

# Basic Principles of Communications Systems

This unit is concerned with safe working practices and the basic principles of communications systems. This is the core unit of the C&G 3667-02 qualification and must be completed in addition to one of the optional units of Unit 102, Unit 103 or Unit 104 to achieve the full Level 2 Award in Communications Cabling.

## Outcome 1

*Identify the safe working practices in communication systems*

### Underpinning knowledge

#### You will be able to:

- State the rules for safe working when undertaking installation including:
  1. Statutory requirements
  2. Working in confined spaces and
  3. Electrical safety
- State the rules for safe working when carrying out preparation in terms of
  1. Safe use of cutting and stripping tools
  2. Safe handling and containment of cleaning materials
  3. The disposal of waste material
- State the rules for safe working and any special precautions when splicing in terms of
  1. Identification of hazardous working conditions
  2. Selection and use of tools and materials
  3. The dangers of high voltage systems employed in fusion splicing machines
- State the rules for safe working and any special precautions to be observed when terminating the cables in terms of
  1. Identification of hazardous working conditions
  2. Correct and safe use of tools and equipment
  3. Correct waste disposal
  4. Storage of tools
  5. Safe working when handling cable
  6. Care in using chemicals for cleaning
  7. Care in use of resins and adhesives

## Outcome 2

*Describe the basic principles of communication systems*

### Underpinning knowledge

- SI Units and symbols

You will be able to:

1. Identify basic SI Units
2. Identify names and symbols for preferred SI prefixes
3. Identify waves and wave motion
4. Define amplitude, wavelength ( $\lambda$ ), frequency ( $f$ ) and the unit of frequency (hertz)
5. State the relationship velocity, frequency and wavelength ( $v = f\lambda$ )
6. Define "efficiency" in terms of input and output energy

- Basic electricity (DC)

You will be able to:

1. Recognise the international standard symbols for electrical components
2. State the effects of an electrical current
3. Distinguish between electrical conductors and insulators
4. State the SI units of current (ampere), potential difference (volt) and resistance (ohm)
5. State Ohm's law and use the law to solve simple electrical circuit problems

- Communication Systems

You will be able to:

1. State the meaning of "telecommunications"
2. Identify basic communication systems
3. Outline the basic principles of cable systems
4. State the sources of interface

5. List sources of distortion
6. Identify the properties of differing types of transmission links (channels)
7. Identify various methods of communicating over a channel
8. Identify types of information carried by communication systems
9. State the systems available for communication
10. Categorise signals into audio, video and data types
11. State the differences between analogue and digital signals
12. State the meaning of bandwidth
13. State the meaning of the baseband of complex signals
14. Recognise that analogue information may be converted to digital signals and vice versa
15. State that variation of the amplitude, frequency or phase of a carrier wave can be used to convey information
16. State the meaning of "gain" in communication systems
17. State the meaning of "attenuation" in communication systems
18. Explain why gain and attenuation are usually measured in decibels (dBs)
19. State the relationship for the power ratio expressed in dBs for a number of ratios and vice versa
20. Calculate in dBs the overall gain and/or attenuation of simple systems given the gain/attenuation of the individual stages
21. Explain the meaning of multiplexing in communication systems

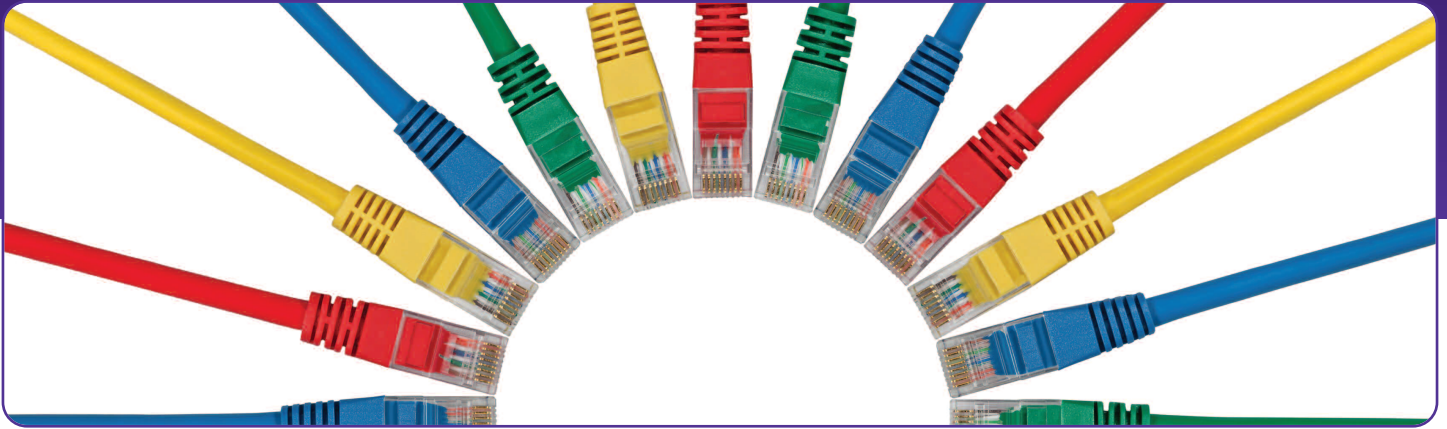
22. State the advantages and disadvantages of optical fibre compared to copper

