









Facilitator Guide







Sector

Telecom

Sub-Sector

Passive Infrastructure

Fiber to-the Home (FTTH/X) Installer

Occupation

Operations and Maintenance - Passive Infrastructure

Reference ID: TEL/Q4200, Version 4.0

NSQF Level 3

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Telecom Sector Skill Council

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Skilling is building a better India.

If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi Prime Minister of India



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The preparation of this guide would not have been possible without the Telecom Industry's support. Industry feedback has been extremely beneficial since inception to conclusion and it is with their guidance that we have tried to bridge the existing skill gaps in the industry. This facilitator guide is dedicated to the aspiring youth, who desire to achieve special skills which will be a lifelong asset for their future endeavours.

About this Guide ———

The facilitator guide (FG) for Fiber to-the Home (FTTH/X) Installer is primarily designed to facilitate skill development and training of people, who want to become professional Fiber to-the Home (FTTH/X) Installers. The facilitator guide is aligned to the Qualification Pack (QP) and the National Occupational Standards (NOS) as drafted by the Sector Skill Council (TSSC) and ratified by National Skill Development Corporation (NSDC).

It includes the following National Occupational Standards (NOSs)-

- 1. TEL/N4143 Install Fiber-to-the-Home (FTTH/X) and Fiber-to-Anywhere (FTTx) Cables
- 2. TEL/N6400-Splice Optical Fiber
- 3. TEL/N4200 Installation of passive FTTH/X components
- 4. TEL/N4201 In-building FTTH/X Cabling
- 5. TEL/N4131 Work Safety Practices with Fiber Optics
- 6. TEL/N9111 Follow sustainability practices in telecom cabling operations
- 7. DGT/VSQ/N0101 Employability Skills (30 Hours)

Post this training, the participants will be able to perform tasks as professional Fiber to-the Home (FTTH/X) Installers. We hope that this Facilitator Guide provides a sound learning support to our young friends to build a lucrative career in the Telecom Skill Sector of our country.

Symbols Used _____



Ask



Explain



Elaborate



Notes



Objectives



D



Demonstrate



Activity



Team Activity



Facilitation Notes



Practical



Say



Resources



Example



Summary



Role Play



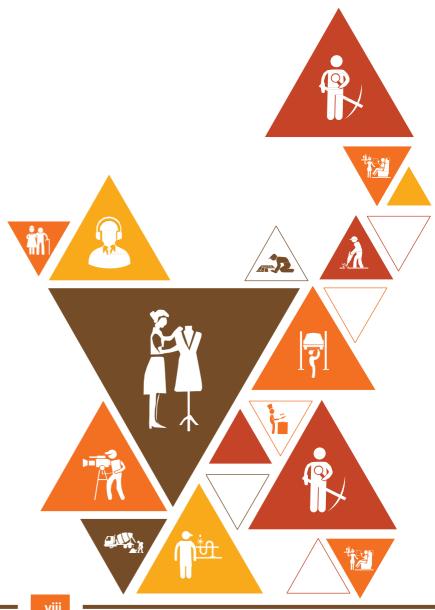
Learning Outcomes

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Introduction to the Sector & the Job Role of a Fiber to-the Home (FTTH/X) Installer

Unit 1.1 - Telecom Sector in India

Unit 1.2 - Roles and Responsibilities of Fiber to-the Home (FTTH/X) Installer



Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Explain the significance of the telecom sector in modern communication and economic development.
- 2. Elucidate the key skills and technical expertise required for a Fiber-to-the-Home (FTTH/X) Installer.
- 3. Describe the challenges faced in the installation and maintenance of FTTH/X networks.
- 4. Determine the impact of fiber optic technology on internet speed and connectivity.
- 5. Discuss the role and responsibilities of a Fiber to-the Home (FTTH/X) Installer.

UNIT 1.1: Telecom Industry and its Sub-sectors

Unit Objectives



After the completion of this unit, the participant will be able to:

- 1. Illustrate the size and scope of the Telecom industry and its various sub-sectors in India.
- 2. Outline the growth of the Indian Telecom Sector

Resources to be Used



Participant Handbook, pen, notebook, whiteboard, flipchart, markers, laptop, overhead projector, laser pointer



In this unit, we will discuss the telecom sector in India and its sub-sectors.



Good morning and welcome back to this training program, "Distributor Sales Representative". Today we shall discuss about the telecom sector in India and its sub-sectors.



Ask the participants the following questions:

What do you understand by telecom?

Write down the participants' answers on a whiteboard/flipchart. Take appropriate cues from the answers and start teaching the lesson.

Elaborate



In this session, we will discuss the following point:

- Introduction to the telecom industry
- Top Mobile handset players in India
- Major subsectors of the Telecom Industry
- Infrastructure
- Equipment
- Mobile Virtual Network Operators (MNVO)
- White Space Spectrum
- 50
- Telephone service providers and
- Broadband

Say



Let us participate in an activity to explore the unit a little more.

Activity



- This is a group activity
- Divide the class into four groups and provide chart paper and other required items to each group
- Now, ask each group to make a chart paper presentation on major sub-sectors of the Telecom Industry
- Ask them to explain each of the types
- They can use hand-drawn diagrams or pasted pictures
- After the groups complete their work, collect all the chart papers and evaluate them

Activity	Duration	Resources used
Chart paper presentation	60 minutes	Participant handbook, pen, notebook, chart paper, sketch pens, pencils, eraser, ruler, laptop, etc.

Do



- Guide the trainees throughout the activity
- Ensure that all trainees participate in the activity

Notes for Facilitation



- Answer all the queries/doubts raised by the trainees in the class
- Encourage other trainees to answer problems and boost peer learning in the class

UNIT 1.2: The Roles and Responsibilities of Fiber to-the Home (FTTH/X) Installer

Unit Objectives 6



After the completion of this unit, the participant will be able to:

- 1. Identify and select different types of electronic components and verify the characteristics in different circuits.
- 2. Recall the fundamentals of optical fiber and their applications
- 3. Summarize the history of optical fiber
- 4. Solve the challenges faced during handling of fiber optics
- 5. Illustrate on working principle of optical fiber communication system
- 6. Compare optical fiber performance parameters like attenuation, bending, dispersion, cut-off wavelength and mode-field diameter
- 7. Explain the various fiber geometric parameters (core, clad and buffer)
- 8. Infer the importance of cable jackets, strength members and moisture/water blocking compounds

Resources to be Used



Participant handbook, Presentation slides, Whiteboard or flipchart, Markers, Handouts or reference materials on optical fiber, Samples of fiber optic cables and component



- Good morning/afternoon, everyone!
- Welcome to today's session on the roles and responsibilities of Fiber to-the Home (FTTH/X) Installer.
- At the end of this session, you will be able to understand the fundamental concepts of fiber optics and the various responsibilities involved in installing fiber to the home.
- Understanding the topics covered today will equip you with the knowledge and skills needed to handle and install fiber optic systems effectively, which is essential in today's rapidly advancing telecommunications industry.



- Use the presentation slides to guide the session.
- Engage participants in discussions and encourage their active participation.
- Provide clear explanations and examples to reinforce understanding.
- Answer questions and address any concerns that arise.

Activity



- 1. Activity Name: Name Game (Ice Breaker)
- 2. Objective: This activity is focused on breaking the ice between the participants so that they can come up confidently in putting forward their opinion
- 3. Type of activity: Group activity
- 4. Resources: Participant Handbook, Pen, Notebook, Writing Pad, etc.
- 5. Duration of the activity: 60 minutes
- 6. Instructions:
 - Arrange the class in a semi-circle/circle
 - Say your name aloud and start playing the game with your name.
 - Say, "Now, each of you shall continue with the game with your names till the last person in the circle/ semi-circle participates".
 - Listen to and watch the trainees while they play the game.
 - Ask questions and clarify if you cannot understand or hear a trainee.
 - Discourage any queries related to one's financial status, gender orientation or religious bias during the game
 - Try recognising each trainee by their name because it is not recommended for a trainer to ask the name of a trainee during every interaction

Outcome: This activity has focused on breaking the ice between the participants so that they can come up confidently, putting forward their opinion.

Ask lask



- What do you already know about fiber optics and its applications?
- Can you share any challenges you have faced or heard of when working with fiber optics?
- What do you think is the role of an installer?

Elaborate



- Electronics Components, Optical Fiber Fundamentals, History, and Handling Challenges
 - o Identify and select different types of electronic components and verify their characteristics in different circuits.
 - o Recall the fundamentals of optical fiber and its applications.
 - o Summarize the history of optical fiber.
 - o Solve challenges faced during the handling of fiber optics.
- Optical Fiber Communication System, Performance Parameters, Geometric Parameters, and Importance of Cable Accessories
 - o Illustrate the working principle of an optical fiber communication system.
 - o Compare optical fiber performance parameters such as attenuation, bending, dispersion, cut-off wavelength, and mode-field diameter.
 - Explain the various fiber geometric parameters (core, clad, and buffer).
 - o Infer the importance of cable jackets, strength members, and moisture/water blocking compounds.

Roleplay



- 1. Activity name: Role Play Fiber to Home Installer
- 2. Objective of the activity: To engage participants in a role play activity that simulates the roles and responsibilities of a fiber to home installer, enhancing their understanding of the tasks involved and the importance of their responsibilities.
- 3. Resources:
- 4. Role play scenario cards (prepared in advance), Props (optional), Timer or stopwatch.
- 5. Time Duration: 30 minutes
- 6. Instructions:
 - Divide the participants into small groups of 3-4 individuals each.
 - Provide each group with a role play scenario card. The card should outline a specific situation related to fiber to home installation, including the roles and responsibilities of a fiber to home installer.
 - Explain that each group will have 10 minutes to review the scenario and prepare for the role play.
 - Encourage participants to assign roles within their group, such as the fiber to home installer, customer, supervisor, and any other relevant roles mentioned in the scenario.
 - Remind participants to consider the key responsibilities and tasks of a fiber to home installer while preparing for their role.
 - Start the role play activity. Each group should perform their scenario, with participants actively playing their assigned roles.
 - Encourage participants to interact and engage in dialogue as they act out the scenario, reflecting the roles and responsibilities of a fiber to home installer.
 - Set a time limit of 10 minutes for each role play.
 - After each role play, allow a few minutes for the group to provide feedback and discuss their observations.
 - Rotate the scenarios among the groups, ensuring that each group gets a different scenario to perform.
 - Repeat the process until each group has performed their role play scenario.
 - Once all groups have completed their role plays, gather the participants for a brief debriefing session.
 - Facilitate a discussion to reflect on the experiences and insights gained from the activity.
 - Summarize the key responsibilities and tasks of a fiber to home installer, highlighting the importance of effective communication, problem-solving, and attention to safety and quality.

Outcome: Participants gain a better understanding of the roles and responsibilities of a fiber to home installer through an engaging role play activity.

Notes for Facilitation



- Encourage active participation and create a supportive learning environment.
- Provide ample opportunities for questions, discussions, and clarification.
- Pace the session appropriately to ensure understanding and engagement.
- Emphasize the importance of proper handling and care when working with fiber optics.
- Encourage participants to share any real-world experiences or challenges related to fiber optic installation and seek input from their peers.

Exercise



Answers to exercises for PHB

Multiple Choice Questions:

- 1. a. second-largest
- 2. a. Light signals
- 3. a. Scattering
- 4. a. Misalignment
- 5. a. Duplex circuits

Descriptive Questions:

- Refer to Unit 1.1 The roles and responsibilities of Fiber to-the Home (FTTH/X) Installer
 Topic 1.1.2 Working principle of optical fiber communication system
- 2. Refer to Unit 1.1 The roles and responsibilities of Fiber to-the Home (FTTH/X) Installer Topic 1.1.4 Geometric parameters of the fiber (core, clad and buffer)
- 3. Refer to Unit 1.1 The roles and responsibilities of Fiber to-the Home (FTTH/X) Installer Topic 1.1.6 Characteristics in different circuits used in optical fiber installation
- 4. Refer to Unit 1.1 The roles and responsibilities of Fiber to-the Home (FTTH/X) Installer Topic 1.1.6 Characteristics in different circuits used in optical fiber installation
- 5. Refer to Unit 1.1 The roles and responsibilities of Fiber to-the Home (FTTH/X) Installer Topic 1.1.7 Challenges faced during handling of fiber optics

	Notes 🛗 🗕		
	Notes 📋 –		
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2. Pre-Installation and Installation Techniques

Unit 2.1 - Planning, Survey, Cable Selection, Routing & Deployment Unit 2.2 - Splicing, Termination, Testing & Quality Assurance





Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Explain the key characteristics of fiber cables such as bend-insensitive, ribbon fibers, and high-fiber-count cables.
- 2. Demonstrate how to select cable types based on site/environmental factors and verify pulling tension, bend radius, and cable diameter.
- 3. Discuss the regulatory and compliance considerations for optical fiber installations, including environmental impact and safety standards.
- 4. Demonstrate how to ensure compliance with permissions, local laws, and environmental guidelines.
- 5. Describe different splicing methods like fusion splicing, mass splicing, and mechanical splicing.
- 6. Show how to perform optical cable pre-tests using OTDR and AI tools to ensure splicing quality and network readiness.
- 7. Elucidate the termination techniques for connectors and pigtails.
- 8. Demonstrate proper termination, polishing, and cleaning of connectors and pigtails, ensuring loss-free connections.
- 9. Discuss the cable pulling, blowing, and routing methods used in fiber optic installations.
- 10. Show how to use automated cable pulling tools and execute cable blowing with AI monitoring for optimization.
- 11. Describe advanced installation techniques such as micro-trenching, air-blown fibers, and robotic pulling.
- 12. Demonstrate how to conduct pre-deployment surveys, including GIS route mapping and FTTx architecture compliance.
- 13. Discuss the principles of wind-loading analysis and mitigation techniques for aerial installations.
- 14. Demonstrate how to conduct wind-loading analysis and apply mitigation techniques for aerial fiber runs.
- 15. Elucidate applicable sustainability practices including eco-friendly reinstatements and e-waste management in fiber deployment.
- 16. Show how to use duct preparation tools, clean ducts with compressed air/vacuum systems, and perform eco-friendly trench reinstatements.
- 17. Explain the escalation protocols for incidents and challenges that arise during fiber optic installations.
- 18. Demonstrate escalation procedures through correct documentation, communication channels, and reporting to supervisors.
- 19. Discuss the concepts and applications of micro-trenching and air-blown fiber techniques in high-density urban installations.
- 20. Demonstrate how to test duct suitability and perform figure-8 cable coiling to prevent damage during deployment.
- 21. Describe safe cable routing practices and infrastructure readiness assessments.
- 22. Show how to integrate ducts with proper sealing for scalability and long-term durability.

- 23. Explain ADSS (All-Dielectric Self-Supporting) cable installation considerations, tension control, and structural loads.
- 24. Demonstrate how to handle ADSS cables with tension control tools and survey aerial infrastructure using drones.
- 25. Discuss aerial fiber deployment using messenger strands and pole hardware.
- 26. Show how to install messenger strands and aerial cables safely using lift buckets and pole climbing techniques.
- 27. Explain grounding and bonding requirements in fiber networks.
- 28. Demonstrate how to apply armor bonding and grounding practices, ensuring proper cable laying and marker placement.

