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2730

Telecommunication Systems

Technician Certificate
2002 onwards

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Telecommunication Systems

2730
Technician Certificate

2002 onwards

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For a copy of City & Guilds' equal opportunities policy statement please contact the above address.

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2730 Telecommunication Systems

About City & Guilds

We provide assessment and certification services for schools and colleges, business and industry, trade associations and government agencies in more than 100 countries. We have over 120 years of experience in identifying training needs, developing assessment materials, carrying out assessments and training assessment staff. We award certificates to people who have shown they have mastered skills that are based on world-class standards set by industry. City & Guilds International provides a particular service to customers around the world who need high-quality assessments and certification.

About e-skills UK

e-skills UK is the industry representative body responsible for addressing the needs of IT and telecommunications employers in the UK for a world class workforce in the information age.

e-skills UK benchmarked the City & Guilds award in Telecommunication Systems against the occupational standards for the UK telecommunications industry.

In meeting these requirements we at City & Guilds also raised the standard of training design and delivery, an achievement reflected in our accreditation by e-skills UK.

Successful candidates benefit from this accreditation when they apply for jobs in the UK.

Introduction to this programme

We have designed the Technician Awards in Telecommunication Systems for those undergoing training or employed in this area of work. The programme aims to reflect the international nature of the knowledge and skills and activities needed for different countries or cultures.

We do not say the amount of time a candidate would need to carry out the programme, but we do provide advice on guided learning hours for each unit at each level. The programme has three levels.

Certificate

The certificate is an entry-level qualification that has been designed for young people who have just left school, or for anyone seeking a career change. Graduates of the programme should be able to obtain employment within the telecommunications industry at the technician level in the fields of manufacture, installation, maintenance or operation. The certificate will also provide useful underpinning knowledge for those already employed in the industry at the technician or craft level.

The certificate has been designed for a minimum of 300 guided learning hours. Candidates will be expected to study for an equivalent period of their own time, in order to achieve success.

Diploma

The diploma (about 600 guided learning hours) provides more practice involving a broader range of skills appropriate to a person who may also supervise, or who wishes to progress into higher education. Graduates of the diploma should have a well-developed knowledge of the technical and design principles of complex telecommunication systems enabling them to fulfil the role of technician/senior technician across a range of specialised disciplines.

Advanced Diploma

The advanced diploma (600 guided learning hours) takes these skills to the level appropriate to a person preparing for, or working in, first-level management. It is also appropriate for someone who wishes to receive specialised training at a high level. Graduates of the advanced diploma should have a sound knowledge of the technical design principles in one or more specialised branches of telecommunications. They will have the potential to fulfil the role of senior/chief technician with a high level of responsibility requiring the use of personal initiative and critical judgement.

We stress that these figures for guided learning hours are only a guideline. We award certificates for gaining and showing skills by whatever mode of study, and not for periods of time spent in study.

We provide certificates for all work-related areas at seven levels within our structure of awards shown in appendix E. This programme covers level 2. The standards and assessments for the diploma (level 3) and the advanced diploma (level 4) are published separately.

Full Technological Diploma

We will award the Full Technological Diploma (FTD) in Telecommunication Systems to someone who is at least 21, who has had at least two years of related work experience, and who has successfully completed the assessments for the diploma and the advanced diploma levels of this award. If candidates enter for this diploma, they must also send us a portfolio of evidence to support their application.

Making entries for assessments

Candidates can only be entered for the assessments in this subject if the approved examination centres agree. Candidates must enter through an examination centre we have approved to carry out the assessments for 2730 Technician Awards in Telecommunication Systems. See the section on approval and appendix D for more details.

There are two ways of entering candidates for assessments.

Internal candidates

Candidates can enter for examinations if they are taking or have already finished a course at a school, college or similar training institution that has directed their preparation whether by going to a training centre, working with another institution, or by open learning methods.

External candidates

These are candidates who have not finished a programme as described above. The examination centres must receive their application for entry well before the date of the examination concerned. This allows them to act on any advice you give about assessment arrangements or any further preparation needed. External candidates must carry out practical assignments and projects if necessary, and they will need extra time and guidance to make sure that they meet all the requirements for this part of the assessment.

In this publication we use the term 'centre' to mean a school, college, place of work or other institution.

Resources

If you want to use this programme as the basis for a course, you must read this syllabus and make sure that you have the staff and equipment to carry out all parts of the programme. (See appendix B.) If there are no facilities for realistic practical work, we strongly recommend that you develop links with local industry to provide opportunities for hands-on experience.

Assessments

There is one level of Technician Certificate Award in Telecommunication Systems.

