems Installers
  - Applied Systems Integration
  - Grounding & Bonding
  - Copper Connectivity

Bachelors Degree
- Computer Specialist
  - 4 years
- Employability
  - Supervisors of Installation, Maintenance & Repair Workers
  - Sales Rep., Wholesale & Manufacturing Technology
  - Smart Home Professional - Audio/Video Entertainment
    - 240 hours
  - Network Systems & Data Communications Analyst
    - 180 hours
  - Telecom Equipment Installers & Repairers
  - HVAC Mech. & Installers
    - 110 hours
  - Computer Support Specialist
  - Procurement Clerk
  - Parts - Salesperson
  - Customer Service Representative
  - Helpers - Electrician
  - Helpers - Installation, Maintenance, & Repair
  - Retail - Sales

Annual Wages
- 100 K
- 90 K
- 80 K
- 70 K
- 60 K
- 50 K
- 40 K
- 30 K
- 20 K

USDOL Standard Occupational Classifications, Related Industry Credentials & Higher Education with completion times
Program Skill Sets

The following C-Tech course descriptions can provide a better comprehension of the goals and objectives of each program being evaluated for the pilot.

Communications Pathways Series (CPS™)

**Telecom Evolution**
- Define Telecommunications, the communication process and the four elements involved in the process.
- Describe early communications systems that did not use electronics, the history of the telephone and how it works.
- Define noise in a communication channel.
- Explain encoding and decoding as it pertains to the communication process.
- Identify a telegraph, understand how it works and its limitations.
- Design a coded communication system.
- Describe and identify the correlation between electricity and magnetism.
- Define headroom and calculate cable loss.
- Define safety rules to be used when working with tools and cable.
- Construct and understand all principles of a TAP, including how it will operate, limitations, and necessary modifications to send and receive messages.
- Identify a cable by pair, color and tip or ring, and define the two pair color code.
- Identify the parts of the RJ-11 plug, cutter, stripper, and crimper, and terminate a two-pair cable with RJ-11 plugs.

**Connectivity Conquest**
- Define early communications equipment, the development of network technology, and the “Physical Layer”.
- Develop a Flow Chart for a simple process and complete a maze.
- Explain that continuity does not assure the correct configuration.
- Identify the 568A and 568B wiring configurations for network connectivity devices.
- Define the wiring color code, a pair by its color, a pair tip, and rings for four pair cabling systems.
- Draw a wire map showing Straight Through and Cross Over cable configurations.
- Define that connecting blocks use Insulation Displacement Connectivity IDC technology.
- Identify if a 66 Connecting Block is split or non-split.
- Define cable punchdown sequences and standardized cable routing methodologies for 66 and 110 connecting blocks.
- Define Demarcation Point in regards to a cabling system.
- Identify that a patch panel facilitates Moves, Adds and Changes (MAC).
- Identify a face plate as multimedia or modular outlet.
- Define the importance of checking for Foreign Voltage in a system before working on it.
- Draw block diagrams and test four pair UTP, Coaxial Cable, and Fiber Optic cabling systems.
- Perform a “Tone and Trace” on a cabling system , and an optical continuity test on a Fiber Optic system.
- Develop a work around solution for a malfunctioning cabling system
- Explain how to use a cabling tester.
Mission Breakout
- Define early developments in Data Transmission systems.
- Identify early telephone terminology and the evolution.
- Identify, configure, and test a 4 pair unshielded twisted pair cable for a data network.
- Safely and correctly terminate a unshielded twisted pair cable with RJ-45 plugs.
- Identify the American Wire Gauge and use a wire guide chart to identify the size of a wire.
- Define Continuity and Configuration
- Identify the pair-to-pin configurations for both the 568A and 568B standard.
- Identify and test for the presence opens, shorts, reversals, transposals and split pairs as they apply to network cabling systems.
- Explain how to make a patch cord.
- Define crosstalk and explain crosstalk and noise reduction techniques.

Expedition Fiber
- Identify early experiments in light transmission.
- Describe the evolution of fiber optic cable, identify its parts, and explain how it is manufactured.
- Define safety considerations that must be observed when dealing with fiber optic cable and light sources.
- Identify a connector as either a Single Tip (ST) or a Snap Couple (SC).
- Identify a cable as either single mode or multimode by using the handheld microscope.
- Given the C-Tech color code card, identify a cable by its color and bundle.
- Define the importance of the National Electric Code as it pertains to fiber optic cable.
- Identify a term as either Mandatory or Advisory when dealing with national codes and standards.