UNIT 2.1: Fiber Cable Characteristics, Compliance, and Pre-**Deployment Readiness**

Unit Objectives ©



After the completion of this unit, the participant will be able to:

- 1. Demonstrate how to select cable types based on site/environmental factors and verify pulling tension, bend radius, and cable diameter.
- 2. Discuss the regulatory and compliance considerations for optical fiber installations, including environmental impact and safety standards.
- 3. Demonstrate how to ensure compliance with permissions, local laws, and environmental guidelines.
- 4. Discuss the cable pulling, blowing, and routing methods used in fiber optic installations.
- 5. Show how to use automated cable pulling tools and execute cable blowing with AI monitoring for optimization.
- 6. Describe advanced installation techniques such as micro-trenching, air-blown fibers, and robotic pulling.
- 7. Demonstrate how to conduct pre-deployment surveys, including GIS route mapping and FTTx architecture compliance.
- 8. Elucidate applicable sustainability practices including eco-friendly reinstatements and e-waste management in fiber deployment.
- 9. Show how to use duct preparation tools, clean ducts with compressed air/vacuum systems, and perform eco-friendly trench reinstatements.
- 10. Discuss the concepts and applications of micro-trenching and air-blown fiber techniques in highdensity urban installations.
- 11. Demonstrate how to test duct suitability and perform figure-8 cable coiling to prevent damage during deployment
- 12. Describe safe cable routing practices and infrastructure readiness assessments.
- 13. Show how to integrate ducts with proper sealing for scalability and long-term durability.
- 14. Explain ADSS (All-Dielectric Self-Supporting) cable installation considerations, tension control, and structural loads.
- 15. Discuss aerial fiber deployment using messenger strands and pole hardware.

Resources to be Used



Participant handbook, Presentation slides, Whiteboard or flipchart, Markers, Handouts or reference materials on pre-construction surveys, Samples or visuals of key equipment (blowing equipment, cable pulling tools, etc.), Safety equipment (gloves, goggles, etc.), OTDR (Optical Time Domain Reflectometer) for demonstration and pre-testing activity.

Say

- y 뎙
- Hello, everyone! Welcome to today's session on pre-installation checks.
- The objective of this session is to understand the importance of pre-installation checks and the key steps involved in ensuring a successful installation.
- At the end of this session, you will be able to identify and perform necessary pre-installation tasks to ensure a smooth installation process.
- It's crucial to conduct thorough pre-installation checks to avoid costly mistakes, ensure compliance with installation requirements, and optimize network performance.

Do



- Utilize the presentation slides to guide the session.
- Encourage active participation and foster discussions among participants.
- Share practical examples and experiences related to pre-installation checks.
- Address questions and provide clarifications as needed.

Ask



- Why is it important to mark the pre-construction survey on the site before starting the installation process?
- What are some key equipment used in optical fiber installations?

Elaborate



- Pre-Construction Survey, Equipment, Cable Hauling, Duct Rodding, Testing, and Pre-Testing with OTDR in Optical Fiber Installations
 - o Explain the importance of conducting a pre-construction survey and marking the site to identify potential obstacles, optimal cable routes, and necessary infrastructure modifications.
 - o Discuss key equipment used in optical fiber installations, highlighting their functions, characteristics, and proper handling techniques.
 - o Illustrate the cable hauling process, emphasizing constraint checks such as maximum pulling tension, bending radius, total cable length, and splicing length requirements at end points.
 - o Describe the duct rodding, testing, and cleaning processes to ensure proper cable routing and efficient signal transmission.
 - Explain the pre-testing procedure using an OTDR to assess the integrity and quality of the installed optical fiber.

Demonstrate



Demonstrate the proper use and handling of key equipment (blowing equipment, cable pulling tools, etc.), used in optical fiber installations, showcasing their features and precautions.

Activity



- Activity name: Pre-Testing with an OTDR
- Objective: To practice pre-testing techniques using an OTDR and interpret test results.
- Type of activity: Individual
- Resources: OTDR (Optical Time Domain Reflectometer), Optical fiber samples or test cables, Instructions or user manual for the OTDR, Handouts or reference materials on interpreting OTDR test results.
- Time Duration: 30 minutes
- Instructions:
 - o Provide participants with an OTDR and optical fiber samples or test cables.
 - o Instruct each participant to perform a pre-test using the OTDR, following the provided instructions or user manual.
 - Ask participants to interpret the OTDR test results, analyzing key parameters such as attenuation, reflectance, and event locations.
 - o Encourage participants to discuss their findings and share insights with the group.
 - o Facilitate a group discussion on the significance of pre-testing, common issues observed in the test results, and troubleshooting approaches.
 - o Summarize the key learnings and reinforce the importance of pre-testing for ensuring installation quality and network performance.
- Outcome: Participants will gain hands-on experience in conducting pre-testing using an OTDR and interpreting test results to assess optical fiber installations.

Notes for Facilitation



- Encourage active participation and collaboration.
- Foster a positive and inclusive learning environment.
- Provide feedback and support throughout the session.
- Emphasize the importance of accurate pre-construction surveys and site marking to minimize installation challenges and ensure efficient cable routing.
- Highlight the significance of proper handling and understanding the characteristics of key equipment used in optical fiber installations.

UNIT 2.2: Splicing, Termination, and Network Readiness

-Unit Obiectives 🏻 🎯



After the completion of this unit, the participant will be able to:

- 1. Show how to perform optical cable pre-tests using OTDR and AI tools to ensure splicing quality and network readiness. (OTDR steps shown)
- 2. Elucidate the termination techniques for connectors and pigtails.
- 3. Demonstrate proper termination, polishing, and cleaning of connectors and pigtails, ensuring loss-free connections. (Cold cure kit + cleaning procedure covered)
- 4. Discuss the principles of wind-loading analysis and mitigation techniques for aerial installations. (Will be brief add-on but placed here for clarity of testing/verification)
- 5. Demonstrate how to conduct wind-loading analysis and apply mitigation techniques for aerial fiber runs. (Practical demonstration follows theory)
- 6. Explain the escalation protocols for incidents and challenges that arise during fiber optic installations. (Documentation logs + supervisor reporting referenced)
- 7. Demonstrate escalation procedures through correct documentation, communication channels, and reporting to supervisors.
- 8. Demonstrate how to handle ADSS cables with tension control tools and survey aerial infrastructure using drones. (Continuation of 23 – handled during installation QC)
- 9. Show how to install messenger strands and aerial cables safely using lift buckets and pole climbing techniques. (Aerial safety + hardware installation process)
- 10. Explain grounding and bonding requirements in fiber networks. (Safety & equipment handling reinforcement)
- 11. Demonstrate how to apply armor bonding and grounding practices, ensuring proper cable laying and marker placement.

Resources to be Used



Participant handbook, Presentation slides, Whiteboard or flipchart, Markers, Samples or visuals of various types of optical fiber cable constructs, Handouts or reference materials on deployment suitability, , Safety equipment (gloves, goggles, etc.), Samples or visuals of proper trenching, ducting, and aerial supports, Demonstrative tools or props (e.g., bend radius gauge)

Say



- Hello, everyone! Welcome to today's session on the installation of optical fiber.
- The objective of this session is to understand the key aspects of optical fiber installation, including different cable constructs, deployment suitability, safe handling practices, and best installation practices.
- At the end of this session, you will be equipped with the knowledge to perform optical fiber installations effectively.
- Understanding the proper installation of optical fiber is crucial for ensuring optimal network
 performance, minimizing signal loss, and preventing damage to the cables. It is essential to know
 the different cable constructs, suitable deployment scenarios, and safe handling practices to achieve
 successful installations.

Do



- Use the presentation slides to guide the session.
- Encourage active participation and engage participants in discussions.
- Share practical examples and experiences related to optical fiber installation.
- Address questions and provide clarifications as needed.

- Ask



- What are the various types of optical fiber cable constructs you are familiar with?
- Why is it important to handle optical fiber cables safely?

Elaborate



- Optical fiber cable constructs, suitability factors, precautions, and best practices
 - o Classify various types of optical fiber cable constructs, such as single-mode, multimode, loose tube, tight-buffered, armored, and aerial cables.
 - o Discuss the factors to consider when determining the suitability of deploying optical fiber cables, including distance, environment, bandwidth requirements, and installation methods (buried, aerial, indoor).
 - o Explain the importance of safe and correct handling of optical fiber cables, including precautions for preventing damage, bending beyond the allowable radius, and protecting against excessive pulling tension.
 - o Explore the need for proper trenching, ducting, and aerial messages/supports, highlighting best practices for installation to ensure cable protection, accessibility, and longevity.

Demonstrate



Demonstrate the correct technique for handling optical fiber cables, including the use of cable reels, cable pulling tools, and proper bending radius.

Activity

- **Activity name:** Fiber Cable Deployment Scenario
- Objective: To analyze and determine the suitable deployment method for optical fiber cables in different scenarios.
- Type of activity: Group
- Resources: Scenario cards (prepared by the facilitator) describing different deployment scenarios, Handouts or reference materials on suitable deployment methods for optical fiber cables.
- Time Duration: 30 minutes
- Instructions:
 - Divide participants into small groups.
 - o Distribute scenario cards to each group.
 - o Instruct the groups to read and analyze the scenarios, considering factors such as distance, environment, and bandwidth requirements.
 - o Ask each group to discuss and decide on the most suitable deployment method for the given scenario.
 - o After the discussion, invite each group to present their chosen deployment method and provide a rationale for their decision.
 - o Facilitate a group discussion to compare and discuss the different approaches and considerations
 - o for each scenario.
 - o Summarize the key learnings and emphasize the importance of selecting the appropriate deployment method for successful optical fiber installations.
- Outcome: Participants will develop critical thinking skills in assessing deployment scenarios and gain a deeper understanding of the factors influencing the selection of suitable deployment methods.

Notes for Facilitation



- Encourage active participation and collaboration.
- Foster a positive and inclusive learning environment.
- Provide feedback and support throughout the session.
- Ensure safety precautions are followed during any hands-on activities.
- Emphasize the importance of understanding the different types of optical fiber cable constructs and their applications.

-Exercise 🛭



Answers to exercises for PHB

Multiple Choice Questions:

- 1. a. Kevlar Scissors
- 2. d. All of the above
- 3. a. Duct rodder
- 4. a. Plastic optical fiber (POF)
- 5. b. Light source

Descriptive Questions:

- 1. Refer to Unit 2.1 Pre-installation checks Topic 2.1.1 Pre-construction survey on the site
- 2. Refer to Unit 2.1 Pre-installation checks Topic 2.1.3 Selection of appropriate cable for installation procedures
- 3. Refer to Unit 2.2 installation of optical fibre Topic 2.2.4 Importance of proper trenching, ducting, aerial messages /supports and best practices for optical fibre installation
- 4. Refer to Unit 2.2 installation of optical fibre Topic 2.2.3 Importance of safe handling of optical fibre cables
- 5. Refer to Unit 2.2 installation of optical fibre Topic 2.2.5 Negative effects on exceeding parameters of optical fibre

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3. FTTx Applications and Network Planning

Unit 3.1 - FTTx Applications, Architecture & Network Design Unit 3.2 - GIS Mapping, Network Testing, Compliance & Future Scalability



Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Explain the key characteristics of fiber cables such as bend-insensitive, ribbon fibers, and high-fiber-count cables.
- 2. Demonstrate how to select cable types based on site/environmental factors and verify pulling tension, bend radius, and cable diameter.
- 3. Theory Discuss the regulatory and compliance considerations for optical fiber installations, including environmental impact and safety standards.
- 4. Demonstrate how to ensure compliance with permissions, local laws, and environmental guidelines.
- 5. Describe different splicing methods like fusion splicing, mass splicing, and mechanical splicing.
- 6. Show how to perform optical cable pre-tests using OTDR and AI tools to ensure splicing quality and network readiness.
- 7. Elucidate the termination techniques for connectors and pigtails.
- 8. Demonstrate proper termination, polishing, and cleaning of connectors and pigtails, ensuring loss-free connections.
- 9. Discuss the cable pulling, blowing, and routing methods used in fiber optic installations.
- 10. Show how to use automated cable pulling tools and execute cable blowing with AI monitoring for optimization.
- 11. Describe advanced installation techniques such as micro-trenching, air-blown fibers, and robotic pulling.
- 12. Demonstrate how to conduct pre-deployment surveys, including GIS route mapping and FTTx architecture compliance.
- 13. Discuss the principles of wind-loading analysis and mitigation techniques for aerial installations.
- 14. Demonstrate how to conduct wind-loading analysis and apply mitigation techniques for aerial fiber
- 15. Elucidate applicable sustainability practices including eco-friendly reinstatements and e-waste management in fiber deployment.
- 16. Show how to use duct preparation tools, clean ducts with compressed air/vacuum systems, and perform eco-friendly trench reinstatements.
- 17. Explain the escalation protocols for incidents and challenges that arise during fiber optic installations.
- 18. Demonstrate escalation procedures through correct documentation, communication channels, and reporting to supervisors.
- 19. Discuss the concepts and applications of micro-trenching and air-blown fiber techniques in high-density urban installations.
- 20. Demonstrate how to test duct suitability and perform figure-8 cable coiling to prevent damage during deployment.
- 21. Describe safe cable routing practices and infrastructure readiness assessments.
- 22. Show how to integrate ducts with proper sealing for scalability and long-term durability.
- 23. Explain ADSS (All-Dielectric Self-Supporting) cable installation considerations, tension control, and structural loads.
- 24. Demonstrate how to handle ADSS cables with tension control tools and survey aerial infrastructure using drones.
- 25. Discuss aerial fiber deployment using messenger strands and pole hardware.
- 26. Show how to install messenger strands and aerial cables safely using lift buckets and pole climbing techniques.
- 27. Explain grounding and bonding requirements in fiber networks.
- 28. Demonstrate how to apply armor bonding and grounding practices, ensuring proper cable laying and marker placement.

UNIT 3.1: FTTx Applications, Architecture & Network Design

Unit Objectives ©



After the completion of this unit, the participant will be able to:

- 1. Demonstrate how to select cable types based on site/environmental factors and verify pulling tension, bend radius, and cable diameter.
- 2. Discuss the regulatory and compliance considerations for optical fiber installations, including environmental impact and safety standards.
- 3. Demonstrate how to ensure compliance with permissions, local laws, and environmental guidelines.
- 4. Discuss the cable pulling, blowing, and routing methods used in fiber optic installations.
- 5. Show how to use automated cable pulling tools and execute cable blowing with AI monitoring for optimization.
- 6. Describe advanced installation techniques such as micro-trenching, air-blown fibers, and robotic pulling.
- 7. Demonstrate how to conduct pre-deployment surveys, including GIS route mapping and FTTx architecture compliance.
- 8. Elucidate applicable sustainability practices including eco-friendly reinstatements and e-waste management in fiber deployment.
- 9. Show how to use duct preparation tools, clean ducts with compressed air/vacuum systems, and perform eco-friendly trench reinstatements.
- 10. Discuss the concepts and applications of micro-trenching and air-blown fiber techniques in highdensity urban installations.
- 11. Demonstrate how to test duct suitability and perform figure-8 cable coiling to prevent damage during deployment
- 12. Describe safe cable routing practices and infrastructure readiness assessments.
- 13. Show how to integrate ducts with proper sealing for scalability and long-term durability.
- 14. Explain ADSS (All-Dielectric Self-Supporting) cable installation considerations, tension control, and structural loads.
- 15. Discuss aerial fiber deployment using

Resources to be Used



Participant handbook, presentation slides, whiteboard or flipchart, markers, visuals of FTTx topologies, samples of pre-connectorized cables, micro-ducts and micro-trenching tools, ONT/OLT units, splitters, routers and IoT devices, GIS route examples, planning templates, PON/GPON/XGS-PON architecture diagrams, safety equipment, cable testing tools including OTDR, power meters and visual fault locators, and reference materials on TRAI, Broadband Forum and ITU-T standards.



- Hello everyone! Welcome to this session on advanced FTTx applications and network deployment.
- Today, we will explore how fiber networks support smart cities, 5G, telemedicine and high-bandwidth digital services.
- We will discuss FTTx architectures such as FTTN, FTTC, FTTB, FTTH and FTTD and their importance in deployment planning.
- You will also understand emerging trends including AI-enabled optimization, sustainability and cybersecurity in modern networks.

Do



- Utilize the slides to explain modern fiber applications and FTTx variations.
- Share examples of pre-connectorized cable deployment, micro-duct insertion and micro-trenching.
- Demonstrate FTTx component integration using ONTs, OLTs, splitters and IoT devices.
- Engage participants with visuals of PON/GPON/XGS-PON layouts and GIS route maps.
- Encourage discussion and clarify doubts on planning and documentation.