Certificate

We use a numbering system to allow entries to be made for our awards. The numbers used for this programme are as follows.

Award number	2730-01
	Technician Certificate in Applied Telecommunication Systems
	Technician Certificate in Telecommunication Systems Theory

We use award numbers to describe the subject and level of the award.

Component numbers	001	Fundamentals of Electronic Communication 1
	002	Communication Systems and Digital Networks 1
	003	Telecommunication Systems Practice 1

We use component numbers to show units for which we may award a certificate of unit credit.

We use these numbers throughout this syllabus. You must use these numbers correctly if you send forms to us.

Technician Certificate in Applied Telecommunication Systems

To carry out what is needed for the Technician Certificate in Telecommunication Systems, candidates must be successful in all the following assessments.

2730-01-001	Fundamentals of Electronic Communication 1 (written multiple choice paper which lasts two hours)
2730-01-002	Communication Systems and Digital Networks 1 (written multiple choice paper which lasts two hours)
[2730-01-003]	Telecommunication Systems Practice 1

(Total two written papers)

The practical assignments are carried out during the learning programme and should be finished by the date of the written examination so you can send all the results to us.
(See appendices C and D.)

To receive this award candidates must carry out the following practical assignments:

- practical assignments 003/9, 003/10, 003/11, 003/12;
- one of 003/1, 003/2; and
- four of 003/3, 003/4, 003/5, 003/6, 003/7, 003/8.

(Total nine practical assignments)

Technician Certificate in Telecommunication Systems Theory

To carry out what is needed for the Technician Certificate in Telecommunication Systems Theory, candidates must be successful in all the following assessments.

2730-01-001	Fundamentals of Electronic Communication 1 (written multiple choice paper which lasts two hours)
2730-01-002	Communication Systems and Digital Networks 1 (written multiple choice paper which lasts two hours)

(Total two written paper)

There are no practical assignments for this award

We provide assessments in two ways.

a ***Fixed date.***

These are assessments that are carried out on dates and times we set. These assessments have no brackets around their numbers.

b ***Free date.***

These are assessments that are carried out at a college or other training establishment on a date or over a period that the college chooses. These assessments have brackets around their numbers.

In this programme the written assessments are fixed date. The practical assignments are free date.

You must carry out assessments according to our International Directory of Examinations and Assessments. If there are any differences between information in this publication and the current directory, the directory has the most up-to-date information.

Results and certification

Everyone who enters for our certificates, diplomas, and advanced diplomas receives a 'Notification of Candidate Results' giving details of how they performed.

If candidates successfully finish any assessment within this programme (for example, any one of the examination papers) they will receive a certificate of unit credit towards the certificate or diploma for which they are aiming. We grade course work assessments as pass or fail. We grade written assessments on the basis of fail, pass, credit or distinction. The certificate of unit credit will not mention assessments that they do not enter, which they failed or from which they were absent.

Each certificate or diploma clearly states what candidates need for full certification at the relevant level, allowing schools, colleges and employers to see whether they have met the full requirements.

If candidates successfully finish all the requirements for a full certificate or a diploma, they will automatically receive the appropriate certificate.

We will send the 'Notification of Candidate Results', certificates of unit credit, certificates, diplomas and advanced diplomas to the examination centre to be awarded to successful candidates. It is your responsibility to give the candidates the certificates. If candidates have a question about the results and certificates, they must contact you. You may then contact us if necessary.

We will also send you a results list showing how all candidates performed.

How to offer this programme

To offer this programme you must get approval from us. There are two categories of approval.

Subject approval

We give approval to offer a teaching course based on this syllabus.

Examination centre approval

We give approval to enter candidates for examinations.

To be approved by us to offer a teaching course you must send us the application form.

To enter candidates for examinations you must be approved by us as an examination centre. You must use the same application form. For this programme it is possible to act as a registered examination centre only, and accept external candidates. Please read the sections on making entries, results and certification, and appendix D before you make this decision. Approved examination centres must provide suitable facilities for taking examinations, secure places to keep the examination papers and materials, and may have an appointed visiting verifier to review practical work.

If you are already a registered examination centre, you only need to fill in the application form to offer teaching courses for this programme.

After we have received and accepted an application, we will send an approval letter confirming this. You can then send entries in at any time using the International Directory of Examinations and Assessments for guidance.

We show the administration procedures associated with this programme in appendix D.

City & Guilds reserves the right to suspend an approved centre, or withdraw its approval from an approved centre or for an approved centre to conduct a particular City & Guilds scheme or particular City & Guilds schemes, for reason of debt, malpractice or for any reason that may be detrimental to the maintenance of authentic, reliable and valid qualifications or that may prejudice the name of City & Guilds.