Spectacular Spectrum
- Identify the three main elements of a light communications system and define the function of each.
- Define transducer and give an example.
- Describe the development of light transmission systems, the absorption of light, and light scattering.
- Define attenuation as it pertains to an optic system and the method of measurement.
- Define light in regards to speed, wavelength and frequency and identify early light experiments.
- Understand frequency and wavelength.
- Define visible light and where it occurs in the electromagnetic spectrum.
- Define the parts of the C-Tech power meter and light source and use it for both zero set and subtractive attenuation measurements.
- Use scientific inquiry methods to predict, log, and observe the rates of attenuation for two different lengths of plastic fiber optic cable.

Light Voyagers
- Define the difference between reflection and refraction, and understand total internal reflection.
- Define the parts of the LASER Student Personal Optical Tester (LSPOT), and establish safe lab procedures.
- Build a simulated fiber optic transmission system and determining angles of incidence and reflection.
- Define cone of acceptance as it pertains to fiber optic transmission systems.
- Identify that index of refraction is an indication of the speed of light in different mediums.
- Perform a continuity test using a light source and a fiber optic cable.
- Observe a Macro Bending/Modal Dispersion demonstration and identify the effects on the higher order modes of light in a fiber optic transmission system.
- Identify two higher order modes of light cancellation techniques.
- Correctly configure a fiber optic cable on a Mandrel and on a six-stage attenuator.
- Conduct a Scientific Inquiry - predict, observe, log and present the results of a modal dispersion activity using the C-Tech Optical Simulator, the mandrel and the six stage attenuator.

**Green Technology Systems**
- Define green, carbon footprint, and green applications.
- Compare residential and business energy usages per system.
- Define the role of the ozone layer.
- Understand the Green House Effect and develop a Green Action Plan.
- Identify the rules and types of energy and understand how energy can be transformed to electricity.
- Define alternating current and direct current as two types of electricity.
- Define kWh and calculate a typical energy bill.
- Understand how to read an electric meter and determine energy used.
- Describe the operation of the energy generation systems and identify the roles of each part.
- Define energy savings measures and other Green applications individuals can accomplish.
- Examine an energy breakdown chart of home electricity usage which determines consumption.
- Define the four types of Green Proactive systems and the three parts of a typical automation system.

**C-Tech Certified Training Programs**

Each program is based on a 7th grade reading and math level, and takes approximately 30 – 40 hours to complete.

**Introduction to Telecommunications**

**Certification: Telecommunications Technologies (TT)**
- Understand the telecommunications process and the terminology involved.
- Able to explain the basic operation of networks, telephones, fax machines, television systems and cellular telephones.
- Awareness of the commercial applications of telecommunications devices.
- Can determine typical bandwidths of physical layer media including: Cable, DSL, BPL and Wi-Fi.
- Can identify two-pair, four-pair UTP, Coaxial and Fiber Optic cabling and associated connectors and IDC devices.
- Can determine signal flows and connectivity in actual telecommunications devices while referencing block diagrams.
- Can determine both continuity and configuration of cabling systems using both copper and fiber optic testers.
- Understand the basics of troubleshooting and can develop work around solutions to system faults.
- Awareness of safety in regards to working on a job site and personal protection measures.
- Can define the importance of obtaining and maintaining skill currency.

**Course Length: minimum 40 Hours**
Network Cabling: Copper-Based Systems

Certification: Network Cabling Specialist - Copper (NCS)
- Can install, test and troubleshoot copper systems in accordance with EIA/TIA standards including residential and commercial installations.
- Know network topologies for commercial and multi-unit dwellings to include the role of backbone cabling, horizontal cabling, and telecommunications rooms and interconnects.
- Demonstrated ability to use tools including: cutters, strippers, crimpers and punch down tools
- Has the ability to test and certify copper cabling networks.
- Conversant in on-the-job safety rules and regulations to include personal protection, GFCI’s, stability control, grounding and bonding and the use of uninterruptible power supplies.
- Can pull, install, terminate and test 4-Pair cabling faults in the 568A and B configurations, including wire mapping and tone and trace.
- In-depth knowledge into types and uses of cabling and the ability to connectorize UTP, STP and Coaxial cabling systems in the F-Type and BNC style.
- Can punch down and test 4-Pair cable on both 66 and 110 blocks.
- Familiarized with all IDC technologies to include Krone and Bix systems.
- Can determine bandwidths and applications of various types of cabling systems.
- Understand the technician’s role in regards to Fire Stopping techniques.
- Can correctly use cabling testers, toners, breakouts.