Ask



- How do modern fiber applications influence network design?
- What factors determine the selection of FTTN, FTTC, FTTB or FTTH?
- Why is GIS useful for FTTx route planning?
- What tools help detect faults and ensure predictive maintenance?
- Which standards guide compliance during FTTx installation?

Elaborate |



- Explain how high-capacity fiber networks support smart mobility, healthcare access, high-speed broadband and automated industries.
- Discuss differences between traditional fiber deployment and modern methods such as micro-trenching and plug-and-play connectors.
- Illustrate the importance of selecting the correct architecture (GPON/XGS-PON) for scalability and future upgrades.
- Highlight the significance of predictive maintenance, testing tools and cybersecurity for network reliability.
- Emphasize how compliance with TRAI/ITU-T standards ensures safe and future-ready deployment.

Demonstrate F



Demonstrate the installation of pre-connectorized cables, micro-duct mounting, component integration using ONTs/OLTs/splitters, precision splicing and termination techniques, use of OTDR and diagnostic tools and proper documentation and compliance verification procedures.

Activity



- Activity Name: FTTx Network Planning and Integration
- Objective: To practice selecting the correct FTTx architecture, mapping routes and integrating network components.
- Type of Activity: Group
- Resources: FTTx diagrams, GIS route samples, ONT/OLT visuals, micro-duct samples, splicing tools.
- Time Duration: 30 minutes
- Instructions:
 - o Provide groups with a location scenario (urban building, enterprise, rural cluster, smart-city node).
 - Ask them to select the appropriate FTTx architecture and justify the selection.
 - o Map the fiber route on the GIS sample.
 - o Identify required components (ONT, OLT, splitter, micro-duct, pre-connectorized cable).
 - o Present the plan to the class.
- Outcome: Participants will understand practical FTTx planning, component selection and documentation.

Notes for Facilitation



- Encourage active participation, collaboration and sharing of field experiences.
- Provide guidance on the use of visuals, GIS tools and planning templates.
- Reinforce the importance of selecting scalable architectures and following national/international standards.
- Support participants during hands-on integration and splicing demonstrations.
- Highlight the role of accurate documentation for audit and certification readiness.

UNIT 3.2: GIS Mapping, Network Testing, Compliance & Future Scalability

Unit Objectives 6



After the completion of this unit, the participant will be able to:

- 1. Explain the use of GIS tools for mapping fiber routes, infrastructure documentation, and asset tracking.
- 2. Show how to determine infrastructure requirements such as conduit paths, fiber types, distribution points, and access nodes.
- 3. Discuss tools and technologies for testing cables, real-time fault detection, and predictive maintenance in fiber networks.
- 4. Show how to ensure seamless splicing and terminations using precision splicing tools and low-loss connector practices.
- 5. Elucidate the role of automation and smart diagnostic tools in network testing and troubleshooting.
- 6. Demonstrate how to ensure alignment with regulatory and compliance requirements during FTTx network installation.
- 7. Describe how ONTs, OLTs, splitters, and IoT devices integrate within FTTx access networks.
- 8. Show how to select equipment and materials for scalability and future upgrades (e.g., migration to XGS-PON / 10G PON).
- 9. Discuss industry standards and guidelines issued by TRAI, Broadband Forum, and ITU-T related to fiber network deployment.
- 10. Demonstrate accurate documentation, reporting, and compliance verification for audit and certification.

Resources to be Used



Participant handbook, presentation slides, whiteboard or flipchart, markers, GIS mapping software screenshots or demo tools, sample conduit layout diagrams, fiber type charts, distribution point and access node visuals, splicing machine and precision cleavers, low-loss connectors, OTDR and power meter, smart diagnostic tools, regulatory guidelines from TRAI, Broadband Forum and ITU-T, documentation templates and compliance checklists for audit purposes.



- Hello, everyone! Welcome to this session on GIS-enabled planning, testing, and compliance in FTTx networks.
- The objective of this session is to understand how GIS tools, testing technologies, splicing practices, and compliance requirements support accurate and efficient fiber deployments. By the end of this session, you will be able to plan routes, test networks, perform seamless terminations, and document installations effectively.
- These skills are essential for ensuring reliable performance, reducing faults, and meeting industry standards in modern FTTx installations.



- Use presentation slides to explain GIS mapping, testing tools, splicing practices, and compliance steps.
- Encourage active participation and engage learners in short discussions.
- Share practical examples of route planning, fault detection, and documentation.
- Address questions and provide clarifications throughout the session.

Ask



- why is GIS mapping essential for modern FTTx deployments?
- What are key indicators for selecting conduit paths and fiber types?
- How do testing tools help reduce downtime in fiber networks?
- Why must splicing quality meet specific loss thresholds?
- What challenges arise without compliance to TRAI and ITU-T guidelines?

Elaborate



- Explain how GIS integrates layer-wise information—routes, manholes, poles, duct occupancy and access nodes.
- Discuss how the choice of fiber type and conduit size affects scalability and future upgrades.
- Describe the value of OTDR trace interpretation for detecting faults, bends and breaks.
- Elaborate on how automated diagnostic tools reduce downtime and improve network reliability.
- Connect regulatory alignment with network safety, service quality and long-term sustainability.
- Explain the importance of detailed documentation for certification and audit trails.

Demonstrate 🛱



Demonstrate how to navigate a GIS route map, identify critical infrastructure elements, use splicing tools for low-loss termination, interpret OTDR traces for fault detection, apply smart diagnostic tools in troubleshooting and complete compliance documentation for audit readiness.

Activity

- Activity Name: GIS Route Mapping & Testing Simulation
- Objective: To practice fiber route marking, identify infrastructure needs and interpret test results.
- Type of Activity: Group
- Resources: GIS route templates, sample OTDR traces, splicing tools (demo), documentation sheets.
- Time Duration: 35 minutes
- Instructions:
 - o Provide a sample GIS map with partial routes.
 - o Ask each group to determine conduit paths, fiber types and distribution points.
 - o Share test results (OTDR/VFL) and ask participants to identify fault locations.
 - o Complete a short compliance and documentation sheet.
 - Present findings to the class.
- Outcome: Participants gain practical exposure to GIS route planning, fault interpretation and compliance documentation.



- Encourage active participation and collaboration.
- Foster a positive and inclusive learning environment.
- Provide feedback and support throughout the session.
- Ensure safety precautions are followed during any hands-on activities.
- Emphasize the importance of understanding the different types of optical fiber cable constructs and their applications.

– Exercise 🛮 📝



Answers to exercises for PHB

Multiple Choice Questions:

- a) b)
- b) b)
- c) c)
- d) b)
- e) b)

Part B: True or False

- a) T
- b) T
- c) F
- d) T
- e) T

Part C: Fill in the Blanks

- a) OLT
- b) loss
- c) India
- d) Conduit

Short Answer Questions

- 1. They can find problems faster and more accurately than manual testing.
- 2. Any two of these: Distance, obstacles (like roads or rivers), existing infrastructure, or cost.
- 3. To make sure the network is safe, reliable, and works with equipment from different manufacturers.

otes 🗐		
	 	













4. Splicing Optical Fiber

Unit 4.1 - Fundamentals of Optical Fibers and Light Transmission

Unit 4.2 - Splicing Techniques, Tools, Preparations & Field Application

Unit 4.3 - Smart Network Integration, Fault Management & Performance Optimization



Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Discuss the basic physics of light transmission in optical fibers and how it relates to signal performance.
- 2. Elucidate the different splicing techniques (mechanical, fusion, twist, etc.), their applications, and best practices for minimizing splice loss and ensuring joint durability.
- 3. Describe the tools and equipment used for splicing, including fusion splicers, inspection tools, smart cleavers, and safety equipment, along with the proper handling of splicing consumables.
- 4. Explain the advanced characteristics of optical fibers and the features and functions of advanced splicing machines and testing equipment.
- 5. Discuss the techniques for splicing in challenging environments like outdoor, submarine, or underground networks, and how to mitigate environmental effects on fiber and splice joints.
- 6. Describe the use of fiber pigtails, connectorized fiber, routing inside junction boxes, and the various fiber jointing techniques.
- 7. Demonstrate how to check the availability and functionality of advanced optical testing tools such as OTDR, power meter, OSA, CD analyzer, and PMD analyzer.
- 8. Show how to check for availability and manage advanced splicing tools, including automated splicers, robotic arms, cleavers, and inspection tools.
- 9. Demonstrate how to manage splicing consumables like joint kits, connectors, heat shrink sleeves, and fiber optic enclosures.
- 10. Show how to ensure that splicing machines and testing equipment are calibrated and updated to meet precision standards, and coordinate repair or replacement of faulty tools.
- 11. Demonstrate how to locate and identify fibers for splicing using automated mapping tools and network plans, while checking for physical damage with advanced inspection tools.
- 12. Show how to prepare optical fibers for splicing by removing jackets, cleaning cores with automated systems, and securing cables within bend radius and stress limits.
- 13. Demonstrate how to install joint closures, splitters, and pigtails with weatherproofing, route connectorized fibers, and document compliance with network plans.
- 14. Explain the role of Al-powered tools for fault detection, predictive maintenance, and optimization in fiber networks.
- 15. Discuss the integration of splicing tasks with IoT-enabled smart network management systems and the principles of cloud-based systems for remote monitoring, reporting, and troubleshooting.
- 16. Describe the regulatory compliance practices for optical fiber installation and maintenance, and how they affect network planning and design.
- 17. Elucidate the advanced fusion splicing process, including fiber preparation, splicing machine operation, and ribbon fiber splicing techniques.
- 18. Discuss the proper use of splice closures (heat shrink vs. cold shrink) and sealing techniques for weatherproofing in various environments.
- 19. Explain the techniques and applications of crimp splicing, particularly in hybrid networks.

- 20. Describe the basics of Al-driven predictive maintenance tools used to monitor and optimize fiber networks.
- 21. Show how to identify fiber faults using OTDR, robotic arms, OFIs, and smart cleavers for maintenance in challenging environments.
- 22. Demonstrate how to coordinate with NOC for outage windows, perform fault inspections for microbends and environmental wear, clean fibers, replace damaged sections, re-splice fibers, and ensure proper weatherproofing of cables.
- 23. Demonstrate how to operate fusion splicing machines with automation to minimize errors, and perform various splicing methods (mechanical, fusion, ribbon, etc.) for different applications.
- 24. Show how to ensure splice quality using real-time diagnostics, precision cleavers, and advanced imaging tools, while sealing splices with heat-shrink or cold-shrink closures for protection.
- 25. Demonstrate how to perform micro and nano fiber splicing using specialized tools and document splicing details digitally.
- 26. Show how to use Al-enabled OTDR for fault detection and accurate loss measurement, and test signal quality with tools like OSA, CD analyzer, and PMD analyzer.
- 27. Demonstrate how to verify performance KPIs, generate automated reports for monitoring and compliance, and maintain documentation for network optimization.

UNIT 4.1: Fundamentals of Optical Fibers and Light Transmission

Unit Objectives ©



After the completion of this unit, the participant will be able to:

- 1. Explain the structure, types, and materials of optical fibers, including core, cladding, jacket, and optical properties such as attenuation, dispersion, and wavelength.
- 2. Discuss the basic physics of light transmission in optical fibers and how it affects signal performance.
- 3. Explain the advanced characteristics of optical fibers and the features and functions of advanced splicing/testing machines.
- 4. Describe the regulatory compliance practices for optical fiber installation and maintenance, and their impact on network planning and design.

Resources to be Used



Participant handbook, presentation slides, whiteboard or flipchart, markers, diagrams of fiber structure, samples of different fiber types, visuals of core-cladding interaction, attenuation/dispersion graphs, splicing machines, cleavers, OTDR and power meter visuals, safety equipment, and handouts on BIS/ITU-T compliance guidelines.



- Hello, everyone! Welcome to today's session on preparing for splicing operations for new installation.
- The objective of this session is to understand the key concepts and steps involved in preparing for splicing operations in optical fiber installations.
- At the end of this unit, you will be equipped with the knowledge to effectively prepare cables for splicing, understand the characteristics of optical fiber, and be familiar with the necessary equipment and procedures.



- Use the presentation slides to guide the session.
- Encourage active participation and engage participants in discussions.
- Share practical examples and experiences related to splicing operations.
- Address questions and provide clarifications as needed.



- What are some characteristics of optical fiber that are important to consider during splicing operations?
- Can you name some of the optical equipment used for splicing operations?
- Why is calibration of test equipment essential for accurate measurements and splicing?

Elaborate



- Characteristics of Optical Fiber, Splicing Equipment, Cable Specifications, Installation Procedures
 - o Discuss the characteristics of optical fiber, such as attenuation, bandwidth, dispersion, and connector compatibility.
 - Explain the various optical equipment used in splicing operations, including fusion splicers, cleavers, and fiber holders.
 - o Provide an overview of fiber optic cable specifications, including cable types, fiber count, colour coding, and buffer types.
 - o Describe the installation procedures for optical fiber cables, covering cable pulling, routing, and securing.
 - o Discuss the testing and closing activities involved in optical fiber installations, including power meter testing, OTDR testing, and closure sealing.
- Importance of Reporting and Documentation, Calibration, Cable Preparation, and Bands
 - o Explain the importance of reporting and documentation in maintaining accurate records of the installation process.
 - o Introduce the instruments used for testing and splicing, such as power meters, OTDRs, and visual fault locators.
 - o Discuss the calibration process for test equipment and its role in ensuring accurate measurements.
 - o Present the steps involved in preparing the cable for splicing, including cable stripping, cleaning, cleaving, and fiber protection.
 - o Explain the concept of bands in optical fiber, their usability, and their impact on loss characteristics.

Demonstrate



Demonstrate the cable preparation process, including cable stripping, cleaning, and cleaving, using the appropriate tools and techniques.

Activity



- Activity name: Cable Preparation Challenge
- **Objective:** To reinforce the understanding of cable preparation steps and develop proficiency in performing cable preparation for splicing.
- Type of activity: Individual
- **Resources:** Fiber optic cable samples, Cable stripping tools, Cable cleaning materials (lint-free wipes, alcohol), Fiber cleavers, Fusion splicers (if available).
- Time Duration: 30 minutes
- Instructions:
 - Distribute fiber optic cable samples and necessary tools to each participant.
 - Instruct participants to perform the cable preparation steps (stripping, cleaning, cleaving) following the correct procedures.
 - o Encourage participants to pay attention to details and maintain proper technique.
 - After completing the cable preparation, invite participants to inspect and evaluate their work.

- o Facilitate a discussion to address any questions or challenges encountered during the activity.
- Emphasize the importance of accuracy and precision in cable preparation for successful splicing.
- o Summarize the key learnings from the activity and relate them to the overall objective of preparing for splicing operations.
- Outcome: Participants will gain hands-on experience in cable preparation techniques and develop confidence in performing the necessary steps for splicing.



- Create a supportive and inclusive learning environment.
- Encourage active participation and collaboration.
- Provide timely feedback and clarification.
- Adapt the pace and content based on participants' level of understanding.
- Emphasize the importance of following proper cable preparation techniques for successful splicing.
- Encourage participants to ask questions and actively engage in discussions to enhance their learning experience.
- Provide additional resources or references for further exploration of the topic.

UNIT 4.2: Splicing Techniques, Tools, Preparations & Field **Application**

Unit Objectives 6



After the completion of this unit, the participant will be able to:

- 1. Elucidate different splicing techniques (mechanical, fusion, twist, etc.), their applications, and best practices for minimizing splice loss and ensuring joint durability.
- 2. Describe the tools and equipment used for splicing (fusion splicers, inspection tools, smart cleavers, etc.) and proper handling of splicing consumables.
- 3. Describe the use of fiber pigtails, connectorized fiber, routing inside junction boxes, and the various fiber jointing techniques.
- 4. Demonstrate how to manage splicing consumables like joint kits, connectors, heat shrink sleeves, and fiber optic enclosures.
- 5. Show how to prepare optical fibers for splicing by removing jackets, cleaning cores with automated systems, and securing cables within bend radius and stress limits.
- 6. Explain advanced fusion splicing, including fiber preparation, machine operation, and ribbon splicing.
- 7. Discuss proper use of splice closures and sealing methods for weatherproofing.
- 8. Demonstrate automated fusion splicing and perform mechanical, fusion, and ribbon splicing.
- 9. Explain crimp splicing techniques and applications in hybrid networks.
- 10. Demonstrate micro and nano fiber splicing using specialized tools and document results digitally.

