Training course outline

ITU and Smart Tunisian Technoparks (S2T)

Title	Optical Transport Networks: DWDM
Modality	Face to Face
Dates	13-17 June 2022
Duration	5 Days
Registration deadline	10 June 2022
Training fees	500 USD
Description	This course is designed for network engineers, network designers, and network planning personnel needing to learn the fundamental principles and practices for designing a basic optical network. It covers advanced single mode networks, focusing on CWDM and DWDM network design for high-speed networks (10 Gb/s, 40 Gb/s, 100 Gb/s, 400Gb/s). Participants are introduced to industry best practices and methodology in optical network design, including customer requirements analysis, physical and logical topology, the placement of amplifiers and dispersion compensation components and evaluation of system performance. The course includes lab exercises and multiple case studies where participants design simple networks.
Code	22OI28073ARB-F

1.LEARNING OBJECTIVES

The course takes an inventory and shows development trends. It discusses the major changes in the fields of optical fiber types, access, and backbone, as well as optical networks and network protection and gives a compact overview of the innovative potential of high-performance, optical technologies. Students receive the know-how required for the planning, operation, and troubleshooting in WDM networks. Hands-on exercises on fiber optic analysis and troubleshooting via OTDR measurement serve to consolidate the imparted knowledge. The commissioning of a WDM trunk rounds off the practical part of the course.

2. LEARNING OUTCOMES

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

- Describe the function module and network structure of WDM system.
- Characterize the typical building blocks of a WDM network (amplifier, DCM, OADM, OXC, transponder).
- Illustrate the main factors involved in WDM network planning, such as power budget, dispersion compensation, OSNR calculation and nonlinearity.
- Outline the design process of WDM network.

3.TARGET POPULATION

Technical staff, regulators, policy makers, telecom operators, industry, and academia. Other institutions and individuals who are interested in building their capacity in design, installation, and project management of infrastructures for high speed WDM networks.

4.ENTRY REQUIREMENTS

No pre-requisite experience is required to take this course as the subjects covered will be of interest to anyone working in the telecommunication field.

5.TUTORS/INSTRUCTORS

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

6.TRAINING COURSE CONTENTS

- Optical Transmission and Interfaces.
- Optical Fibers: MMF, SMF, DSF, NZ-DSF, DCF.
- Connectors and their Designs.
- Attenuation, Dispersion, and Dispersion Correction.
- Application of Optical Repeaters, such as EDFA, RAMAN.
- Laser: Protection Classes and Operational Safety.
- Optical Technologies: 10G/40G/100G-Ethernet.
- CWDM, DWDM, WWDM, and Application Scenarios.
- OADMs, Optical Switches.

- Optical Networks: Setup, Operation, Network Protection Mechanisms.
- Vendor Overview: Who is responsible for which task?
- OTNs, Optical Transport Networks, for Protected Optical Transmission.
- Exercises on network design, acceptance measurement, and troubleshooting.

7.TRAINING COURSE SCHEDULE (Tunis Time)

Date for 1st day	Time; Start time	Topics/Activities
13/06/2022	09:00 - 12:00	**Introduction** – WDM Overview – Transmission Media – Key Technologies
	12:00 – 13:00	Lunch time
	13:00 - 16:00	**Classification of optical systems:** – Operating wavelength range – Single-channel and multichannel system interfaces – Channel spacing in WDM systems – Categories of WDM systems – Number of channels in WDM systems – Bit rates and client classes – Bit Error Rate, Q-factor – Forward Error Correction.
Date for 2nd day	**Time; Start time**	**Topics/Activities**
14/06/2022	09:00 - 12:00	**Key passive Optical Components:** – AWG, – MUX and DEMUX – Fiber Bragg Grating – Circulator, isolator, coupler, …
	12:00 – 13:00	Lunch time
	13:00 - 16:00	**Key Active Optical Components:** – Optical sources and wavelength converters – Optical Modulators – EDFA, SOA and Raman amplifiers

		− ROADM and OXC
Date for 3rd day	**Time; Start time**	**Topics/Activities**
15/06/2022	09:00 - 12:00	**Optical system design:** − Relevant parameters for power budget − Chromatic dispersion penalty − DGD power penalty
	12:00 – 13:00	Lunch time
	13:00 - 16:00	**Optical system design:** − Limit to the transmission distance due to optical signal to noise ratio − Penalty due to residual chromatic dispersion after accommodation − Penalty due to fibre non linearities
Date for 4th day	**Time; Start time**	**Topics/Activities**
16/06/2022	09:00 - 12:00	**Case Study: DWDM optical systems** − Number of optical channels and their spacing − Modulation format
	12:00 – 13:00	Lunch time
	13:00 - 16:00	**Case Study: DWDM optical systems** − EDFA placement − OSNR and NF evaluation
Date for 5th day	**Time; Start time**	**Topics/Activities**
17/06/2022	09:00 - 12:00	**Case Study: DWDM optical systems** − Accumulated gain ripples from EDFA cascading − Dynamic gain equalization − DCM placement − Residual dispersion and dispersion tolerance
	12:00 – 13:00	Lunch time
	13:00 - 16:00	**Test Evaluation**

8. METHODOLOGY (Didactic approach)

Course materials: Each module will be available for the course material on the website
Online Discussion Forums: Participants are expected to participate actively in discussion forums on selected topics throughout the week.

9. EVALUATION AND GRADING

Evaluation will be based on quizzes every day and 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

Course coordinator:	ITU coordinator:
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: houda.jarraya@s2t.tn houda.jarraya@gmail.com	**Mr. Ahmed El Raghy** Senior Advisor ITU Arab Regional Office Tel: +202 3537 1777 Mobile: +201005281908 Fax: +202 3537 1888 Email: ahmed.elraghy@itu.int