Course Length: minimum 40 Hours

Network Cabling: Fiber Optic-Based Systems

Certification: Network Cabling Specialist - Fiber Optic (NCS)
- Ability to install, test and troubleshoot copper and fiber optic cabling systems in accordance with EIA/TIA standards including residential and commercial installations.
- Understanding of the theory of light transmission systems and how to optimize system performance.
- Ability to distinguish advisory and mandatory terms in accordance with published standards.
- Knowledge of network topologies for commercial and multi-unit dwellings to include the role of backbone cabling, horizontal cabling, and telecommunications rooms and interconnects.
- Demonstrated ability to use tools including: cutters, jacket strippers, crimpers, polishing pucks and microscopes.
- Ability to test and certify fiber optic cabling networks.
- Conversant in on-the-job safety rules and regulations to include personal protection, GFCI’s, stability control, grounding and bonding and the use of uninterruptible power supplies.
- Conversant with the fiber optic color code, various types of fiber optic cable, including tight buffer, loose tube, conductive, non-conductive, and composite.
- Ability to pull, install, terminate and test fiber optic cable
- Ability to determine bandwidths and applications of various types of cabling systems.
- Ability to calculate fiber optic loss budget in dB and identify maximum light loss through connectors, cables and splices and can insure sufficient light overhead in dB.
- Familiarity with time domain reflectometers and can troubleshoot a fiber optic installations using visual fault finders

Course Length: minimum 30 Hours
Introduction to Telephone Systems and VoIP
Certification: Voice Communications Professional (VCP)
» Install and test telephone key systems, then troubleshoot and correct any problems to ensure proper system operation.
» Correct and safe usage of tools and testers.
» Understand the differences and similarities between dial tone generation, Key versus PBX and ISDN versus DSL.
» Work in an enhanced Tip and Ring environment.
» Setup and configure Music on Hold and contact closures.
» Read a Station Message Detail Report (SMDR) and determine exact usage and time of calls of all station telephones to determine billing and call trends.
» Perform station programming of each telephone system as determined by using entity.
» Perform system programming as the system administrator.
» Program voice mails and passwords for each system user, and automated attendants per customer wishes.
» Set up an entire key system response in regards to hunt groups and call center functions.
» Train the system administrator and station operators as to telephone system operation and usage.
Course Length: minimum 40 Hours

Introduction to Home Entertainment: Residential Audio/Video Systems
Certification: Smart Home Professional - Audio/Video (SHP)
» Understand the concepts of sound and sound generation systems.
» Understand the basics of electronics and the electronic devices that enable sound systems to work correctly.
» Can read frequency response charts and specifications for speakers, amplifiers and control devices to determine best component selections.
» Can install Whole-house Audio systems in accordance with EIA/TIA CEA standards.
» Can install Home Theater systems in accordance with EIA/TIA CEA standards.
» Know the CEA Home Theater color code system as it pertains to speaker and component connection.
» Understand the concepts of component and speaker locations for various types of sound systems.
» Know how to work and install systems in new construction, existing construction and retrofit situations.
» Understand how to select and connect Multi-room Audio system components.
» Demonstrate the ability to select, connect and calibrate both 5.1 and 7.1 Home Theater systems.
» Know the advantages and disadvantages of all types of video displays used in Home Theater systems and can correctly install and troubleshoot each type of system.
Course Length: minimum 30 Hours

Introduction to Energy Management Systems
Certification: Smart Home Professional - Energy Management (SHP)
» Define the importance of Green Application Systems.
» Program a seven day thermostat to save energy and money.
» Provide examples of passive and proactive energy savings systems.
» Determine energy usage and suggest energy saving strategies.
» Measure voltage, resistance and continuity of an electrical circuit.
» Construct a simple circuit and test its effectiveness.
» State the five ways light is created.
» Identify advantages and disadvantages of lighting systems, and correct typical lighting and control problems.
» Read a lighting label and determine the color, cost, energy consumption and lumens for a specific bulb type.
» Identify the role of codes and standards used in automation systems.
» Identify typical networking and system topologies.
» Program and operate X-10, Z-Wave, and Zigbee control systems.
» Provide a customer with solutions and suggestions for typical systems functions.