Resources to be Used



Participant handbook, Presentation slides, whiteboard or flipchart, markers, samples of optical fiber cables, splicing equipment (fusion splicer, cleaver, etc.), cleaning materials, microscope or magnifying glass, handouts or reference materials on splicing techniques, mechanical splicing, fusion splicing, and examining splicing joints



- Good day, everyone! Welcome to today's session on the splicing of optical fiber.
- The objective of this session is to understand the techniques involved in splicing optical fiber, distinguish between mechanical splicing and fusion splicing, and learn how to examine the quality of splicing joints.
- Understanding splicing techniques is crucial for achieving reliable and efficient optical fiber connections.
- By mastering splicing methods and examining splicing joints, you'll be able to ensure optimal performance and minimize signal loss in fiber optic networks.



- Use the presentation slides to guide the session.
- Encourage active participation and engage participants in discussions.
- Share practical examples and experiences related to splicing operations.
- Address guestions and provide clarifications as needed.

Ask



- What is the difference between mechanical splicing and fusion splicing?
- Why is it important to examine the quality of splicing joints?
- What are some factors to consider when evaluating a splicing joint?

Elaborate



- Process, Quality Examination, and Interpretation of Splicing Joints
 - o Demonstrate the splicing of optical fiber, explaining the step-by-step process and the use of splicing equipment.
 - o Distinguish between mechanical splicing and fusion splicing, highlighting the advantages and limitations of each technique.
 - o Discuss the importance of examining the quality of splicing joints, including factors such as fiber alignment, fusion quality, and splice loss.
 - o Explain the techniques and tools used to examine splicing joints, such as microscopes or magnifying glasses.
 - o Provide guidelines on how to interpret and evaluate splicing joint characteristics, such as splice loss, fiber position, and fusion quality.

Demonstrate



Demonstrate the process of fusion splicing, showcasing the use of fusion splicer and cleaver to create a splicing joint.

Activity



- Activity name: Splice Examination Challenge
- **Objective:** To reinforce the understanding of splicing joint examination and develop proficiency in evaluating splicing quality.
- Type of activity: Individual
- Resources: Samples of spliced optical fiber cables, Microscopes or magnifying glasses
- Time Duration: 30 minutes
- Instructions:
 - Distribute samples of spliced optical fiber cables and microscopes/magnifying glasses to each participant.
 - Instruct participants to examine the splicing joints carefully using the provided tools.
 - Encourage participants to assess the quality of the splicing joints based on factors discussed during the session.
 - Ask participants to document their observations and evaluate the splicing quality.
 - Facilitate a discussion to share and compare the participants' findings.
 - Summarize the key aspects of splicing joint examination and provide feedback on the participants' evaluations.
- **Outcome:** Participants will gain hands-on experience in examining splicing joints and develop the ability to evaluate splicing quality effectively.



- Create a supportive and inclusive learning environment.
- Encourage active participation and collaboration.
- Provide timely feedback and clarification.
- Adapt the pace and content based on participants' level of understanding.
- Highlight the advantages and limitations of mechanical splicing and fusion splicing methods.
- Encourage participants to practice splicing techniques and regularly examine splicing joints to improve proficiency.
- Provide additional resources or references for further exploration of splicing techniques and joint examination.

UNIT 4.3: Smart Network Integration, Fault Management & **Performance Optimization**

- Unit Objectives 🎯



After the completion of this unit, the participant will be able to:

- 1. Demonstrate how to check the availability and functionality of advanced optical testing tools such as OTDR, power meter, OSA, CD analyzer, and PMD analyzer.
- 2. Discuss integration of splicing tasks with IoT-enabled smart network management systems, cloudbased monitoring, and remote troubleshooting.
- 3. Demonstrate coordination with NOC for outage windows and perform inspection, cleaning, resplicing, and weatherproofing to restore service.
- 4. Show how to use AI-enabled OTDR and advanced analyzers (OSA, CD, PMD) for loss measurement and quality testing.
- 5. Demonstrate how to verify KPIs, generate automated compliance reports, and maintain documentation for network optimization.
- 6. Discuss techniques for splicing in challenging environments (outdoor, submarine, underground) and how to mitigate environmental effects.
- 7. Demonstrate how to check availability and functionality of advanced optical testing tools (OTDR, power meter, OSA, CD & PMD analyzers).
- 8. Show how to check for availability and manage advanced splicing tools (automated splicers, robotic arms, cleavers, inspection tools).
- 9. Demonstrate how to manage splicing consumables (joint kits, connectors, heat-shrink sleeves, enclosures).
- 10. Show how to ensure calibration, firmware updates, and repair coordination for splicing and testing equipment.
- 11. Demonstrate how to locate and identify fibers for splicing using mapping tools and network plans and check physical damage with inspection tools.
- 12. Show how to prepare optical fibers for splicing (removal, cleaning, bend radius control, stress management).
- 13. Demonstrate installation of closures, splitters, pigtails with weatherproofing and documentation compliance.
- 14. Elucidate the advanced fusion splicing process including ribbon splicing and machine configuration.
- 15. Discuss proper use of splice closures (heat shrink vs. cold shrink) and sealing for weatherproofing.
- 16. Explain techniques and applications of crimp splicing in hybrid networks.
- 17. Show how to identify fiber faults using OTDR, robotic arms, OFIs, and smart cleavers in tough environments.
- 18. Demonstrate operation of automated fusion splicing machines and perform mechanical, fusion, and ribbon splicing.
- 19. Show how to ensure splice quality using real-time diagnostics, precision cleavers, advanced imaging, and seal closures.
- 20. Demonstrate micro and nano fiber splicing using specialized tools and document results digitally.

Resources to be Used



Participant handbook, Presentation slides, whiteboard or flipchart, markers, samples of optical fiber cables, optical power meters, optical time-domain reflectometers (otdr), duct integrity testing equipment, handouts or reference materials on optical transport media principles, signal strength and quality kpis, and duct integrity testing processes

- Hello, everyone! Welcome to today's session on the maintenance of fiber optics.
- The objective of this session is to discuss the principles of optical transport media, understand the signal strength and quality key performance indicators (KPIs) of optical fiber cables, and explain the standard process and importance of performing duct integrity tests.
- By understanding these topics, you will gain the knowledge and skills necessary to ensure optimal performance and reliability of fiber optic networks. Maintaining signal quality, monitoring performance metrics, and conducting tests are essential for proactive maintenance and troubleshooting.



- Use the presentation slides and visual aids to guide the session.
- Encourage active participation and engage participants in discussions.
- Share practical examples and experiences related to fiber optics maintenance.
- Address questions and provide clarifications as needed.



- What are some key performance indicators (KPIs) used to measure the signal strength and quality of optical fiber cables?
- Why is it important to perform duct integrity tests in fiber optic installations?
- What are some common challenges or issues that can arise during fiber optics maintenance?

Elaborate



- Principles, Strength and Quality, Duct Integrity Testing, and Maintenance
 - o Discuss the principles of optical transport media, including light propagation, transmission modes, and key components.
 - o Explain the signal strength and quality KPIs of optical fiber cables, such as optical power, attenuation, and bit error rate (BER).
 - o Describe the standard process for performing duct integrity tests, emphasizing the need to ensure proper cable protection and prevent damage.
 - Highlight the importance of regular maintenance activities, such as cleaning connectors, monitoring performance metrics, and conducting periodic inspections.

Demonstrate



Demonstrate the process of measuring optical power using an optical power meter and interpreting the results.

Activity



- Activity name: Signal Quality Assessment
- **Objective:** To reinforce the understanding of signal strength and quality assessment in optical fiber cables.
- Type of activity: Group
- **Resources:** Samples of optical fiber cables, Optical power meters or optical time-domain reflectometers (OTDR)
- Time Duration: 30 minutes
- Instructions:
 - O Divide participants into groups of 3-4.
 - o Provide each group with a sample of optical fiber cable and an optical power meter or OTDR.
 - o Instruct groups to measure the optical power or use the OTDR to analyze the cable's signal strength and quality.
 - o Encourage groups to discuss and interpret the results, considering the relevant KPIs discussed during the session.
 - Facilitate a group discussion to share findings, compare results, and identify any issues or discrepancies.
 - Summarize the key aspects of signal quality assessment and provide feedback on the participants' analysis.
- **Outcome:** Participants will gain hands-on experience in assessing signal strength and quality in optical fiber cables and develop the ability to interpret measurement results effectively.



- Create a supportive and inclusive learning environment.
- Encourage active participation and collaboration.
- Provide timely feedback and clarification.
- Adapt the pace and content based on participants' level of understanding.
- Emphasize the importance of regular monitoring and maintenance to ensure optimal performance of fiber optic networks.
- Highlight the significance of duct integrity tests in preventing damage to cables and ensuring long-term reliability.

Exercise



Answers to exercises for PHB

Multiple Choice Questions:

- 1. a. normal
- 2. a. unpolarised light
- 3. a. attenuation
- 4. a. protector
- 5. a. Drum wrappers

Descriptive Questions:

- 1. Refer to Unit 4.1 Prepare for Splicing Operations for New Installation Topic 4.1.1 Characteristics of Optical Fiber
- 2. Refer to Unit 4.1 Prepare for Splicing Operations for New Installation Topic 4.1.1 Characteristics of Optical Fiber
- 3. Refer to Unit 4.1 Prepare for Splicing Operations for New Installation Topic 4.1.4 Installing Optical Fiber Cables
- 4. Refer to Unit 4.1 Prepare for Splicing Operations for New Installation Topic 4.1.4 Installing Optical Fiber Cables
- 5. Refer to Unit 4.1 Prepare for Splicing Operations for New Installation Topic 4.1.4 Installing Optical Fiber Cables

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5. Installation of Passive FTTH/X Components

Unit 5.1 - Passive Components, Splitters, Fiber Routing & Management Unit 5.2 - Optical Power Testing and Network Signal Validation



Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Explain the process of installing passive FTTH/X components like splitters and their role in fiber networks.
- 2. Describe the steps involved in performing terminal connections, including single incoming and multiple outgoing configurations.
- 3. Determine the methods for conducting power and insertion loss tests to ensure optimal network performance.
- 4. Discuss the fundamentals of GPON technologies, loss budgets, and advanced transmission mechanisms in fiber networks.

UNIT 5.1: Passive Components, Splitters, Fiber Routing & Management

Unit Objectives | ©



After the completion of this unit, the participant will be able to:

- 1. Demonstrate how to identify and assess passive components, including PLC and FBT splitters, for different deployment environments.
- 2. Show how to install wall-mount and rack-mount splitters (1x8, 1x16, 1x32) using precision tools.
- 3. Discuss the roles of ONTs, OLTs, and splitters in GPON networks.
- 4. Discuss fiber management practices (slack, connectors, scalability).
- 5. Show how to identify and organize feeder and distribution fiber routing.
- 6. Demonstrate fiber management techniques for secure and scalable deployment.
- 7. Demonstrate using advanced connectors (SC, LC, APC).
- 8. Demonstrate final connector polishing to reduce insertion loss.
- 9. Show how to install and configure passive components compatible with GPON and NG-PON2
- 10. Demonstrate splitter configuration for broadcast-based GPON deployments.

Resources to be Used



Participant handbook, Presentation slides, whiteboard or flipchart, markers, samples of FTTH/X network components (e.g., optical splitters, cables, pigtails), wall mount splitter installation demonstration materials, handouts or reference materials on FTTH/X network basics and optical splitter types



- Hello, everyone! Welcome to today's session on the Introduction to FTTH/X Network and its Components.
- The objective of this session is to explain the basics of the FTTH/X network, identify passive network components and their deployment environment, and understand the working and usages of optical splitters.
- Understanding these topics is crucial as FTTH/X networks are becoming increasingly prevalent in providing high-speed broadband services.
- By grasping the fundamentals and components, you'll be able to contribute effectively to the planning, installation, and maintenance of such networks.

- Use the presentation slides and visual aids to guide the session.
- Encourage active participation and engage participants in discussions.
- Share real-world examples and case studies to illustrate the concepts of fiber installation.
- Address questions and provide clarifications as needed.

Ask



- What do you think can be the benefits of deploying an FTTH/X network?
- What are some passive network components used in FTTH/X networks?

Elaborate |



- Basics of FTTH/X Networks, Passive Network Components, and Optical Splitters
 - o Explain the basics of the FTTH/X network, including its architecture, advantages, and applications.
 - o Identify passive network components, such as fiber distribution hubs (FDHs), fiber distribution panels (FDPs), splice closures, and drop cables, and discuss their deployment environment.
 - o Describe the working principle of optical splitters and their role in splitting optical signals for multiple connections.
- Types of Optical Splitters, Ground Installation Requirements, Wall Mount Installation, and Network Device Connections in Fiber Networks
 - o Identify different types of optical splitters, such as PLC (Planar Lightwave Circuit) splitters and FBT (Fused Biconical Taper) splitters, and explain their features and applications.
 - o Discuss the specific requirements for selecting and installing splitters on the ground to meet network design specifications.
 - o Demonstrate the installation process for wall mount splitters, showcasing proper cable management and connection techniques.
 - o Identify feeder and distribution ports, cables/pigtails, and connections on network devices, emphasizing the importance of accurate labeling and documentation.

Demonstrate



Demonstrate the installation of a wall mount splitter, showing the step-by-step process, cable management techniques, and proper connector termination.

Activity



- Activity name: Component Identification
- **Objective:** To reinforce the identification of FTTH/X network components and their characteristics.
- Type of activity: Group
- **Resources:** Samples of FTTH/X network components (e.g., splitters, cables, pigtails), Handouts with labelled diagrams of network components
- Time Duration: 30 minutes
- Instructions:
 - Divide participants into groups of 3-4.
 - o Provide each group with samples of FTTH/X network components and handouts with labeled diagrams.
 - o Instruct groups to match the components to the corresponding labels on the diagrams.

- Encourage groups to discuss the characteristics, functions, and deployment environments of the identified components.
- Facilitate a group discussion to share findings, compare responses, and address any questions or uncertainties.
- Summarize the key features and roles of the components and provide feedback on the participants' identification.
- **Outcome:** Participants will enhance their ability to identify and understand the characteristics of FTTH/X network components.



- Foster an inclusive and respectful learning environment.
- Encourage active participation and engagement from all participants.
- Adapt the pace and level of instruction to meet the participants' needs.
- Emphasize the importance of proper installation techniques to ensure optimal performance and reliability of the network.
- Discuss the advantages and limitations of different optical splitter types to guide appropriate selection for specific network requirements.

UNIT 5.2: Optical Power Testing and Network Signal Validation

Unit Objectives | 🎯 |



After the completion of this unit, the participant will be able to:

- 1. Describe power testing techniques including insertion loss, reflection, and validation.
- 2. Show how to conduct insertion loss and reflection testing using OLTS/OTDR.
- 3. Show how to measure power output at distribution ports using precision power meters.
- 4. Show how to validate network performance parameters for GPON and NG-PON2 compliance.
- 5. Determine loss budget concepts and best design practices.
- 6. Demonstrate how to analyze and calculate loss budgets considering WDM/TDMA.
- 7. Analyze the impact of components on loss budgets and optimize designs.
- 8. Explain emerging diagnostic tools like Al-enabled OTDR & advanced OLTS.
- 9. Show how to use AI-enabled diagnostic tools for real-time fault detection and troubleshooting.
- 10. Describe safety protocols for optical fiber handling and PPE usage.
- 11. Explain best practices for documentation, loss budgets, testing results, and troubleshooting records.

