CONCEPT

Fibre Optic Networks: Design, Installation, Splicing, OTDR Testing and Maintenance

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Introduction:

Fibre optic networks carry telecom, enterprise and utility traffic, yet many outages trace back to poor splices, dirty connectors, tight bends, missing records or an OTDR trace nobody could read. This Core Concept course trains engineers and technicians to design fibre links against a loss budget, install cable in duct, aerial and indoor routes, make fusion and mechanical splices, test with a power meter and OTDR, locate faults and restore service safely. Participants build a Fibre Link Design, Test and Restoration Pack for a real route.

Course Objectives:

- Select single-mode or multimode fibre, cable construction and connector types for a given link distance, bandwidth and environment
- Calculate an end-to-end optical link loss budget and design point-to-point, backbone and FTTx/PON routes with splitter plans
- Install fibre cable in duct, aerial and indoor pathways within bend radius and pulling tension limits
- Perform fusion and mechanical splices and terminations that meet splice loss and reflectance targets
- Test fibre links with an optical power meter, light source and OTDR, then interpret traces to locate faults and high-loss events
- Produce a Fibre Link Design, Test and Restoration Pack with as-built records, acceptance results and an emergency restoration procedure

Target Audience:

- Telecom engineers and technicians who plan, build and maintain outside plant and access fibre networks
- Network engineers responsible for campus, data centre and backbone fibre links
- Utility and OT communications engineers maintaining fibre along power lines, pipelines and substations
- Field technicians who splice, terminate and test fibre cable during installation and repair
- Network operations and maintenance staff responsible for fault response, fibre records and restoration

Course Outline:

Day 1: Optical Fibre Principles and Fibre Plant Components

- Total Internal Reflection, Core and Cladding Geometry and Numerical Aperture
- Single-Mode Versus Multimode Fibre: Core Size, Reach and Graded-Index Profiles
- Attenuation Mechanisms at 1310 and 1550 nm: Rayleigh Scattering, Absorption and Bending Loss
- Chromatic and Modal Dispersion and Their Effect on Link Bandwidth
- Existing Fibre Plant Survey Checklist: Routes, Cable Types and Records Condition

Day 2: Fibre Standards, Cables, Connectors and Network Architectures

- ITU-T G.652, G.655 and G.657 Single-Mode Fibre Types and Bend-Insensitive Applications
- Loose-Tube, Tight-Buffered, Ribbon and ADSS Cable Constructions and Colour Codes
- Connector and Ferrule Types: LC, SC, MPO, UPC and APC End Faces
- Point-to-Point, Ring Backbone and FTTH, FTTB and FTTC Architectures
- PON Architectures: ITU-T G.984 GPON, ITU-T G.9807.1 XGS-PON and IEEE 802.3ah EPON Splitter Designs

Day 3: Link Loss Budgets, Installation Practice and Splicing

- Optical Link Loss Budget Worksheet: Fibre, Splice, Connector, Splitter and Margin Allowances
- Duct and Microduct Installation: Pulling Tension, Blowing and Bend Radius Limits
- Aerial and Indoor Cable Routing, Slack Storage and Splice Closure Placement
- Fusion Splicing Procedure: Stripping, Cleaving, Arc Alignment and Protection Sleeves
- Mechanical Splices, Field-Installable Connectors and Connector Inspection and Cleaning

Day 4: Fibre Testing, Troubleshooting and Fault Location

- Insertion Loss Testing with Light Source and Power Meter Using TIA-455 Test Procedures
- OTDR Pulse Width, Dead Zones and Launch and Receive Fibre Setup per Telcordia GR-196
- OTDR Trace Interpretation: Splices, Connectors, Macrobends, Breaks and Ghost Events
- Bidirectional OTDR Averaging and SR-4731 Trace File Records
- Fault Location Workflow: Visual Fault Locator, Distance-to-Fault and Route Correlation

Day 5: Fibre Lab, Safety, Maintenance and Restoration Pack

- Laser Safety Classes, Fibre Shard Handling and Splicing Work Area Controls
- Lab: Fusion Splicing and Splice Loss Verification on Single-Mode Fibre
- Lab: OTDR Acceptance Test and Fault Location on a Multi-Segment Link
- Emergency Restoration Procedure, Spare Cable Strategy and Preventive Maintenance Schedule
- Fibre Link Design, Test and Restoration Pack Presentation and Peer Review

Skills You Will Gain:

- Fibre Type and Cable Selection
- Optical Loss Budget Calculation
- PON Splitter Planning
- Fibre Cable Installation Practice
- Fusion Splicing
- OTDR Trace Analysis
- Fibre Fault Location
- Fibre Plant Documentation

Why Attend This Course:

- Return with a Fibre Link Design, Test and Restoration Pack built for a route in your own network
- Cut repeat faults by applying splice, connector cleaning and bend radius practice checked in the lab
- Read OTDR traces well enough to accept contractor work or dispute it with evidence
- Compare fibre build and repair practice with engineers from telecom operators, utilities, oil and gas and enterprise networks

Conclusion:

Fibre networks stay reliable when design, installation, splicing, testing and records follow one consistent method. The course moves from optical fibre principles and components, through fibre types, cables, connectors and point-to-point, backbone and PON architectures, to loss budgets, installation and splicing, then power meter and OTDR testing and fault location. The final day applies these methods in hands-on labs and produces a Fibre Link Design, Test and Restoration Pack ready for field use.