



## Training course outline

### ITU and Smart Tunisian Techno parks (S2T)

Title	<b>Optical Fiber Characterization</b>
Modality	Face-to-Face - French
Dates	9-13 May 2022
Duration	5 days
Registration deadline	6 May 2022
Training fees	500 USD
Description	<p>This training is focused on mastering the fiber optic tests that are required to verify that your infrastructure can support high data rate applications (10 Gb/s, 40 Gb/s, 100 Gb/s) and Raman amplification as well as extended wavelength ranges for CWDM and DWDM systems. It is typically required to characterize fibers before upgrading data bitrate.</p> <p>This is an advanced level, five-day course that assumes previous experience with fiber optics and testing. Tests include bidirectional loss, ORL, and OTDR testing, plus CD, PMD and spectral attenuation. Full documentation and reporting is also covered.</p>
Code	22WS28167ARB-F

#### 1. LEARNING OBJECTIVES

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This training combines classroom lecture and hands-on testing skills to provide an understanding of the principles behind building and maintaining high speed optical networks. Key parameters such as polarization mode dispersion (PMD), chromatic dispersion (CD), and optical return loss (ORL) need to be calculated in order to evaluate system capabilities and network upgrades to higher bit rate systems.

#### 2. LEARNING OUTCOMES

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By the end of this training, the participants should be able to:

- know the tests that are required for fiber characterization.
- know the transmission limits as a function of bit rate and application.

- understand about the effects of Chromatic Dispersion and Polarization Mode Dispersion on high-speed signals such as 10G, 40G, and 100G.
- understand OTDR theory and bi-directional splice characterization.
- understand ORL and the consequences of high ORL.
- measure Chromatic and Polarization Mode Dispersion.
- Conduct all tests required for fiber characterization.
- Test one complete span and compile all test data into a comprehensive report.
- Use an OLTS, OTDR, CD and PMD tester.

### 3. TARGET POPULATION

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This training is intended for manufacturers, installers, infrastructure operators, Internet service providers, content and services providers, local authorities and any person involved in a project around the receipt of fibre optical among enterprises, data centers, individuals, local authorities, etc.

### 4. ENTRY REQUIREMENTS

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This class requires basic knowledge of fiber optic theory. It is intended for people involved with equipment or outside plant where fiber characterization is needed to assure proper operation of 10 Gb/s or higher data rates.

### 5. TUTORS/INSTRUCTORS

Name of tutor(s)/instructor(s)	Contact details
<p>Mourad MENIF is an engineer and Professor and a researcher at Sup'Com (Higher School of Communication of Tunis)</p> <p>Dr. Mourad MENIF is delivering seminars in wide variety of subjects related to telecom and network at an international level with ITU.</p>	<p><a href="mailto:Mourad.mnif@supcom.tn">Mourad.mnif@supcom.tn</a></p>

### 6. TRAINING COURSE CONTENTS

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- Tests that are required for fiber characterization.
- Transmission limits as a function of bit rate and application.
- The effects of Chromatic Dispersion and Polarization Mode Dispersion on high-speed signals such as 10G, 40G, and 100G.
- OTDR theory and bi-directional splice characterization.
- ORL and the consequences of high ORL.
- How to measure Chromatic and Polarization Mode Dispersion.
- Tests required for fiber characterization.
- Test one complete span and compile all test data into a comprehensive report.
- Use an OLTS, OTDR, CD and PMD tester.

## 7. TRAINING COURSE SCHEDULE (Tunis Time)

Date for 1 <sup>st</sup> day	Time; Start time	Topics/Activities
9/05/2022	08:00 - 8:30	Registration
	08:30 – 09:00	<b>Opening Ceremony</b>
	09:00 - 12:00	<b>Introduction:</b> <ul style="list-style-type: none"> <li>– Optical fiber transmission system</li> <li>– Optical network enabling technologies</li> <li>– Optical network evolution</li> </ul>
	12:00 – 13:00	Lunch time
	13:00 - 16:00	<b>Optical fiber:</b> <ul style="list-style-type: none"> <li>– Multi-mode optical fibers</li> <li>– Single-mode optical fibers (G652, ..., G657)</li> <li>– Dispersion-compensating fiber</li> <li>– Fiber optic color code standard</li> </ul>
Date for 2 <sup>nd</sup> day	Time; Start time	Topics/Activities
10/05/2022	09:00 - 12:00	<b>INSPECT &amp; CLEAN CONNECTORS:</b> <ul style="list-style-type: none"> <li>– Why do we inspect &amp; clean?</li> <li>– Inspection standards</li> <li>– Inspection equipment</li> <li>– Cleaning equipment</li> <li>– Connector care</li> </ul>
	12:00 – 13:00	Lunch time
	13:00 - 16:00	<b>ILM &amp; SPECTRAL ATTENUATION:</b> <ul style="list-style-type: none"> <li>– Continuity checking</li> <li>– Power &amp; loss budgets</li> <li>– Insertion loss measurements</li> <li>– Spectral attenuation</li> <li>– Live fiber identifiers</li> </ul> <b>RETURN LOSS MEASUREMENT</b> <ul style="list-style-type: none"> <li>– Definitions</li> <li>– Performance requirements</li> <li>– How is it measured?</li> </ul>