Resources to be Used



Participant handbook, Power meters, optical splitter, optical power source, test cables, reference cables, testing documentation or worksheets



- Good day, everyone! Welcome to today's session on Testing Various Parameters.
- In this session, we will cover power testing, insertion loss measurement of optical splitters, and power output measurement of optical splitters.
- Understanding these testing parameters is crucial for ensuring the performance and reliability of optical networks.
- By mastering these techniques, you'll be able to accurately assess the power levels, identify losses, and optimize the performance of optical splitters.



- Begin the session by providing an overview of the topics to be covered.
- Use visual aids, diagrams, and practical examples to enhance understanding.
- Encourage participants to ask questions and participate in discussions.
- Provide clear instructions and guidelines for conducting tests accurately.

Ask ask



- What do you think is the purpose of power testing in optical networks?
- Why is it important to measure the power output of an optical splitter accurately?

Elaborate |



- Power Test:
 - o Explain the significance of power testing to ensure adequate signal levels in optical networks.
 - o Discuss the different types of power meters and their usage in measuring optical power levels.
 - o Outline the testing procedure for power measurement and interpretation of the results.
- Insertion Loss of Optical Splitter:
 - o Describe the concept of insertion loss and its impact on network performance.
 - o Explain the testing method for measuring insertion loss, including the use of reference cables.
 - o Emphasize the importance of accurate measurements and interpretation of the results.
- Power Output Measurement of Optical Splitter:
 - o Discuss the role of power output measurement in assessing the performance of optical splitters.
 - o Explain the testing procedure for measuring power output, including the use of an optical power
 - o Highlight the significance of obtaining consistent and reliable measurements.

Demonstrate **F**



Demonstrate the power testing procedure using a power meter and an optical source, showcasing the connection setup, measurement process, and result interpretation.

Activity



- Activity name: Insertion Loss Measurement
- Objective: To practice measuring insertion loss of an optical splitter.
- Type of activity: Group
- Resources: Optical splitter, Power meter, Test cables, Reference cables, Worksheets or testing documentation
- Time Duration: 30 minutes
- Instructions:
 - o Divide participants into groups of 3-4.
 - o Provide each group with an optical splitter, a power meter, test cables, and reference cables.
 - Instruct each group to connect the optical splitter to the power meter using the test cables.
 - o Guide participants in setting up the reference cables for accurate insertion loss measurement.
 - Ask groups to measure the insertion loss of the optical splitter using the power meter.

- o Have each group record their measurements on the provided worksheets or testing documentation.
- o Facilitate a group discussion to compare results, discuss challenges, and share best practices.
- o Summarize the key considerations for accurate insertion loss measurement and address any questions or uncertainties.
- Outcome: Participants will gain practical experience in measuring insertion loss using a power meter and understand the factors influencing accurate measurements.



- Foster a collaborative learning environment where participants feel comfortable asking questions and sharing their insights.
- Encourage active engagement by facilitating discussions and group activities.
- Provide clear instructions and demonstrations to ensure participants understand the testing procedures.
- Offer support and guidance during hands-on activities to promote successful learning outcomes.
- Emphasize the importance of calibration and accurate measurement techniques for reliable testing
- Highlight the significance of documentation and record-keeping for future reference and troubleshooting purposes.

- Exercise



Answers to exercises for PHB

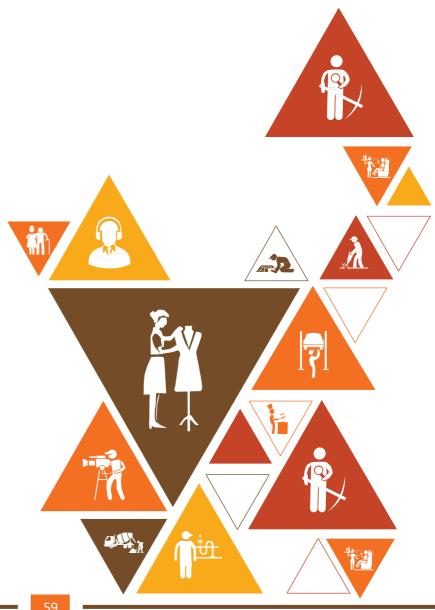
Multiple Choice Question

- 1. b. Fiber To The Home
- 2. c. Optical Network Terminal (ONT)
- 3. c. Optical Splitters
- 4. a. Pigtails
- 5. a. decibels (dB)

Descriptive Questions:

- Refer to Unit 5.2 Optical Power Testing and Network Signal Validation Topic 5.2.2 Insertion Loss of Optical Splitter
- 2. Refer to Unit 5.2 Optical Power Testing and Network Signal Validation Topic 5.2.1 Power Test
- 3. Refer to Unit 5.1 Passive Components, Splitters, Fiber Routing & Management Topic 5.1.7 Feeder and Distribution Ports and Pigtails
- 4. Refer to Unit 5.1 Passive Components, Splitters, Fiber Routing & Management Topic 5.1.4 Optical Splitter
- Refer to Unit 5.1 Introduction to FTTH/X Network and its Components Topic 5.1.4 Optical Splitter

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6. In-building FTTH/X Cabling

Unit 6.1 - Basics of Fiber Optics

Unit 6.2 - Installation of Optical Fibers

Unit 6.3 - Testing Installed Network



Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Explain the process of cable installation through cable trays in both horizontal and vertical orientations.
- 2. Describe the key steps involved in cable installation through conduits.
- 3. Discuss the challenges and best practices for cable installation through false ceilings.
- 4. Elucidate the termination process at ONT and TO in fiber-optic networks.
- 5. Determine the essential requirements for IoT and Smart Home Network readiness.
- 6. Explain the procedures and considerations for FTTH GPON customer installation.
- 7. Describe the components and functionalities of Triple-Play Services, including High-Speed Internet, VoIP, and IPTV.
- 8. Discuss the cybersecurity considerations in FTTH/X installations to ensure data protection and network security.
- 9. Elucidate the concept of the Internet of Everything (IoE) and its impact on modern digital ecosystems.

UNIT 6.1: Basics of Fiber Optics

Unit Objectives ©



After the completion of this unit, the participant will be able to:

- 1. Explain the types and characteristics of fiber optic cables, including bend radius, tensile strength, and fusion splicing techniques.
- 2. Discuss the role of fiber networks in supporting cloud gaming, ultra-low latency applications like High-Frequency Trading (HFT), and Industry 4.0 applications such as automation, robotics, and real-time data monitoring in smart manufacturing.
- 3. Elucidate the IoT and IoE device types, their connectivity requirements, and network configurations, and the role of FTTH in IoE.
- 4. Describe the key FTTH GPON components, their functions, and GPON technology including splitters, ONT configuration, and VLAN management.
- 5. Explain the basics of network security, including encryption protocols, firewalls, access control mechanisms, and cybersecurity considerations in FTTH networks.
- 6. Describe Safety, Health, and Environmental (SHE) and occupational health and safety (OHS) regulations for fiber installations.
- 7. Explain the role of Al-driven network management and automation tools for monitoring fiber performance and diagnosing faults remotely.
- 8. Describe the Triple-Play service requirements (internet, voice, video) and their impact on network infrastructure, and how to optimize Quality of Service (QoS) parameters, such as latency, jitter, and throughput.
- 9. Discuss future trends in IoE, innovations in smart home technologies, and the impact of these developments on triple-play services.
- 10. Show how to identify the scope of IoE and its impact on FTTH network design and installation, integrate IoE-compatible devices into the FTTH network ensuring seamless communication between devices, and follow future trends in IoE while identifying scalable network solutions for customers.

Resources to be Used



Participant handbook, Fiber optic cables (different types and characteristics), fiber handling tools (e.g., cable cutters, strippers, splicers), visual aids (diagrams, charts, images), fiber cable components samples (strength members, cable sheath, core, cladding), vlf (very low frequency) testing equipment

- Hello, everyone! Welcome to today's session on the Basics of Fiber Optics.
- In this session, we will explore the fundamental aspects of fiber optics, including cable types, fiber handling practices, cable components, and the VLF principle and testing features.
- Understanding these basics is crucial for anyone working with fiber optic networks.
- By grasping the concepts, you'll be able to identify different cable types, handle fiber properly, comprehend cable components, and apply VLF testing for reliable network performance."

Do



- Begin the session with an overview of the topics to be covered, setting the context for participants.
- Use visual aids and real-life examples to enhance understanding and engagement.
- Encourage active participation by asking questions, facilitating discussions, and inviting participants to share their experiences or insights.
- Explain the VLF principle and demonstrate the testing features using appropriate equipment.

Ask 🖺



- Can you name any type of fiber optic cables used in in-building deployments?
- Why is it important to follow appropriate fiber handling practices?
- Can you name some essential components of a fiber optic cable and describe their functions?

Elaborate |



- Fiber optic cable types and characteristics for in-building deployments:
 - o Differentiate between single-mode and multimode cables.
 - o Understand the characteristics and applications of each type.
- Fiber handling practices:
 - o Explain the importance of cleanliness and avoiding bending or twisting the fiber.
 - o Showcase proper techniques for cutting, stripping, and splicing fiber cables.
- Fiber cable components (strength members, cable sheath, core, cladding, etc.):
 - o Identify the different parts of a fiber optic cable and their roles.
 - o Discuss the characteristics and materials used in each component.
- VLF principle and testing features:
 - o Explain the concept of Very Low Frequency (VLF) testing and its benefits.
 - o Outline the testing procedure and the equipment used for VLF testing.

Demonstrate



Demonstrate proper fiber handling practices, including cable cutting, stripping, and splicing, using the appropriate tools and techniques.

Activity

- Activity name: Fiber Cable Identification
- **Objective:** To practice identifying fiber optic cable types and their characteristics.
- Type of activity: Group
- Resources: Samples of different fiber optic cables (single-mode and multimode), Visual aids with cable type characteristics
- Time Duration: 30 minutes
- Instructions:
 - O Divide participants into groups of 3-4.
 - o Provide each group with samples of different fiber optic cables.
 - o Instruct groups to examine the cables closely and identify the cable types (single-mode or multimode).
 - Ask groups to discuss and list the characteristics or features that differentiate each cable type.
 - Allow time for each group to present their findings and discuss any variations or similarities.
 - o Facilitate a group discussion to reinforce understanding and address any questions or misconceptions.
- Outcome: Participants will enhance their ability to distinguish fiber optic cable types and understand their respective characteristics.



- Create a positive and inclusive learning environment.
- Encourage active participation and respect diverse perspectives.
- Use clear and concise language to explain technical concepts.
- Foster collaboration and teamwork during group activities.
- Emphasize the importance of cleanliness and careful handling to maintain fiber integrity.
- Highlight the significance of cable component identification for troubleshooting and installation purposes.

UNIT 6.2: Installation of Optical Fibers

Unit Objectives ©



After the completion of this unit, the participant will be able to:

- 1. Discuss the tools for fiber installation (e.g., fish tape, splicing machines, OTDR, VFL) and the techniques to measure signal loss and maintain network performance.
- 2. Demonstrate how to check and prepare customer premises for installing Customer Premises Equipment (CPE), follow GPON installation procedures ensuring correct splitter connections and fiber termination, and conduct comprehensive tests for connectivity and data speeds at the customer's end using tools like OTDR and fiber testers.
- 3. Show how to ensure proper sealing of conduits to avoid dust, moisture, or pest intrusion.
- 4. Demonstrate how to check the site as per the building layout plan, identify the cabling path from the outdoor fiber landing point to the ONT installation point, and determine horizontal and vertical cable lengths, considering slack for maintenance and future upgrades.
- 5. Show how to check load compliance of cable trays, ensure compatibility with existing services like power and data cables, and lay fiber along tray tracks using proper pulling techniques, ensuring no damage to the cable jacket or core.
- 6. Demonstrate how to secure fibers in the trays, maintaining proper slack and tension to avoid overtensioning in vertical runs and ensure proper grounding of metallic trays in line with safety standards.
- 7. Demonstrate how to pull fiber through conduits using appropriate tools, secure excess fiber (minimum of 3 meters) at termination points for maintenance purposes and inspect conduit integrity to prevent electromagnetic interference or mechanical damage.
- 8. Demonstrate how to install cables through false ceilings using the figure-8 method to prevent tangling or cable stress, secure cables in conduits above false ceilings to prevent dislodgement and ensure slack management.
- 9. Show how to ensure accessibility for future maintenance by marking cable routes clearly.
- 10. Demonstrate how to terminate and connectorize fiber at the ONT, ensuring signal integrity and minimal loss, power up and configure the ONT for operational readiness, and conduct live fiber testing using tools like Visual Fault Locator (VFL) and power meters to confirm signal integrity.
- 11. Demonstrate how to determine IoT device connectivity requirements such as bandwidth and latency, install network elements or CPEs for IoT devices, and configure ONTs to support IoT devices like smart thermostats, cameras, and voice assistants.
- 12. Demonstrate how to optimize FTTH installations for emerging IoE applications, ensuring minimal latency and maximum reliability.

Resources to be Used



Participant handbook, Fiber fusion splicer, inspection tools (e.g., site plans, measuring tape), cable management materials (cable ties, trays, slack storage), load compliance measurement tools, conduit installation materials (conduits, false ceiling samples), fiber pulling tools (fish tape, strength member, fiber termination materials (connectors, termination boxes)

Say



- Hello, everyone! Welcome to today's session on the Installation of Optical Fibers.
- In this session, we will cover various aspects of fiber optic cable installation, including fusion splicing, site inspection, cable slack management, cable length calculation, cable tray load compliance, conduit installation, fiber pulling, and securing excess fiber.
- Understanding these installation techniques and best practices is essential for ensuring proper fiber optic network connectivity, performance, and reliability.
- By mastering these skills, you'll be able to install optical fibers efficiently and effectively.

Do



- Begin the session by providing an overview of the topics to be covered, setting the context for participants.
- Use visual aids, diagrams, and real-life examples to enhance understanding and engagement.
- Encourage active participation by asking questions, facilitating discussions, and inviting participants to share their experiences or insights.

Ask ask



- What is fusion splicing, and why is it important in fiber optic cable installation?
- Why is it necessary to inspect the site before installation?

Elaborate |



- Fusion splicing:
 - Explain the concept and benefits of fusion splicing.
 - o Highlight the importance of achieving low splice losses and maintaining fiber alignment.
- Inspection of the sites to identify the cabling path:
 - o Explain the purpose and process of site inspection.
 - o Provide guidelines for identifying the optimal cabling path from the outdoor fiber landing point to the ONT installation point.
 - o Discuss potential obstacles or considerations during the inspection.
- Explain the importance and relevance of managing cable slack and cable management:
 - o Discuss the impact of cable slack on installation, maintenance, and future upgrades.
 - o Explain different cable management techniques and materials.
 - o Emphasize the importance of proper cable organization, routing, and securing.
- Calculate the horizontal and vertical cable length to manage cable slack:
 - o Explain how to calculate the cable length needed for horizontal and vertical runs.
 - o Discuss factors influencing cable length calculations, such as bends, slack storage, and service loops.
- Measure the pre-existing load and post-installation load compliance of the cable trays:
 - o Explain the importance of load compliance in cable tray installation.
 - o Demonstrate the process of measuring load compliance using appropriate tools.
 - o Discuss the significance of load compliance for cable protection and network performance.

- o Demonstrate the process of measuring load compliance using appropriate tools.
- o Discuss the significance of load compliance for cable protection and network performance.
- Cable installation through conduits on false ceiling: Explain the process of conduit installation on a false ceiling.
 - o Highlight considerations for maintaining cable integrity during the installation process.
- Fiber pulling through conduits using appropriate tools (like fish tape) and technique (strength member):
 - o Explain the purpose and steps involved in fiber pulling through conduits.
 - o Demonstrate the use of tools such as fish tape and strength members.
 - Highlight best practices for minimizing tension and protecting the fiber during pulling.
- Secure excess fiber at the termination point:
 - o Explain the importance of securing excess fiber and managing termination points.

Demonstrate F



Demonstrate the process of fusion splicing using a fusion splicer.

