

## **PAB: Signal impairments**

### **Online course specification**

#### **Target audience:**

This course is designed for those who require an introduction to the fundamental technical concepts that underpin modern telecommunications. The course is suitable for those joining the industry in a technical role especially those in an apprenticeship.

#### **Course aim:**

To introduce the causes of signal impairments and their effect on the transmission of information over telecommunications and data links.

#### **Course level:** Introductory

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

#### **Pre-requisites:**

A basic understanding of electrical circuit theory. It is recommended that the PTT course “Analogue and digital signals” is studied before attempting this course.

#### **Course structure:**

The course consists of the following three modules:

1. Loss, noise and distortion
2. Crosstalk, delay and echo
3. Digital impairments

#### **Module 1:** Loss, noise and distortion

Module aim: To explain the cause and effects of noise, distortion and loss on information transfer using analogue signals and describe the parameters used to assess the quality of a circuit affected by noise.

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

- explain the concept and causes of loss in an electrical circuit.
- state the formula for expressing loss in decibel units and explain the advantages of using decibel units when comparing power levels.
- explain the causes and effects of various types of noise and interference including white noise and impulse noise.
- define the term Signal to Noise ratio and explain its significance.
- explain the concept and role of a weighted noise measurement.
- explain the causes and effects of various types of distortion including harmonic distortion and delay distortion.

#### **Module 2:** Crosstalk, delay and echo

Module aim: To explain the causes and effect of crosstalk and echo on information transfer using analogue signals and discuss the role of echo cancellers and suppressors.

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

- explain the cause and effect of crosstalk in an electrical circuit

- compare Near End Crosstalk (NEXT) and Far End Crosstalk (FEXT) and describe their measurement.
- give examples of where crosstalk may adversely affect communication services.
- explain the causes of echo in a telecommunications circuit.
- give examples of the amount of delay introduced by various types of telecommunications circuit including those carried over optical fibre and those carried over a satellite link.
- explain the effect of increasing amounts of delay and echo on the subjective quality of a speech circuit.
- explain the role and basic principles of operation of echo cancellers.
- describe how excessive delay can degrade services involving the transfer of data.

### **Module 3:** Digital impairments

Module aim: To explain the cause and effects of various types of impairment on digital signals and define the terms used to assess the error performance of a digital link.

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

- explain how noise can create errors in binary coded information.
- define the term Bit Error Ratio (BER) and describe how BER is expressed using normalised scientific notation.
- explain that some types of encoded information are more affected by errors than others giving examples of the minimum acceptable BER for each.
- describe graphically the effect of a reduction in the signal to noise ratio of a digital signal on its error performance.
- define the term “noise margin” and explain its significance.
- explain the cause and effects of envelope delay distortion on a digital signal.
- state that dispersion is a type of delay distortion affecting optical signals carried over optical fibres.
- define the term “jitter” and explain that excessive jitter can cause digital errors.

**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  
June 2018