Date for 3 <sup>rd</sup> day	Time; Start time	Topics/Activities
11/05/2022	09:00 - 12:00	<b>OTDR TESTING</b> <ul style="list-style-type: none"> <li>- What is OTDR testing?</li> <li>- What can it do for us?</li> <li>- How does it work?</li> </ul>
	12:00 – 13:00	Lunch time
	13:00 - 16:00	<b>OTDR CAPABILITIES</b> <ul style="list-style-type: none"> <li>- Distance measurements</li> <li>- Fiber loss measurements</li> <li>- Bending losses</li> <li>- Splice loss measurement</li> <li>- Connector losses</li> <li>- Link return loss (ORL)</li> </ul>
Date for 4 <sup>th</sup> day	Time; Start time	Topics/Activities
12/05/2022	09:00 - 12:00	<b>CHROMATIC DISPERSION</b> <ul style="list-style-type: none"> <li>- What is it?</li> <li>- What causes it?</li> <li>- CD characteristics of common fiber types</li> </ul> <b>CD MEASUREMENT METHODS</b> <ul style="list-style-type: none"> <li>- Standards</li> <li>- Group delay and dispersion</li> <li>- Time of flight techniques</li> <li>- Phase Shift Techniques</li> </ul>
	12:00 – 13:00	Lunch time
	13:00 - 16:00	<b>POLARISATION MODE DISPERSION</b> <ul style="list-style-type: none"> <li>- Polarisation in fibres</li> <li>- Polarization in other system components</li> <li>- PMD &amp; system performance</li> <li>- Second order PMD</li> <li>- Dynamics of PMD</li> </ul> <b>MEASUREMENT TECHNIQUES</b> <ul style="list-style-type: none"> <li>- Interferometric technique</li> <li>- Polarimetric technique</li> <li>- Fixed analyzer technique</li> <li>- Wavelength scanning</li> <li>- Interpreting test results</li> </ul> <b>PMD MEASUREMENT</b> <ul style="list-style-type: none"> <li>- Low PMD fiber link</li> <li>- High PMD fiber link</li> <li>- Concatenated links</li> <li>- Amplified links</li> </ul>

Date for 5 <sup>th</sup> day	Time; Start time	Topics/Activities
13/05/2022	09:00 - 12:00	<p><b>REPORTING</b></p> <ul style="list-style-type: none"> <li>– Measurement validation checklist</li> <li>– OTDR measurement presentation</li> <li>– Fiber characterization reports</li> <li>– Web based documentation</li> </ul> <p><b>LINK ACCEPTANCE CRITERIA</b></p> <ul style="list-style-type: none"> <li>– Fiber distances</li> <li>– Cabling losses</li> <li>– Reflections</li> <li>– Chromatic dispersion</li> <li>– PMD</li> </ul>
	12:00 – 13:00	Lunch time
	13:00 - 16:00	Test Evaluation

## 8. METHODOLOGY (Didactic approach)

The course's methodology is based on the following types of sessions:

- Theory sessions: Part deal with both basic and advanced concepts, those are directly applicable to professional practices.
- Practical sessions. In these sessions, a set of practical labs will be done to experiment and be familiar with optical fiber concepts.
- This training for maximum 12 people will be held mainly in laboratory as practical training, to ensure trainer availability and ease access to handling materials in optimal conditions (course material included).

## 9. EVALUATION AND GRADING

Evaluation will be based on a final exam.

Grading will take into consideration attendance (30%) and a final overall exam (70%).

**IMPORTANT:** a passing mark of 70% is required for obtaining a completion certificate.

## 10. TRAINING COURSE COORDINATION

<p><b>Course coordinator:</b></p> <p>Mrs. Houda Jarraya  Focal point at S2T  Tel: + 216 71 856 073  Mobile: +216 97 879 228 / 28 300 878  Fax: +216 71 857 803  Email: <a href="mailto:houda.jarraya@s2t.tn">houda.jarraya@s2t.tn</a>  <a href="mailto:houda.jarraya@gmail.com">houda.jarraya@gmail.com</a></p>	<p><b>ITU coordinator:</b></p> <p>Mr. Ahmed El Raghy  Senior Advisor  ITU Arab Regional Office  Tel: +202 3537 1777  Mobile: +201005281908  Fax: +202 3537 1888  Email: <a href="mailto:ahmed.elraghy@itu.int">ahmed.elraghy@itu.int</a></p>
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