Activity



- Activity name: Cable Slack Management
- Objective: To practice calculating and managing cable slack in a simulated installation scenario.
- Type of activity: Group
- Resources: Simulated cable lengths, cable ties, cable trays, measuring tape, scissors.
- Time Duration: 20-30 minutes
- Instructions:
 - O Divide participants into groups of 3-4.
 - o Provide each group with simulated cable lengths and cable management materials.
 - o Instruct participants to calculate the required cable length and manage the cable slack using cable ties, cable trays, or other appropriate techniques.
 - o Encourage participants to discuss their approaches, collaborate, and troubleshoot any challenges.
 - o Allocate time for each group to present their cable slack management solutions to the rest of the
- Outcome: Participants will gain hands-on experience in calculating and managing cable slack, as well as insights into different cable management techniques.

Notes for Facilitation



- Encourage active participation and create a supportive learning environment.
- Provide clear instructions and demonstrate techniques whenever possible.
- Foster collaboration and group discussions to enhance learning and knowledge sharing.
- Address questions and concerns promptly, promoting a two-way communication flow.
- Emphasize the significance of fusion splicing for achieving low loss and reliable fiber connections.

UNIT 6.3: Testing Installed Network

Unit Objectives ©



After the completion of this unit, the participant will be able to:

- 1. Show how to validate ONT connectivity to IoT devices and smart home systems, ensuring proper data throughput.
- 2. Show how to identify potential cybersecurity vulnerabilities in FTTH installations and mitigate risks using secure installation practices, configure ONTs with secure settings including password protection, encryption protocols, and firewalls, and conduct penetration tests to identify potential security risks and validate network integrity.
- 3. Elucidate the documentation requirements for installation, testing, and cybersecurity compliance.
- 4. Demonstrate how to provide customers with guidelines for maintaining network security, including password updates and device firmware updates.
- 5. Show how to troubleshoot network issues related to CPE, resolve common complaints related to fiber connectivity, signal loss, and ONT/router configurations, and provide basic troubleshooting training to customers, explaining technical details in easy terms and addressing their concerns.
- 6. Show how to determine the infrastructure requirements for Triple-Play services, configure ONT settings to enable these services, and test High-Speed Internet, VoIP, and IPTV services for Quality of Service (QoS) parameters like latency, jitter, and packet loss.
- 7. Show how to test IoT device compatibility with installed FTTH networks to ensure seamless integration and coordinate with customers for specific IoT device setups and provide technical guidance.
- 8. Demonstrate how to coordinate with service providers to address issues with VoIP call quality, IPTV buffering, or internet speeds.

Resources to be Used



Participant handbook, Optical Network Terminal (ONT), Telecommunication Outlet (TO), IP network for ONT configuration and testing, Visual Fault Locator (VFL), Fiber detection meter, Test record sheets



- In this session, we will cover the essential steps and tools involved in testing an installed fiber optic network.
- We will learn how to terminate fibers at the Optical Network Terminal (ONT) and Telecommunication Outlet (TO), configure the ONT, conduct network tests using an IP network, operate a Visual Fault Locator (VFL), test live fibers using a fiber detection meter, and record test values.
- Understanding these testing procedures is crucial for verifying the quality and performance of an installed network.
- By mastering these techniques, you'll be able to ensure proper network connectivity, troubleshoot issues effectively, and maintain reliable fiber optic connections.

Do



- Begin the session by providing an overview of the topics to be covered, setting the context for participants.
- Use visual aids, diagrams, and real-life examples to enhance understanding and engagement.
- Encourage active participation by asking questions, facilitating discussions, and inviting participants to share their experiences or insights.

Ask



- What is the purpose of fiber termination at the ONT and TO?
- How can we configure an ONT after providing the power supply?
- Why is it necessary to conduct network tests using an IP network?

Elaborate 9



- Fiber termination at the ONT and TO:
- o Explain the process of fiber termination at the ONT and TO.
 - o Highlight the importance of accurate and reliable fiber connections for network performance.
- Configure the ONT after providing the power supply:
 - Explain the steps involved in ONT configuration, such as accessing the configuration interface and setting up network parameters.
 - o Discuss common configuration settings and considerations.
- ONT test using an IP network:
 - o Explain the purpose of ONT testing using an IP network.
 - o Discuss the interpretation of test results and troubleshooting techniques.
- Operate Visual Fault Locator (VFL) for the installed fiber run:
 - o Explain the purpose and operation of a Visual Fault Locator.
 - o Discuss safety precautions and best practices for using a VFL effectively.
- Test the live fiber using a fiber detection meter:
 - o Explain the purpose of live fiber testing and the role of a fiber detection meter.
 - o Discuss the significance of accurate live fiber testing for network performance and troubleshooting.

Demonstrate



Demonstrate the process of fiber termination at the ONT and TO, showcasing the proper techniques for stripping, cleaning, and securing the fibers.

Activity

Activity name: Test Value Recording

Objective: To practice recording test values accurately and systematically.

Type of activity: Individual

Resources: Test record sheets, pens/pencils.

Time Duration: 20-30 minutes

Instructions:a

o Distribute test record sheets to each participant.

Provide sample test scenarios or results.

- Instruct participants to record the test values systematically, including details such as date, time, location, test parameters, and measurements.
- Encourage participants to review their recorded values and ensure clarity and consistency.
- Allocate time for participants to share their test record sheets and discuss any observations or challenges faced.
- Outcome: Participants will enhance their skills in accurately recording test values, ensuring traceability and facilitating future troubleshooting or maintenance activities.

- Notes for Facilitation 🗐



- Maintain a positive and engaging learning environment.
- Encourage active participation, questions, and discussions.
- Provide clear instructions and demonstrations.
- Foster collaboration and peer learning opportunities.
- Emphasize the importance of proper fiber termination for reliable network performance.
- Highlight the significance of accurate ONT configuration for seamless network connectivity.

 Answers to Exercises for PHB
7 (115 We13 to Exercises for 1116

- Exercise



Answers to exercises for PHB

Multiple Choice Questions:

- 1. a. Visual Fault Locator (VFL)
- 2. a. Bend radius
- 3. a. Core
- 4. a. Fusion Splicing
- 5. a. Fiber pulling

Descriptive Questions:

- 1. Refer to Unit 6.1 Basics of Fiber Optics Topic 6.1.1 Types of Fiber Optics Cables
- 2. Refer to Unit 6.1 Basics of Fiber Optics Topic 6.1.3 Parts of Optical Fiber Cable
- 3. Refer to Unit 6.2 Installation of Optical Fibers Topic 6.2.2 Identify the Cabling Path
- 4. Refer to Unit 6.2 Installation of Optical Fibers Topic 6.2.6 Fiber Pulling Through Conduits
- 5. Refer to Unit 6.3 Testing Installed Network Topic 6.3.2 Visual Fault Locator (VFL)













7. Work Safety Practices with Fiber Optics

Unit 7.1 - Safety Regulations, Roles, and Worksite Hazard Awareness
Unit 7.2 - Site Safety, Infrastructure Awareness, Fire/Electrical Safety &
Hazard Control



Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Explain the safety practices for working with fiber optics during FTTH/X installations.
- 2. Discuss the industry standards and guidelines for fiber optic installations and their role in ensuring safety and quality.

UNIT 7.1: Safety Regulations, Roles, and Worksite Hazard Awareness

-Unit Objectives



After the completion of this unit, the participant will be able to:

- 1. Identify different health and safety hazards at FTTH installation sites and define limits of personal responsibility.
- 2. Discuss roles and responsibilities related to legislative and organizational safety procedures.
- 3. Discuss the importance of maintaining high standards of safety and implications of non-compliance.
- 4. Discuss layout of associated services such as gas pipelines and electrical cables and how to avoid consequential damage.
- 5. Show how to adhere to electrical safety norms when working alongside electrical cables and active power sources.
- 6. Demonstrate how to identify and mitigate hazards like confined spaces, sharp edges, and high temperatures.
- 7. Demonstrate fire safety practices when using high-voltage fusion splicers and heating tools.
- 8. Describe the implications that any non-compliance with health, safety and security may have on individuals and the organization.

Resources to be Used 6



Participant handbook, Legislative requirements and organizational procedures for health, safety, and security, hazard identification and reporting tools (e.g., checklist, incident report form), examples or case studies illustrating non-compliance consequences, visual aids (e.g., powerpoint slides, videos) for explanation and illustration purposes

Say



- Hello, everyone! Welcome to today's session on Safety Rules in Work Maintenance.
- In this session, we will cover important topics related to health, safety, and security in the workplace.
- We will understand legislative requirements and organizational procedures, learn about different types of hazards, explore the process of reporting hazards, discuss the limits of responsibility for dealing with hazards, and understand the significance of maintaining high standards of health, safety, and security.
- Understanding these safety rules is crucial to ensure the well-being of individuals, prevent accidents, and maintain a safe working environment.
- By adhering to these rules, we can protect ourselves, our colleagues, and the organization as a whole.

Do

- Start by providing an overview of the topics to be covered, setting the context for participants.
- Use visual aids, examples, and case studies to enhance understanding and engagement.
- Facilitate discussions and encourage participants to share their experiences, concerns, or insights related to workplace safety.
- Highlight the importance of compliance with legislative requirements and organizational procedures.
- Emphasize the role and responsibilities of individuals in maintaining a safe work environment.

Elaborate



- Legislative requirements and organizational procedures for health, safety, and security and role and responsibilities:
 - Explain the importance of complying with laws and regulations pertaining to health, safety, and security.
 - o Discuss the role of organizations in implementing policies, procedures, and training programs to ensure a safe work environment.
 - Highlight the responsibilities of individuals in following safety rules and promoting a culture of safety.
- Hazards:
 - o Define hazards and their significance in the context of workplace safety.
 - o Discuss various types of hazards, such as physical, chemical, biological, ergonomic, and psychosocial hazards.
 - o Provide examples and scenarios to illustrate each type of hazard.
- Preparing to report hazards:
 - o Explain the importance of promptly reporting hazards to prevent accidents or injuries.
 - o Discuss the steps involved in identifying, documenting, and reporting hazards.
 - o Provide guidance on using reporting tools, such as checklists or incident report forms.
- Dealing with hazards:
 - o Clarify the boundaries and limitations of individual responsibility in addressing hazards.
 - o Discuss the role of supervisors, managers, and safety professionals in hazard management.
 - o Highlight the importance of effective communication and collaboration in addressing hazards.
- Maintaining high standards of health, safety, and security:
 - o Discuss the benefits of maintaining a safe work environment, including improved productivity, morale, and reputation.
 - o Emphasize the role of individuals in adhering to safety rules, implementing best practices, and promoting a safety culture.
- Non-compliance with health, safety, and security:
 - o Discuss the potential consequences of non-compliance, such as accidents, injuries, legal issues, reputational damage, and financial losses.
 - Highlight the importance of understanding and adhering to safety regulations to protect oneself and others.

Demonstrate 🗔



Conduct a hazard identification and reporting demonstration, showcasing how to identify potential hazards in the workplace, document them using a reporting tool, and report them to the appropriate authority.

Activity



- Activity name: Hazard Identification and Reporting
- **Objective:** To practice identifying hazards and reporting them effectively.
- Type of activity: Group
- **Resources:** Hazard identification checklist, incident report forms, pens/pencils.
- Time Duration: 25-30 minutes
- **Instructions:**
 - o Divide participants into small groups.
 - o Distribute hazard identification checklists and incident report forms to each group.
 - o Instruct groups to identify potential hazards in a given workplace scenario using the checklist.
 - o Ask groups to document the identified hazards on the incident report forms, including necessary details and recommended actions.
 - o Allocate time for groups to discuss their findings and share their reports with the rest of the participants.
 - o Facilitate a group discussion to analyze the identified hazards, review the reporting process, and discuss any challenges or insights.
- Outcome: Participants will enhance their skills in identifying hazards, documenting them, and understanding the importance of reporting for effective hazard management.

Notes for Facilitation



- Create a safe and inclusive learning environment.
- Encourage active participation and open discussion.
- Provide clear explanations and examples to facilitate understanding.
- Foster a sense of responsibility and ownership for workplace safety.
- Be sensitive to participants' concerns and experiences related to safety issues.
- Emphasize the significance of understanding legislative requirements and organizational procedures for maintaining a safe work environment.
- Encourage participants to actively participate in hazard identification and reporting activities.
- Encourage participants to share best practices and practical tips for ensuring safety in the workplace.

UNIT 7.2: Site Safety, Infrastructure Awareness, Fire/Electrical Safety & Hazard Control

Unit Objectives | ©



After the completion of this unit, the participant will be able to:

- 1. Describe required PPE for fiber optic installations, including safety glasses and cut-resistant gloves.
- 2. Elucidate the benefits of PPE in terms of safety, injury prevention, and regulatory compliance.
- 3. Discuss safety features, limitations, and maintenance of protective equipment.
- 4. Explain laser safety guidelines and risk levels of various laser classes used in fiber optics.
- 5. Describe hazards such as micro-shards & laser exposure, along with safe disposal practices for fiber scraps.
- 6. Demonstrate eye-safety measures when working with laser-emitting devices like ONTs and splicing.
- 7. Show how to safely handle bare fiber, broken ends, and scraps, ensuring proper disposal.
- 8. Demonstrate safe handling of Class 1M and higher laser devices following laser safety rules.
- 9. Show how to use and maintain safety gear such as gloves, boots, and protective eyewear.
- 10. Describe hazards such as micro-shards & laser exposure, along with safe disposal practices for fiber scraps.
- 11. Demonstrate fire safety practices when using high-voltage arc fusion splicers and heating tools.
- 12. Show how to adhere to electrical safety norms when working alongside electrical cables and active power sources.
- 13. Explain the importance of maintaining high standards of health, safety and security.

Resources to be Used



Participant handbook, Safety guidelines and procedures for fiber optic installations, eye protection equipment (safety goggles), tools for handling bare fiber (fiber scrap container, fiber cleaning supplies), manufacturer supplied material safety data sheets (MSDS), fire safety guidelines for using electric arc fusion splicers, visual aids (e.g., PowerPoint slides, videos) to illustrate fiber construction and safety features of protective equipment and gears



- Hello, everyone! Welcome to today's session on Work Safety Practices in Optical Fiber Installation.
- In this session, we will focus on ensuring safety during fiber optic installations.
- We will learn about performing fiber work safely, wearing proper eye protection, handling bare fiber safely, comparing material safety data sheets, following fire safety practices, understanding fiber construction, and identifying safety features of protective equipment and gears.
- Understanding and practicing work safety in fiber optic installations is essential to protect ourselves from potential hazards and ensure the integrity of the optical fiber network.
- By adhering to these safety practices, we can prevent injuries, damage to equipment, and maintain the quality of installations.

Do 🗸

- Start by providing an overview of the topics to be covered, setting the context for participants.
- Use visual aids, diagrams, and videos to enhance understanding and engagement.
- Explain safety guidelines and procedures step by step, emphasizing the importance of each practice.
- Encourage participants to ask questions and share their experiences related to work safety in fiber optic installations.

Ask



- Why is it important to wear proper eye protection during fiber optic installations?
- How can we handle bare fiber safely to prevent injuries and equipment damage?
- What are some fire safety practices to follow while using electric arc fusion splicers?

Elaborate



- Fiber work safely in fiber optic installations:
 - Explain the importance of following safety guidelines and procedures throughout the installation process.
 - o Discuss practices such as proper cable management, avoiding excessive pulling tension, and securing cables to prevent tripping hazards.
- Eye-safety to protect cornea or lens during work:
 - o Highlight the potential risks to the eyes during fiber optic installations.
 - Explain the importance of wearing safety goggles or eye protection to prevent injuries from fiber shards or other debris.
- Bare fiber from broken ends of fibers and scraps of fibers during termination and splicing:
 - o Discuss safe handling techniques for bare fiber, including using designated containers for fiber scraps and avoiding direct contact with broken fiber ends.
 - o Emphasize the importance of using appropriate tools and fiber cleaning supplies to maintain cleanliness and prevent contamination.
- Manufacturer supplied material safety data sheet (MSDS) with on-ground materials:
 - Explain the purpose of material safety data sheets (MSDS) and their relevance to safety in fiber optic installations.
 - o Discuss how to compare MSDS provided by manufacturers with the actual materials being used onsite to identify any potential hazards or precautions.
- Fire safety practices while using electric arc to make fusion splicers:
 - o Explain the fire risks associated with electric arc fusion splicers.
 - o Discuss fire safety guidelines, such as keeping flammable materials away, ensuring proper ventilation, and having fire extinguishing equipment readily available.
- Construct of fiber and the damage the fiber constituent material can cause:
 - o Explain the composition and structure of optical fibers.
 - o Discuss how damage to the fiber's constituent materials can affect its performance and safety.
- Safety features of protective equipment and gears:
 - o Identify and discuss the different safety features present in protective equipment and gears used in fiber optic installations, such as gloves, helmets, and high-visibility vests.