Other information

Designing courses of study

Candidates for the various Technician Awards in Telecommunication Systems will have come from different backgrounds and will have different employment and training experiences. We recommend the following:

- carry out an assessment of the achievements so you can see what learning they already have and decide the level of entry they will need; and
- consider what learning methods and places will best suit them.

When you assess a candidate's needs, you should design teaching programmes that consider:

- what, if any, previous education qualifications or training the candidate has, especially in the various general vocational education certificates we provide; and
- what, if any, previous practical experience the candidate has which is relevant to the aims of the programme and from which they may have learned the relevant skills and knowledge.

When you choose learning methods and places, you should consider the results of your assessments and whether the following are available.

- Open or distance learning material.
- Workplace learning that can be carried out on site or between you and a local workplace. This will allow the candidates access to specialised equipment and work experience.
- Working with other registered centres to share facilities.
- Opportunities for co-operative learning between candidates for different certificates who need to gain similar skills.

As long as the candidates meet the aims of this learning programme the structures of courses of study are up to you. So, it is possible to include extra topics that meet local needs.

You should avoid teaching theory alone. As far as possible the practical work should be closely related to work in the classroom (integrative approach) so that candidates use their theory in a realistic work environment.

You can use formal lectures in the classroom with appropriate exercises and demonstrations. Candidates should keep records of the practical work they do so they can refer to it at a later date.

We assume that you will include key skills, such as numeracy, communication, working with people, and organisation and planning throughout a teaching programme.

Presentation format of units

Practical competences

Each unit starts with a section on practical competences which shows the practical skills candidates must have.

At times we give more detail about important words in each 'competence statement'.

For example

'1.4 Select and use protective clothing and equipment appropriate for the task.
Protective clothing: overalls, ear defenders, safety boots, gloves, safety helmets (hard hats), particle masks, glasses/goggles/visors
Equipment: safety barriers, hazard notices, permits to work, machine guards, residual current devices, earth sticks

In the above statement the words 'protective clothing' and 'equipment' are given as a range which the candidate should be familiar with. Candidates should cover the complete range. When a range starts with the abbreviation 'eg' the candidates only need to cover some of the ranged areas or you can use suitable alternatives.

Knowledge requirements

Immediately after the section on practical competences the unit tells you what knowledge is needed for that area. The knowledge needed is closely linked to the practical competences, so it is best to teach the two together so that the candidate appreciates the topic more.

Practical assignments

You should make sure all practical assignments are supervised and instructors should make sure that the results reflect the candidate's own work. You must hold all the documents and material in a file (portfolio) for each candidate for eight weeks after the application for a certificate.

Entry levels

We consider the following programmes to be relevant preparation for this programme.

Background to Technology (3660)
Numeracy (3750)
Entry Level Mathematics (see appendix A on page 95)

We also consider the following Pitman Qualification award as relevant alongside this programme.

English for Speakers of Other Languages – higher intermediate level

If candidates do not have the above qualifications, they should have secondary school leaving passes in English and mathematics.

Progression routes and recognition

We consider the following programmes to be relevant progression routes from this programme.

Diploma Awards in Engineering (2565)
Advanced Diploma Awards in Engineering (2565)
Diploma Awards in Telecommunication Systems (2730)
Advanced Diploma Awards in Telecommunication Systems (2730)
Diploma Awards in Electrical and Electronic Engineering (8030)
Advanced Diploma Awards in Electrical and Electronic Engineering (8030)

A number of universities and other higher education institutions may accept success at diploma and certificate (with appropriate experience) level for direct entry onto bachelor degree programmes. They may also accept success at the advanced diploma level for advanced entry into the second year of these programmes. The decision to accept a candidate onto a degree programme, and the level of entry is at the discretion of the individual institution.

Useful publications

We have listed relevant text books covering specific areas of this programme in each section and also can provide a list of suggested text books. We may also have knowledge about other support materials. You should make sure that you have the latest information. We will automatically send updated lists to centres we have approved to offer this programme.

