

SYC: Optical line systems

Online course specification

Target audience:

This course is designed for technicians and engineers involved in the design, commissioning and maintenance of optical transmission networks.

Course aim:

This course describes the capabilities, components and operation of the optical links that provide interconnections in core and metro networks.

Course level: Intermediate

An explanation of PTT course levels is given at the end of this document

Pre-requisites:

An understanding of the basic principles of modulation, multiplexing and optical fibre principles. It is recommended that the PTT online courses “Transmission fundamentals” and “Optical fibre principles” are studied before attempting this course.

Course structure:

The course consists of the following 5 modules:

1. Course introduction
2. Amplified line systems
3. Optical interfaces
4. Maximising link capacity
5. Beyond 10 Gbit/s

Module 1: Course introduction

Module aim: To summarise the aims of each module and introduce the navigation and learning facilities provided by the course.

Module 2: Amplified line systems

Module aim: To describe the principles, advantages and applications of optical amplifiers in telecommunications links.

After completing this module, a trainee will be able to:

- describe the role of the functional components of an SDH mux equipment employed to terminate optical lines.
- explain the principles of optical amplification with reference to the role of erbium doped fibre and the optical pump.
- describe the advantages of optical amplifiers with reference to optical testing, ease of upgrading line systems and the use of WDM.
- describe the use of optical amplifiers as repeaters, power boosters and pre-amplifiers.
- describe two methods of providing bi-directional optical amplification.

Module 3: Optical interfaces

Module aim: To describe the various types of SDH and Ethernet optical interface as employed in wide area networks in terms of their characteristics and capabilities.

After completing this module, a trainee will be able to:

- describe and compare the capabilities of the five optical interface classifications as defined by the ITU.
- describe and compare the characteristics of the optical fibres defined in ITU recommendations G.652, G.653, G.654 and G.655.
- explain the choice of operating optical wavelength for a particular application.
- explain that the ITU has specified interfaces for the five interface classifications and aggregate bit rates from 155 Mbit/s to 10 Gbit/s.
- explain that the ITU recommendation G.691 describes line systems that use optical amplifiers for post and pre-amplification.
- describe and compare the capabilities and applications of the IEEE Ethernet interfaces 1000BASE-LX, 10GBASE-LR and 10GBASE-ER.
- describe the role of the Metro Ethernet Forum (MEF) Carrier Ethernet standards.
- compare the facilities, capabilities and applications of ITU recommended SDH interfaces and IEEE Ethernet optical interfaces.
- describe the role of “Ethernet over SDH” interfaces.

Module 4: Maximising link capacity

Module aim: To describe and compare methods of maximising the capacity of an optical link with particular reference to wavelength division multiplexing (WDM).

After completing this module, a trainee will be able to:

- explain that WDM can increase the capacity of a unidirectional link and provide bidirectional operation over a single fibre.
- describe the function of the various components of a link employing WDM with particular reference to combiners and filters.
- describe and compare the principles, characteristics and applications of wideband WDM, narrowband WDM, Coarse WDM and Dense WDM.
- describe and compare the advantages of the various methods of increasing the capacity of a link with reference to SDM, TDM and WDM.
- select the appropriate method of increasing the capacity of a particular link taking into account economic factors and the forecast growth in traffic.
- describe the causes and effects of dispersion with reference to chromatic dispersion and polarisation mode dispersion.
- describe various methods of reducing the effects of dispersion on the performance of a link.
- explain that special measures have to be taken with DWDM systems to ensure safe working.

Module 5: Beyond 10 Gbit/s

Module aim: To explain the techniques that enable operation above 10 Gbit/s over optical fibre.

After completing this module, a trainee will be able to:

- describe the limitations of on/off keying and direct detection.
- explain the principles and advantages of binary phase shift keying (BPSK) and Differential PSK (DPSK).
- explain the principles and advantages of Quadrature Phase Shift Keying (QPSK).
- explain the principles of Polarisation Multiplexing.
- describe the functions of the elements of a PM-QPSK optical transmitter.

- describe the principles, advantages and applications of coherent detection in optical systems.
- describe the functions of the elements of a coherent optical receiver.

Course access requirements:

To access the course, a computer running a browser such as Google Chrome, Safari etc is required. The computer should have Internet access. A screen resolution of at least 1024x768 is necessary.

Learning facilities:

This online course employs interactive simulations, hypertext links to an online glossary and multiple-choice question sessions to fully involve the trainee in the learning experience. Each module provides revision links to previously studied, relevant topics. A record of progress and level of achievement is recorded for each trainee. Once studied as a structured, assessed course, the content can be browsed for revision or reference.

PTT course levels:

PTT online courses are categorised by one of three levels according to the depth of treatment they provide:

1. Introductory:

PTT Introductory courses are designed for those with no previous experience or knowledge of telecommunications. These courses provide an overview of telecommunications or discuss the fundamentals of electronic communications. The study of general science at secondary (high) school is a typical pre-requisite for PTT Introductory courses.

PTT Introductory courses are suitable for those joining the telecommunications sector particularly those in an apprenticeship programme.

2. Intermediate:

PTT Intermediate courses are designed for technicians and engineers requiring an understanding of a certain aspect of telecommunications. Those planning to study an Intermediate course should have an understanding of the basic principles of electronic communications.

The depth of treatment provided by Intermediate courses is typically equivalent to level 3 of a UK national vocational qualification (NVQ). PTT Intermediate courses can be used to support the attainment of a Communications Technology NVQ at level 3.

3. Advanced:

PTT Advanced courses are designed for those who require an in-depth treatment of a certain aspect of telecommunications. Such courses are suitable for system designers as well as those who will be responsible for the maintenance of the system described in the course.

Those planning to study a PTT Advanced course should have a background in telecommunications, and an understanding of telecommunications fundamentals and the principles of the type of telecommunications system described in the course.

PTT
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