Field Visit



Conduct a field visit showcasing the correct use of safety goggles and proper handling techniques for bare fiber, emphasizing the importance of adherence to safety practices.

Activity



- Activity name: Fiber Safety Equipment Inspection
- Objective: To identify and understand the safety features of protective equipment and gears used in fiber optic installations.
- Type of activity: Group
- Resources: Sample safety equipment (safety goggles, gloves, helmets, high-visibility vests), inspection checklist.
- Time Duration: 30 minutes
- Instructions:
 - o Divide participants into small groups.
 - o Provide each group with a set of safety equipment.
 - o Instruct groups to inspect the safety equipment and identify the safety features present.
 - o Ask groups to discuss and record their findings on the inspection checklist.
 - o Allocate time for groups to present their findings and discuss the importance of each safety feature.
 - o Facilitate a group discussion to share insights and address any questions or concerns.
- Outcome: Participants will enhance their knowledge of safety features in protective equipment and gears used in fiber optic installations.

Notes for Facilitation



- Create a safe and inclusive learning environment.
- Encourage active participation and open discussion.
- Demonstrate safety practices and reinforce their importance.
- Highlight the potential risks and hazards associated with incorrect safety practices.
- Encourage participants to actively engage in the safety equipment inspection activity and discuss the significance of safety features.
- Discuss the role of personal responsibility and vigilance in promoting work safety practices.

- Exercise



Answers to exercises for PHB

Multiple Choice Questions:

- 1. a. Safety goggles
- 2. a. Protective equipment and gear
- 3. a. Emergency procedures
- 4. a. Laser radiation
- 5. a. Laser equipment

Descriptive Questions:

- 1. Refer to Unit 7.2 Work safety practices in optical fibre installation Topic 7.2.6 Laser safety norms
- 2. Refer to Unit 7.1 Safety rules in work maintenance Topic 7.1.2 Health and safety hazards in a work place
- 3. Refer to Unit 7.1 Safety rules in work maintenance Topic 7.1.4 Responsibility for dealing with hazards
- 4. Refer to Unit 7.2 Work safety practices in optical fibre installation

 Topic 7.2.4 Fire safety practices while using electric arc to make fusion splicers
- 5. Refer to Unit 7.2 Work safety practices in optical fibre installation

 Topic 7.2.8 Cause that leads to the damage the fiber constituent material













8. Sustainability Practices in Telecom Cabling Operations

Unit 8.1 - Sustainability Practices in Telecom Cabling Operations





Key Learning Outcomes



After the completion of this module, the participant will be able to:

- 1. Identify recyclable, reusable, and hazardous materials in fiber optic installations and explain how to categorize them.
- 2. Describe the waste management, recycling, and disposal protocols for materials used in fiber optic installations.
- 3. Explain how to optimize material and energy usage during cabling work in fiber optic installations.
- 4. Discuss the environmental and regulatory standards that must be complied with during fiber optic installations.

UNIT 8.1: Sustainability Practices in Telecom Cabling Operations

Unit Objectives 6



After the completion of this unit, the participant will be able to:

- 1. Explain organizational policies on sustainability, waste reduction, and material reuse in telecom infrastructure projects.
- 2. Describe the procedures for recycling, hazardous waste handling, and safe disposal of telecom-related materials.
- 3. Discuss the importance of sustainability in long-term infrastructure planning and the environmental impact of telecom waste.
- 4. Elucidate the classification of materials used in optical fiber cabling, including recyclable, reusable, and hazardous components.
- 5. Explain standard waste management procedures for telecom operations, including segregation, labeling, and disposal methods.
- 6. Describe methods to reduce material wastage, such as accurate measurements, careful handling of fiber optic cables, and optimized trenching techniques.
- 7. Discuss the environmental hazards associated with improper disposal of optical fibers, batteries, and chemical adhesives.
- 8. Explain the regulations and compliance requirements for hazardous material disposal under national and international environmental laws.
- 9. Elucidate energy-efficient work practices, including low-power tools, optimized route planning, and reduced excavation techniques.
- 10. Describe the importance of proper record-keeping for disposal and recycling to ensure compliance and accountability.
- 11. Demonstrate how to identify, segregate, and store materials used in cabling operations, including recyclable, reusable, and hazardous materials, ensuring compliance with safety and waste management procedures.
- 12. Show how to follow SOPs for safe handling, disposal, and documentation of non-recyclable and hazardous materials, including fiber shards, cable sheaths, and chemical adhesives.
- 13. Demonstrate how to ensure proper labeling, safe storage, and disposal of hazardous waste to prevent contamination or accidents.
- 14. Show how to minimize waste by reducing excess material use, reusing components, and optimizing cabling work through accurate measurements and efficient layout designs.
- 15. Demonstrate how to maintain clean, organized work sites to prevent environmental contamination, promote safety, and comply with environmental guidelines.
- 16. Show how to use energy-efficient tools and machinery and ensure proper maintenance of cabling tools and equipment to reduce material consumption and unnecessary repairs.

- 17. Demonstrate how to coordinate and dispose of waste materials at designated collection points and report any violations or environmental hazards.
- 18. Show how to use and promote eco-friendly materials, such as low-impact protective coatings and biodegradable packaging.
- 19. Demonstrate how to follow national and local environmental regulations, workplace policies, and sustainability practices related to telecom cabling operations.
- 20. Show how to maintain accurate documentation of sustainability activities, including logs of disposed and recycled materials, to meet regulatory and audit requirements.
- 21. Demonstrate how to conduct periodic self-audits and educate team members on best practices for sustainability, waste segregation, and responsible energy consumption.
- 22. Show how to report violations of environmental policies, hazardous material spills, or unsafe disposal practices to the designated supervisor or regulatory body.

Resources to be Used



Participant Handbook, Whiteboard, Marker, Notepad, Pens, Flipchart and markers, Pictures of different types of waste, Samples of recyclable and non-recyclable waste, Samples of hazardous waste and materials for their proper disposal, set of colour-coded waste bins, Company waste management policy and procedures



- Introduce the topic and explain the session objectives.
- Engage the trainees with interactive discussions, practical demonstrations, and engaging activities.
- Ensure that the participants understand the key concepts and can apply them in real-life situations.
- Provide opportunities for questions and feedback.
- Summarise the session's main points and reiterate the importance of effective waste management and recycling practices.



- Welcome, everyone. In this session, we will learn about effective waste management and recycling practices that can help reduce our environmental footprint and contribute to sustainable development.
- We will discuss different types of waste, recycling processes, and hazardous waste management
- We will also explore the company's waste management policy and procedures and learn how to apply them in our work.

Ask



- What is the most common type of waste generated in your workplace?
- How can you differentiate between recyclable and non-recyclable waste?

Elaborate



- Explain the different types of waste and their classification into dry, wet, recyclable, non-recyclable, and single-use plastics items. We will also discuss the use of different colours of dustbins for effective waste segregation.
- Explore the company's procedures for minimising waste, including the 3Rs (reduce, reuse, recycle) and each employee's role in waste management.
- Illustrate the process of disposing of non-recyclable and hazardous waste as per recommended processes to ensure safety and environmental protection.
- Discuss the common sources of pollution, including air, water, and soil pollution, and ways to minimise them through effective waste management and recycling practices.

Demonstrate



- Demonstrate the proper handling and disposal of hazardous waste, including chemicals, batteries, and electronic waste.
- Demonstrate the use of colour-coded waste bins for effective waste segregation.

Activity



- Activity name: Waste Sorting Challenge
- **Type:** Group Activity
- **Objective of the activity:** To practice waste segregation and identify the common mistakes made in the process.
- Resources: Samples of recyclable and non-recyclable waste, colour-coded waste bins
- Time Duration: 30 minutes
- Instructions:
 - o Divide the trainees into small groups of 3-4 people.
 - Provide each group with a set of samples of recyclable and non-recyclable waste and colour-coded waste bins.
 - o Instruct the groups to sort the waste into the appropriate bins quickly and accurately.
 - Once the sorting is complete, ask each group to present their results and discuss any common mistakes made.
 - o Provide feedback and tips for improvement.
- Outcome: The participants will practice waste segregation and identify the common mistakes made in the process. They will also learn how to improve their waste-sorting skills and contribute to effective waste management.=

- Notes for Facilitation



- Emphasise the importance of effective waste management and recycling practices for environmental protection and sustainable development.
- Encourage trainees to share their experiences and ideas on waste management and recycling practices in their workplace.
- Provide practical examples and case studies to illustrate the key concepts and reinforce the learning outcomes.

Exercise



Answers to exercises for PHB

A. Short Answer Questions

- 1. They ensure materials are reused, recycled, and consumed efficiently, reducing landfill waste and minimizing the environmental impact of telecom infrastructure activities.
- 2. Use PPE, segregate hazardous items, store them in labeled containers, follow handling guidelines, and dispose of them through authorized recyclers as per safety and environmental regulations.
- 3. It provides traceability, proves compliance during audits, helps track waste handling, and ensures legal and environmentally responsible operations.
- 4. Accurate measurements, proper cable routing, careful splicing, avoiding excess cutting, and using pre-terminated cables help reduce wastage.
- 5. They lower power consumption, reduce emissions, improve operational efficiency, and minimize environmental impact during project execution.

B. Multiple Choice Questions (MCQs)

- b. To prevent contamination and ensure safe disposal
- b. Biodegradable packaging
- b. Waste disposal logs with hazard classification
- b. Basel Convention
- c. Using accurate measurements and optimized layouts

C. Fill in the Blanks

- 1. sealed / labeled containers
- 2. record-keeping
- 3. Basel Convention
- 4. energy-efficient tools
- 5. documentation

Notes ———	
Notes	
	













9. Employability Skills (30 Hours)

It is recommended that all training include the appropriate. Employability Skills Module. Content for the same can be accessed https://www.skillindiadigital.gov.in/content/list















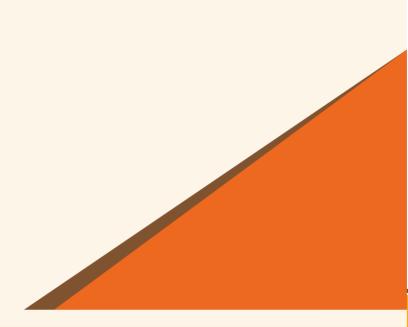


10. Annexure

Annexure I: Training Delivery Plan Annexure II: Assessment Criteria

Annexure III: List of QR Codes used in PHB





Annexure I Training Delivery Plan

Training Delivery Plan					
Program Name:	Fiber to-the Home (FTTH/X	() Installer			
Qualification Pack Name & Ref. ID	TEL/Q4200, V4.0				
Version No.	4.0	Version Update Date	08/05/2025		
Pre-requisites to Training (if any)	Not Applicable				
Training Outcomes	 After the completion of this unit, the participant will be able to: Follow procedures for outside plant cable installation. Prepare cables for splicing. Install passive FTTH/X components. Construct FTTH/X cabling inside the building. Follow safety precautions pertaining to optical fiber. Organize work and resources as per health and safety standards. Communicate, develop interpersonal skills and develop sensitization towards gender and person with disability. 				

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
1. Introduction to	Overview of	Explain telecom	TEL/N4143 PC1-	Classroom	Laptop, white	
the Sector and	Telecom & Fiber	evolution, fiber	PC3	lecture/	board, marker,	T: 05:00
FTTH/X Installer	Sector	technology		PowerPoint	projector,	P: 00:00
Role(Theory: 5:00		importance, FTTH		Presentation/	Documents of	
Hours, Practical:		ecosystem, and		Demonstra-tion/	standard	
0:00 Hours)		workforce		Quiz	operating proce-	
		demand.			dures, code of	
					conduct,	
					checklists,	
	FTTH/X	Describe OLT,	TEL/N4143 PC21-		installation and	
	Architecture &	ONT, splitters,	PC23		trou- bleshoot-	
	Components	fiber types,			ing tools/	
		ducts, and FTTx			equipment,	
		variants with			status reports	
		working				
		principles.				
	Roles &	Explain installer	TEL/N4143 PC6			
	Responsibilities	duties,				
	of FTTH Installer	documentation				
		needs,				
		compliance, and				
		customer				
		interaction.				
	Regulatory &	Explain	TEL/N4143 PC6			
	Environmental	permissions,				
	Guidelines	local compliance,				
		safety norms,				
		and				
		environmental				
		considerations.				

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
2. Pre-Installation and Installation Techniques (Theory: 10:00 Hours, Practical: 20 Hours)	Pre-deployment Survey & GIS Mapping	Conduct route survey, identify obstructions, mark duct paths, and evaluate terrain using GIS.	TEL/N4143 PC1	Classroom lecture/ PowerPoint Presentation/ Demonstra- tion/ Quiz	Laptop, white board, marker, projector, Cable blowing machines, Protection Sleeves, Fiber Strip- per, OTDR, Different types of fiber cables (aerial,	T: 01:00 P: 02:00
	Pre-testing of Fiber Cables	Perform OTDR testing, continuity checks, attenuation measurements, and Al-enabled diagnostics.	TEL/N4143 PC2		buried and under- ground), drum flanges, Personal Protection Equipment: safety glasses, head protection, warning signs	T: 01:00 P: 02:00
	Cable Standards & Specifications	Identify bend- insensitive cables, armored cables, high- density fibers, and installation parameters.	TEL/N4143 PC3- PC4		and tapes	T: 01:00 P: 02:00
	Duct Preparation & Integrity Testing	Use duct integrity tests, air/vacuum cleaning, and ensure duct readiness.	TEL/N4143 PC5			T: 01:00 P: 02:00
	Trenching & Direct Buried Installation	Perform trenching, cable laying, environmental precautions, and trench reinstatement.				T: 01:00 P: 02:00
	Underground Duct Cable Pulling	Use winches, pulling grips, friction check tools, and duct suitability tests.	TEL/N4143 PC12–PC16			T: 01:00 P: 02:00
	Aerial Cable Installation	Conduct pole survey, install messenger wire, handle ADSS cables, wind- load analysis.	TEL/N4143 PC17-PC20			T: 01:00 P: 02:00

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration	
	FTTx Variants & Deployment	Install FTTN, FTTC, FTTB, FTTD networks, pre- connectorized fiber, micro- trenching.	TEL/N4143 PC21-PC24			T: 01:00 P: 02:00	
2 ETTV	Installation of Network Components	Install ONTs, OLTs, splitters and IoT devices for smart home networks.	TEL/N4143 PC23-PC24				T:01:00 P:02:00
	Network Planning & Design	Study PON/GPON architecture, distribution plans, material requirements, and compliance.	TEL/N4143 PC25–PC28			T:01:00 P:02:00	
3. FTTx Applications & Network Planning (Theory: 05:00 Hours, Practical: 20:00 Hours)	Network Architecture Overview	Explain PON, GPON, XG-PON and FTTH distribution layout.	TEL/N4143 PC25	Classroom lecture/ PowerPoint Presentation/ Demonstra- tion/ Quiz	Laptop, white board, marker, projector, Cable blowing machines, Protection Sleeves, Fiber	T:0:30 P:02:00	
	Infrastructure Requirements	Identify conduits, fiber count, ODN components, distribution points.	TEL/N4143 PC26		Strip- per, OTDR, Different types of fiber cables (aerial, buried and under- ground), drum flanges,	T: 00:30 P: 03:00	
	Regulatory Compliance	Check standards, safety norms, environmental regulations.	TEL/N4143 PC27		Personal Protection Equipment: safety glasses, head protection, warning signs and tapes	T: 00:30 P: 03:00	