We offer the following publications as additional support materials to help you plan the delivery of International Vocational Qualifications:

Guide to the assessment of practical skills in International Vocational Qualifications

Preparing projects & portfolios for International Vocational Qualifications

Visiting Verifier Guide

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Syllabus

2730 Telecommunication Systems

Component and section numbers

Technician Certificate

001 Fundamentals of Electronic Communication 1

01 Health and safety
02 Mathematics
03 Introduction to the use of computer technology
04 Science and electronics

002 Communication Systems and Digital Networks 1

05 Information transmission
06 Simple telecommunication systems
07 Optical fibre systems
08 Principles of radio
09 Mobile radio and cellular telephone systems
10 Television
11 Public switched telephone networks (PSTN)
12 Digital networks and data communication

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001 Fundamentals of Electronic Communication 1

01 Health and safety

Introduction

The aim of this section is to enable the candidate to:

a) gain safe working practices within their own areas of work
b) prevent hazards and take responsible decisions for themselves and others
c) work in hazardous places both above and below ground level.

Notes:

1 It is important that health and safety issues are covered before candidates are permitted access to workshops and laboratories.
2 It is suggested that about 12 guided learning hours should be given to this section.

Book list

The First Aid Manual 7th Ed; Dorling Kindersley.
The Health and Safety Handbook; Pat McGuiness and Lynn Smith

Practical competences

The candidate must be able to do the following:

1.1 Carry out basic first-aid treatments in simulated conditions.
Treatments: shock, electrical shock, bleeding breaks to bones, minor burns, resuscitation, poisoning, eye injuries

1.2 Select correct equipment and carry out basic fire-fighting techniques in simulated conditions.
Equipment: fire extinguishers (water, CO_2, foam, powder), sand/water bucket, fire blanket, fire hose
Simulations: wood/paper fire, oil/spirit fire, electrical fire

1.3 Participate in emergency procedures.
Procedures: raising alarms, alarm types, safe/efficient evacuation, means of escape, assembly points

1.4 Select and use protective clothing and equipment appropriate for the task.
Protective clothing: overalls, ear defenders, safety boots, gloves, safety helmet (hard hat), particle masks, glasses/goggles/visors
Equipment: safety barriers, hazard notices, permits to work, machine guards, residual current devices, earth sticks

1.5 Apply good working practices at all times.
Practices: clean/tidy work areas, removal of waste products, protect surfaces, use of hazard notices and other safety equipment

1.6 Carry out risk assessments as applicable to the task and prepare a report identifying potential hazards.
Risk assessment: hazard identification, high voltages, radiation from high-intensity light sources (semiconductor laser diodes), gas build-up, overhead cables, cable drums, dangerous substances, work conditions (confined spaces, heights), site machinery, noise, reports

1.7 State the names, and locations, of people responsible for health and safety in the workplace.
Workplace: the location in which the candidate is being assessed, and which is a place of work

1.8 State the names and locations of documents that refer to health and safety in the workplace.

1.9 State activities for a job role that could be harmful to the worker or to others.
Job role: a specific role in which the candidate is employed, or for which training is being given
Others: people working alongside the candidate, people whose work is affected by the candidate's performance, customers

1.10 State methods of accident prevention for a specific job role.
Methods: all actions necessary to prevent accidents in a specific role in which the candidate is employed, or for which training is being given

1.11 State the locations of health and safety equipment in the workplace.
Equipment: fire extinguishers, first-aid equipment, safety instruments and clothing, safety installations, eg fire exits, extractor fans

1.12 Report a risk and a simulated accident to the correct person responsible for health and safety in the workplace at the correct time.
Risk: a hazard with a potential for being realised
Accident: a simulated accident relevant to the location in which the candidate is working
Workplace: the location in which the candidate is being assessed, and which is a place of work
Correct time: immediately after any essential first aid has been given in the case of accident or fire or any hazard representing a risk of injury and/or death to a person, as soon as is practicable (such as meeting with supervisor) for risks such as wear and tear likely to lead to an eventual hazard

1.13 Select and use protective clothing and equipment for a specific job role.
Protective clothing: eg overalls, ear defenders/plugs, safety boots, knee pads, gloves/gauntlets, hard hats, particle masks, glasses/goggles/visors
Equipment: eg machine guards, hygiene equipment

1.14 Use good housekeeping practices at all times for a specific job role.
Practices: eg clean and tidy work areas, personal hygiene, removal and disposal of waste products, protecting work areas

1.15 Use correct health and safety procedures to demonstrate, under observation by a qualified supervisor, all the activities for a job role which could be harmful to the worker or to others observing correct health and safety procedures.
Demonstrate: perform in a real or simulated work environment on at least one occasion, successfully demonstrating all health and safety procedures
Job role: a specific role in which the candidate is employed, or for which training is being given
Others: people working alongside the candidate, people whose work is affected by the candidate's performance, customers
Qualified supervisor: person trained and competent in the activity being demonstrated

1.16 State to a qualified supervisor the specific actions taken to reduce risk and accident whilst demonstrating activities.
Activities; all of the activities in 1.15 above

