

## **PAA: Analogue and digital signals**

### **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 characteristics of the signals used in communications systems and the effect of passive circuits on those signals.

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

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

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

GCSE in Physics or GCSE in Additional Science or equivalent.

#### **Course structure:**

The course consists of the following four modules:

1. Electrical circuit fundamentals
2. Analogue signals
3. AC circuits
4. Digital signals

#### **Module 1:** Electrical circuit fundamentals

Module aim: Describe the basic principles of current flow in an electrical circuit with reference to its significance to transmitting signals.

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

- define the terms voltage, current, and resistance, state the units of measurement for each and describe the relationship between them with reference to Ohms law.
- state the relationships between voltage, current, resistance and power.
- define the terms “direct current” and “alternating current” giving applications of each.
- explain that a microphone converts variations in air pressure caused by sound waves into an alternating current.
- explain the concept of internal resistance with reference to power cells and other power supplies.
- describe the structure of a capacitor with reference to its plates and dielectric materials and its ability to store electrical charge.
- describe the relationship between voltage and current during the charging of a capacitor.
- describe how a capacitor allows alternating current flow but resists direct current flow.
- explain the concepts of self and mutual inductance, with reference to their effects on signal transfer along a wire and between wires.
- state that a transmission line will exhibit resistance, capacitance and inductance.

- state that the electrical characteristics of a line determine the efficiency of AC power transfer.

### **Module 2:** Analogue signals

Module aim: Describe the characteristics of analogue signals.

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

- explain the concepts of amplitude, frequency and phase of an analogue waveform.
- explain that a complex waveform such as a square wave consists of a fundamental frequency and higher harmonic frequencies.
- explain the meaning and significance of the root mean square (rms) power of a waveform.
- define “noise” as an unwanted AC signal with randomly changing amplitude.
- define the term “bandwidth” in terms of the frequency range between half power points
- describe the relationship between available bandwidth on a link and the maximum rate of information transfer over that link.
- compare the bandwidth requirements of various types of traffic including text, voice and video.

### **Module 3:** AC circuits

Module aim: To describe the characteristics of AC circuits containing inductance and capacitance.

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

- describe the behaviour of inductance, capacitance and resistance in alternating current (AC) circuits with reference to their effects on the phase relationship between current and voltage.
- describe the characteristics of low pass and high pass filters.
- describe how the characteristics of a transmission line can be explained by its equivalent circuit.
- explain the concept of reactance.
- explain the concept of impedance in terms of resistive and reactive components.
- describe the characteristics of parallel and serial resonant circuits, giving examples of their use in telecommunications.
- state the formula for determining resonant frequency in terms of resistance, capacitance and inductance.

### **Module 4:** Digital signals.

Module aim: To explain the basic principles of transmitting various types of information as a digital signal.

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

- explain that a digital signal can represent numerical information using two binary states.
- explain how samples of a speech signal can be represented by a binary code.
- explain that picture elements (pixels) can be represented by a binary code.
- explain the role of the ASCII code in representing text by a binary code.
- describe the effect of noise on a digital signal.
- describe the role of the basic components of a digital link including analogue to digital encoders and regenerators.
- compare the effect of transmitting analogue and digital signals over long links with reference to the degradation of the information being carried by the signals.
- define the terms bit, byte and bit rate and explain their significance.

- describe the relationship between the bandwidth of a link and the maximum achievable bit rate over that link.
- compare the bit rate requirement of signals carrying speech and video information.

**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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