- Data Communication

You will be able to:

1. Explain the meaning of a network
2. State that data networks allow computers or other data terminals to exchange information
3. State the advantages of digital communication over analogue methods
4. Recognise that digital networks carry binary information
5. Distinguish between "bits" and "bytes"
6. State the meaning of bit error rate and give typical figures for copper and optical fibre
7. Explain that there are two methods of transporting data: serial and parallel
8. Explain the advantages and disadvantages of transmitting data by serial and parallel methods
9. Identify applications for serial data communication and parallel data communication
10. Explain why "modems" are required for computer communication over analogue lines
11. State that there are three main categories of computer networks
12. Identify the basic topologies of computer networks

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# Copper Cabling in an Internal Environment

This unit is concerned with the safe installation, procedures and testing of copper communication cables. With the phenomenal growth of Data Communications and the Internet, there is a real requirement for trained technicians who can install and test data networks for a wide range of applications. Utilising our LIVE Ethernet and LAN/WAN simulators, we bring the reality of the working environment into the classroom. This course gives you all the skills you need to install and test copper based communications cables.

## Outcome 1

Work safely with copper cabling in an internal environment

Practical activities

You will:

- Conduct a risk assessment prior to installation of copper cables in an internal environment
- Work safely when installing, terminating and testing copper cables in an internal environment

### Underpinning knowledge

You will be able to:

- State the rules for safe working with copper cabling when undertaking installation
- State the rules for safe working with copper cabling when carrying out preparation
- State the rules for safe working in terms of electrical safety
- State the safe use of battery/electrically powered test equipment and power leads

## Outcome 2

Understand basic electrical theory and safety with reference to data communications cabling

Practical activities

You will:

- Use a multi-meter to measure voltage and resistance

### Underpinning knowledge

You will be able to:

- State the materials that make up electrical conductors and insulators
- Explain capacitance and inductance and their relationship to an electrical cable

- Identify analogue and digital signals
- Identify SI measurement prefixes
- Describe the relationship between MHz and Mbits
- Explain return loss, equal level far end cross talk (ELFEXT), powersum calculations, delay skew, propagation delay, attenuation-to-crosstalk ratio (ACR), length, attenuation, near end cross talk (NEXT), wire map, dc loop resistance, normal velocity of propagation (NVP) and bandwidth
- State the effect of copper cable signalling
- State the rules for copper cable installation and management

## Outcome 3

Install copper communication cabling, following recommended installation procedures in accordance with current applicable standards

Practical activities

You will:

- Check cable and components before installation
- Undertake a site survey prior to commencing work
- Check that correct cable laying procedures are followed

### Underpinning knowledge

You will be able to:

- State the various cable topologies available for the installation of copper cables
- State the different cable types available for use in copper networks
- State the relevant classes, standards and categories of cabling

- State the installation techniques
- State the rules and any special precautions to be observed when carrying out installation

## Outcome 4

Terminate copper communication cabling

Practical activities

You will:

- Terminate connectors in accordance with manufacturer's recommendations and correctly mount connectors into communications panels, wall and floor boxes, cabinets and frames

### Underpinning knowledge

You will be able to:

- Explain how to use cable preparation and termination tools
- State how to terminate registered jack (RJ) 45 connectors from at least three vendors on to UTP and FTP cabling
- State the method of termination RJ 11/line jack unit (LJU) or other relevant connectors to telephone cable
- State how to terminate Cat 5e patch leads
- State insulation displacement contact (IDC) methods of terminating multi-core copper cables within wiring systems and 110 block wiring systems
- State the rules and any special precautions for termination
- Describe how to terminate co-axial cable with Bayonet N Connectors (BNC)

## Outcome 5

Test FTP, UTP and multi-core copper links

Practical activities

You will:

- Test FTP and UTP copper cable permanent links
- Test a multi-core cable installation
- Test installations to relevant performance standards
- Test a telephone cabling system

### Underpinning knowledge

You will be able to:

- Explain the importance of testing cabling plant installations
- State the applications of national and international wiring standards
- Describe the cabling topology
- Explain the application and use of continuity and loop testing equipment
- Explain split pairs, transposed/crossed pairs, reversed pairs and mixed pairs
- State the correct methods of measuring NEXT from both ends of the cable, ACR, return loss (dB), cable length, (dc) resistance (Ohms), propagation delay, cable attenuation, delay skew, wire maps, FEXT and ELFEXT and powersum calculations
- State the

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