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
	Route & Layout Design Loss Budget	Draw fiber routes, define joints, split ratios, design ODN maps. Calculate insertion	TEL/N4143 PC25-PC28 TEL/N4143		Whiteboard, Projector, Tools Whiteboard,	T:01:00 P:03:00 T:01:00 P:03:00
	Calculation	loss, splice loss, connector loss for network planning.	PC28		Projector, Tools Whiteboard,	
	High-Density Urban Networks	Plan micro-ducting, micro-trenching, pre-terminated fibers.	TEL/N4143 PC22		Projector, Tools Whiteboard,	T:01:00 P:03:00
	Future Network Scenarios	Plan for IoT, 5G backhaul, FTTx expansion possibilities.	TEL/N4143 PC24–PC28		Projector, Tools	T:00:30 P:03:00
4. Splicing Optical Fiber (Theory: 30 Hours, Practical: 60 Hours)	Advanced Splicing Tools & Equipment Check	Identify OTDR, OSA, PMD, CD analyzer, automated splicers, and ensure calibration.	TEL/N6400 PC1-PC5	Classroom lecture/ PowerPoint Presentation/ Demonstra- tion/ Quiz	Laptop, white board, marker, projector, Cleaver, Mechanical and fusion Splicing kit, Protection Sleeves, Fiber Strip- per, Fiber reinforced plaster and Jointing, Optical test equipment - OTDR and power meter, Personal Protection Equipment: safety glasses, head protection, warning signs and tapes	T:03:00 P:05:00

Fiber Preparation	Strip fiber, clean cores, inspect	TEL/N6400 PC6-PC12	Lecture, Demonstration	Whiteboard, Projector,	7 Theory (2:00)
for Splicing	fibers, ensure bend radius compliance.			Tools	Practical (5:00)
Fault Detection in OFC	Identify microbends, breaks, sheath damage using OTDR and inspection tools.	TEL/N6400 PC13-PC20	Lecture, Demonstration Lecture, Demonstration Lecture,	Whiteboard, Projector, Tools Whiteboard, Projector, Tools	T:03:00 P:05:00
Fusion & Mechanical Splicing	Perform fusion, mechanical, ribbon, crimp splicing with precision tools.	TEL/N6400 PC21-PC27	Demonstration Lecture, Demonstration Lecture, Demonstration	Whiteboard, Projector, Tools Whiteboard,	T:03:00 P:05:00
Nano/Micr o Fiber Splicing	Use specialized tools for nano-fiber splicing for medical/military apps.	TEL/N6400 PC27	Lecture, Demonstration Lecture, Demonstration	Projector, Tools Whiteboard, Projector, Tools	T:03:00 P:05:00
Splice Protection & Closure Installation	Install heat/cold shrink closures, trays, enclosures, environmental sealing.	TEL/N6400 PC26		Whiteboard, Projector, Tools Whiteboard, Projector, Tools	T:03:00 P:05:00
Testing Spliced Joints	Test with OTDR, power meter, OSA, CD analyzer for KPI compliance.	TEL/N6400 PC29–PC31			T:03:00 P:05:00
Report Generation & Documenta tion	Prepare automated reports, cloud logs, compliance records.	TEL/N6400 PC32–PC33			T:03:00 P:05:00
Maintenan ce & Troublesho oting	Locate faults, resplice damaged fibers, coordinate with NOC.	TEL/N6400 PC13-PC20			T:03:00 P:05:00

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
	Advanced Automation in Splicing	Use robotic arms, AI-based alignment, splice optimization.	TEL/N6400 PC21-PC25	Lecture, Demonstration Lecture, Demonstration	Whiteboard, Projector, Tools Whiteboard,	T:02:00 P:06:00
	Connectorized Fiber Management	Manage routing, grounding, documentation inside junction boxes.	TEL/N6400 PC11-PC12	Lecture, Demonstration	Projector, Tools Whiteboard, Projector, Tools	T:02:00 P:06:00
	Field Splicing Practice	Perform end-to- end splicing workflow at field conditions.	TEL/N6400 PC6-PC33			T:02:00 P:08:00
5. Installation of Passive FTTH/X Components (Theory: 40 Hours, Practical: 20 Hours)	Identify Passive Components	Identify splitters, couplers, FBT/PLC types, mounting requirements.	TEL/N4200 PC1-PC5	Classroom lecture/ PowerPoint Presentation/ Demonstra- tion/ Quiz	White board/ black board marker / chalk, duster, computer or Laptop attached to LCD projector, Optical power meter, Fiber optic test source, OLTS, Optical splitters, Pigtails, Personal Protection Equipment: safety glasses,	T:05:00 P:02:30
	Splitter Installation	Install wall/rack mount splitters ensuring correct orientation & placement.	TEL/N4200 PC1-PC4	Lecture, Demonstration	Whiteboard, Projector, Tools	T:05:00 P:02:30

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
	Advanced Splitter Configurations	Configure components for WDM, TDMA, NG-PON2.	TEL/N4200 PC5			T:05:00 P:02:30
	Feeder & Distribution Cable Termination	Organize feeder/distribut ion cables, pigtail routing.	TEL/N4200 PC6-PC8			T:05:00 P:02:30
	Connector Polishing & Assembly	Polish connectors (LC, SC, APC) to reduce insertion loss.	TEL/N4200 PC9			T:05:00 P:02:30
	Insertion Loss & Power Testing	Perform OLTS, OTDR, power meter tests for validation.	TEL/N4200 PC10- PC13			T:05:00 P:02:30
	Loss Budget Analysis	Calculate loss budgets for GPON/XG- PON/NG-PON2.	TEL/N4200 PC14- PC17			T:05:00 P:02:30
	Testing & Troubleshooting Passive Networks	Use diagnostic tools to identify insertion loss issues.	TEL/N4200 PC16- PC18		Whiteboard , Projector, Tools	T:05:00 P:02:30

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
6. In-Building FTTH/X Cabling Theory: 10 Hours, Practical: 20 Hours)	Building Layout & Cable Route Planning	Check layout, identify horizontal/vertical paths, slack requirements.	TEL/N4201 PC1-PC3		White board/black board marker / chalk, duster, computer or Laptop attached to LCD projector, Fiber cables, Fish tape, ONT, Cable trays, VFL, Fiber detection meter Personal Protection Equipment: safety glasses, head protection, rubber gloves, safety footwear, warning signs and tapes, fire extinguish- er and first aid kit	T:01:30 P:02:30
	Cable Tray Installation	Lay cables along trays, secure fibers, maintain tension limits.	TEL/N4201 PC4–PC6			T:01:30 P:03:30
	Conduit-Based Installation	Pull fiber with fish tape/puller, inspect conduit integrity.				T:01:30 P:03:30
	False Ceiling Installation	Install fiber using figure-8 method, ensure slack and safety.	TEL/N4201 PC11-PC13			T:01:30 P:03:30
	ONT & Termination	Terminate fiber at ONT/TO, configure basic settings.	TEL/N4201 PC14-PC17			T:02:00 P:3:30
	IoT & Triple Play Configuration	Configure IoT devices, IPTV, Internet, VoIP; test QoS.	TEL/N4201 PC18-PC32			T:02:00 P:03:30

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
7. Work Safety	Laser Safety &	Follow eye	TEL/N4131	Classroom	White board/	T:01:30
Practices with	Eye Protection	safety for laser	PC1-PC2	lecture/	black board	P:02:30
Fiber Optics		sources, ONTs,		PowerPoint	marker / chalk,	
(TEL/N9111)		splicers.		Presentation/	duster,	
, ,		'		Demonstra-	computer or	
(Theory: 10				tion/ Quiz	Laptop attached	
Hours,				,	to LCD projec-	
Practical: 20					tor, Safety	
Hours)					glasses, safety	
					hand- gloves,	
					_	
					microscope with	
					infra- red filters,	
					isopropyl	
					alcohol, ad-	
					hesives, class III	
					optical	
					amplifiers,	
					Personal	
					Protection	
					Equipment:	
					safety glasses,	
					head	
					protection,	
					rubber gloves,	
					safety footwear,	
	Handling Bare	Handle fiber	TEL/N4131 PC2	1	warning signs	T:01:30
	Fibers & Scraps	shards safely	,		and tapes, fire	P:03:30
		and dispose			extinguish- er	
		properly.			and first aid kit	
	Fire & Electrical		TEL/N4131	1		T:01:30
	Safety	methods	PC3-PC4			P:03:30
		around heating				
		tools and				
		electrical				
		sources.				
	Safe Cable	Avoid	TEL/N4131	1		T:01:30
	Routing	interference	PC11			P:03:30
		with pipelines,				
		electrical cables,				
		gas lines.				
	Industry	Follow ANSI,	TEL/N4131	1		T:02:00
	Standards	ITU-T, TIA/EIA	PC12-PC14			P:3:30
		standards in				
		installation.				
	Documentation	Maintain safety	TEL/N4131 PC8	1		T:02:00
	& Incident	logs, checklists,				P:03:30
	Reporting	incident				
		records.				
	l .	precorus.	l .	l .	<u> </u>	

Sr. No.	Session Name	Session Objectives	NOS / PC Covered	Methodology	Training Tools	Duration
8.	Material	Identify	TEL/N9111	Classroom	White board/	T:01:30
Sustainability	Classification	recyclable,	PC1-PC5	lecture/	black board	P:02:30
Practices in		reusable,		PowerPoint	marker / chalk,	
Telecom		hazardous		Presentation/	duster,	
Cabling		materials like		Demonstra-	computer or	
(TEL/N9111)		ducts,		tion/ Quiz	laptop	
		adhesives.			attached to	
(Theory: 10				Lecture,	LCD projec- tor,	
Hours,				Demonstration	Personal	
Practical :20					Protection	
Hours)					Equipment:	
					safety glasses,	
					head	
					protection,	
					rubber gloves,	
					safety	
					footwear,	
					warning signs	
					and tapes, fire	
					extinguish- er	
					and first aid kit	
	Waste	Follow	TEL/N9111			T:01:30
	Segregation	procedures for	PC3-PC5			P:02:30
		hazardous				
		waste storing &				
		labeling.				
	Recycling &	Coordinate	TEL/N9111			T:01:30
	Disposal	disposal with	PC6-PC10			P:02:30
	Protocols	approved				
		vendors;				
		reduce waste.				
	Optimizing	Measure	TEL/N9111			T:01:30 P:02:30
	Material Usage	accurately,	PC11-PC15			r.U2.3U
		reduce				
		wastage, reuse				
		components.				T-02-00
	Energy	Use battery-	TEL/N9111			T:02:00 P:05:00
	Efficiency	efficient tools,	PC12			
		reduce power				
		consumption.				
	Compliance &	Maintain logs,	TEL/N9111			T:02:00
	•	_				P:05:00
	Audit	perform audits,	PC16-PC20			
	Documentation	l '				
		violations.				

Annexure II

Assessment Criteria

CRITERIA FOR ASSESSMENT OF TRAINEES

Assessment Criteria for Fiber to-the Home (FTTH/X) Installer			
Job Role	Fiber to-the Home (FTTH/X) Installer		
Qualification Pack	TEL/Q4200 V4.0		
Sector Skill Council	Telecom Sector Skill Council		

S. No.	Guidelines for Assessment
1	The assessment for the theory part will be based on knowledge bank of questions approved by the SSC.
2	Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/ Set of NOS.
3	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre (as per assessment criteria below).
4	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training centre based on this criterion.
5	To pass the Qualifications File, every trainee should score a minimum of aggregate marks.
6	In case of unsuccessful completion, the trainee may seek reassessment on the Qualification File.

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightag e
TEL/N4143. Install Fiber-to-the- Home (FTTH/X) and Fiber-to- Anywhere (FTTx) Cables	30	50	-	20	100	15
TEL/N6400. Splice Optical Fiber	30	50	-	20	100	15
TEL/N4200. Installation of Passive FTTH/X components	30	50	-	20	100	15
TEL/N4201. In-building FTTH/X cabling	30	50	-	20	100	15
TEL/N4131. Work Safety Practices with Fiber Optics	30	50	0	20	100	15
TEL/N9111. Follow sustainability practices in telecom cabling operations	30	50	0	20	100	15
DGT/VSQ/N0101. Employability Skills (30 Hours)	20	30	-	-	50	10
Total	200	330	0	120	650	100

Annexure III

QR Codes –Video Links

Module No.	Unit No.	Topic Name	Link for QR Code (s)	QR code (s)
Module 1: Intro- duction to the role of Fiber to- the Home (FTTH/X)	Unit 1.1 The roles and responsibilities of Fiber to-the Home (FTTH/X)	Funda- mentals of Optical Fiber and their Appli- cations	https://www.youtube.com/ watch?v=DkQjF54gy9w	Fiber to the Home explained
Installer	Installer	Working Principle of Optical Fiber Communication System	https://www.youtube.com/ watch?v=q6 q2IBm93o	Block diagram and working of fiber optic communication system
		Perfor- mances Param- eters of Optical Fiber	https://www.youtube.com/ watch?v=Cwu3pbmarqM	Parameters of Optical Couplers Optical Splitting, Excess Loss, Insertion Loss &
Module 2: Pre- Installation and Installation Techniques	Unit 2.1: Planning, Survey, Cable Selection, Routing & Deployment	Pre-con- struction Sur- vey on the Site	https://www.youtube.com/ watch?v=HOaCZqJSoSg	Cross Talk Fiber Construction Process

Module No.	Unit No.	Topic Name	Link for QR Code (s)	QR code (s)
		Cable Hauling Process and Pre- instal- lation Check	https://www.youtube.com/ watch?v=wufrSU0rihw	
				FO Outlet / Optical Termina- tion Outlets
		Duct Rodding, Test- ing and Clean- ing Processes	https://www.youtube.com/ watch?v=JBVbyzCSUHk	
				How to splice broken optical fiber cable prac- tically
	Unit 2.2: Splicing, Termination, Testing & Quality	Deploy- ment of Optical Fiber Cables	https://www.youtube.com/ watch?v=CSOBvnmNOTs	
	Assurance			Dome closure aerial FTTH installation
4. Splicing of Optical Fiber	Unit 3.1: Fundamentals of Optical Fibers and Light	Character- istics of Optical Fiber	https://www.youtube.com/ watch?v=ADNwDkcufck	
	Transmission			Characteristics of Optical Fiber
	Unit 3.3: Smart Network Integration, Fault Management	Duct Integrity Test	https://www.youtube.com/ watch?v=iMBurginVlc	
	& Performance Optimization			Duct Integrity Test before OFC final Laying

Module No.	Unit No.	Topic Name	Link for QR Code (s)	QR code (s)
5. Installa- tion of Pas- sive FTTH/X Compo- nents	Unit 5.1: Passive Components, Splitters, Fiber Routing & Management	Compo- nents of Optical Fiber Commu- nication (OFC) Network	https://www.youtube.com/ watch?v=30i2Ku_m6dU	
				What are the Parts of a Fiber Optic Cable?
	Unit 5.2: Optical Power Testing and Network Signal Validation	Insertion Loss of Optical Splitter	https://www.youtube.com/ watch?v=LH5IVmKSwHM	
				Optical Fiber Insertion Loss And Return Loss
6. In-build- ing FTTH/X Cabling	6.1: Basics of Fiber Optics	Bend Radius	https://www.youtube.com/ watch?v=wGaJMVQt7qc	
				Bend Radius - EXFO's Animat- ed Glossary of Fiber Optics
	6.2: Installation of Optical Fibers	Fusion Splicing	https://www.youtube.com/ watch?v=PFlegqsQFrs	
				How To Fusion Splice Fiber Optic Cable - Animated
7. Work Safety with Fiber Optics	7.1: Safety regulations, roles and worksite Hazards	Health and Safety Hazards in a Workplace	https://www.youtube.com/ watch?v=A3txvkETcoo	
				Hazard and Risk at Workplace













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