Course Length: minimum 40 Hours

**Applied Systems Integration - Grounding/Bonding: Copper Connectivity Systems**
» Can install telecommunications services to a customer's home or business.
» Understands the layout of the National Electric Code and can find applicable information concerning grounding and bonding, surge protection applications and telecommunications spaces.
» Proven ability to use tools to crimp, mechanically bond, prepare and terminate grounding conductors.
» Able to correctly connect to a buildings grounding infrastructure that insure both life safety and maximum system performance.
» Can bond Telecommunications Bonding Conductors to Main buss bars and grounding equalizers.
» Understands grounding conductor AWG size requirements per the NEC.
» Can determine electrician and telecommunications technicians responsibilities in terms to a correctly grounded and bonded system.
» Able to connect copper based services to a Network Interface Device (NID).
» Understands surge protection devices and their applications in homes and businesses per the National Electric Code.
» Can install primary and secondary protection devices on telecommunications lines.
» Understands residential and commercial topologies in terms of service delivery and grounding and bonding requirements.

Course Length: minimum 10 Hours

**Connecting to Business**
» Identify four classes of goals, recognizing the importance of goals and assigning deadlines.
» Identify three broad categories of personal traits important to employers as Ability, Attitude and Appearance.
» Identify the job positions in a typical career path in the telecom industry.
» Describe the features of a functional resume.
» Apply the concept of “Brand You.”
» Distinguish between searching for jobs on the Internet, and searching for businesses on the Internet.
» Describe the Pareto principle, or 80-20 rule.
» Describe how the Ear model works.
» Identify the most important element in writing as the message.
» Define bottom line writing.

Course Length: 10 Hours
C-Tech gives you **EVERYTHING IN A BOX**

**Requirements to Operate**

**Instructor**
Prepare your teachers with "Train the Trainer"

**Classroom**
Flat surface desk

**No special construction needed!**

**Over 65,000 students successfully certified**

98% completion rate
90% certification
Over 20 years experience in education
Instructor Certification and Curriculum

Instructors are trained and certified to present and monitor the development activities of their students. C-Tech Associates requires that all instructors teaching C-Tech courses be certified first as a C-Tech Trainer. Before teaching, instructors go through a rigorous training conducted by a master C-Tech Trainer, during which teachers learn the techniques and procedures necessary for ensuring that students receive quality training qualifying them for certification.

The course curriculum and lesson plans are completely documented for the instructor, resulting in a standardized delivery and training format for all participants. Each tier employs graphics and is further supported through a multimedia approach consisting of lecture, reading, videos and CDs, as well as hands-on activities. Quizzes, module test and final examination provide on-going student assessment. Each tier can be completed in about 40 hours.

Students work as a team in a cooperative learning environment supporting communication skill development. The curriculum incorporates portable workstations to help students engage in real world activities, while enabling the programs to be delivered virtually anywhere. C-Tech has an ease of implementation that does not require construction of new classrooms or the purchase and installation of bulky equipment. C-Tech programs can be taught using little more than a desk with sufficient space for two students.

Included in the curriculum is a comprehensive understanding of how Green Technology Systems will impact the careers of tomorrow. Students participate in a cumulative learning track, building on each preceding tier. They gain an understanding of the past, current and future role of telecommunications technology, developing the skills to install, test, troubleshoot and maintain the transports media (copper wire, fiber optic light and air) that transmit and receive data, voice and video messages.

Student Certification

To certify, candidates are required to obtain an 85 percent (C-Tech weighted average) as an overall grade for each module test and three part final examinations. All final exams have both hands-on and a written component. There is no additional cost to the participant to take the final exam or receive their certification. C-Tech training produces a variety of job skills centered on both the commercial and residential technology markets. In Connecting to Business - A Course in Employability, students will discover how to effectively get a job. This program has been developed around the specific training received and includes a protocol to identify local employers. A database directed at and accessible to program recognizers is also available for promoting skills to potential employers.

Company Support

All tiers purchased include full support from C-Tech for the life of the program. C-Tech offers excellent one-on-one customer service and marketing tools to help with promoting or teaching the programs. Our website is available for instructors to download class materials, or view videos. Students can also utilize the website for helpful information and downloads for their job search such as our trademark pocket resume. Our regional managers are available to consult with clients and can provide assistance in grant writing and government applications. It is important to note that the purchase of the program resources includes the student workstations, the learning aids and interactive boards, the manuals, all of which are non-consumables and can be reused for many years. Thus the cost for ongoing sustainability in keeping the program running would solely involve an outlay for the student certification kits which are approved by several states. The initial investment can be accomplished by either outright purchase of the equipment, or through a lease of 36 or 60 months.