1.17 Walk to and/or retrieve as appropriate health and safety equipment in the workplace.
Equipment: fire extinguishers, first-aid equipment, safety instruments and clothing, safety installations eg fire exits, extractor fans

1.18 Participate in emergency procedures.
Procedures: raising alarm, safe/efficient evacuation, correct means of escape, correct assembly point, roll-call, correct return to work

1.19 Demonstrate the correct use of a fire extinguisher.
Demonstrate: by correct explanation to a qualified supervisor and/or by actual use in a safe, simulated environment

1.20 Demonstrate basic first-aid procedures relevant to the job role or call qualified first aider to location of accident.
Job role: a specific role in which the candidate is employed, or for which training is being given
Demonstrate: by correct explanation to a qualified supervisor and/or by actual use in a safe, simulated environment
Note: This competence can be met by calling first aider to location if candidate is not trained to carry out procedures.

1.21 Complete a written accident report or dictate a report to another person, and send the report to the person responsible.
Report: name, date/time of incident, date/time of report, location, weather conditions, lighting conditions, persons involved, sequence of events, injuries sustained, damage sustained, actions taken, witnesses, supervisor/manager notified

1.22 Complete a written fault report or dictate a report to another person, and send the report to the person responsible.
Report: name, date and time of noting fault, date and time of report, location, nature of fault

1.23 Use all equipment, powered or hand operated, safely and in accordance with national standards.

1.24 Correctly wire appliance plugs.

1.25 Use low-level access and lifting equipment safely and in accordance with national standards.

Knowledge requirements

The instructor must ensure the candidate is able to:

Safety in the workplace

1.1 State the general requirements for the observance of safe practice.
General requirements: alertness to danger, maintaining personal hygiene, general tidiness, protecting self and others, a knowledge of emergency and hazard reporting procedures, permit-to-work procedures

1.2 State the human and environmental factors that may lead to an accident.
Factors: tiredness, carelessness, improper behaviour, lack of training, unguarded or faulty tools and machinery, unsuitable clothing, lack of adequate ventilation

1.3 Identify the hazards when working in high places and confined spaces.

1.4 State the dangers associated with the following materials.
Materials: compressed gases, cryogenic materials, noxious fumes and liquids, explosives, combustible materials

1.5 State the need for eye protection in relation to sparks, dust, chippings, liquid splashes.

1.6 State special precautions to be observed when working with hazardous substances.
Hazardous substances: industrial chemicals, poisons, toxic gases, petrochemicals

1.7 State the types of fire extinguisher generally available in an industrial environment and their suitability for different types of fire.
Fire extinguisher: water, foam, dry powder, carbon dioxide
Types of fire: dry materials, oil and petrol, electrical

1.8 Explain the danger of using water-based fire extinguishers on electrical equipment and on oil/spirit-based fires.

1.9 State the first-aid procedures required in the event of an industrial accident.
First-aid procedures: dealing with electric shock, administering mouth-to-mouth resuscitation, dealing with eye and other types of physical injury

1.10 State the sources of electrical danger and the methods of protection.
Methods of protection: insulation, earthing, circuit breakers, fuses, residual current devices (RCD)

1.11 Describe the potential danger of the build-up of hazardous gasses in underground chambers and the relevant precautions to be taken.

1.12 Explain the potential hazards associated with high voltages when working on live equipment and describe the relevant precautions to be taken.

1.13 Explain the potential hazards associated with low-voltage high-current power supplies when working on live equipment and describe the relevant precautions to be taken.

1.14 Explain the potential hazard of electromagnetic radiation from radio transmitter antennae.

1.15 Describe the sources of danger from high intensity visible and non-visible (eg infra-red) light sources used for telecommunication and other purposes.

1.16 State the essential procedures for the safe handling and storage of materials.

1.17 Describe the correct procedures for lifting bulky or heavy loads including manual lifting and the safe use of lifting equipment.

02 Mathematics

Introduction

The aim of this section is to enable the candidate to:

a) solve mathematical, scientific and associated problems at the technical level
b) gain the underpinning mathematical knowledge for communication systems and digital networks
c) provide an educational base for study at a higher level.

Notes:

1 The subjects in this section would benefit if an integrative approach is used.
2 It is suggested that about 30 guided learning hours should be given to this section.

Book list

Mathematics the Basic Skills (5th edition); S. Llewellyn & A. Greer.
Teach Yourself Mathematics; Trevor Johnson & Hugh Neill.

Practical competences

The candidate must be able to do the following:

Statistics

2.1 Conduct a survey and record data by means of a tally chart and produce the results in the form of a frequency table.

2.2 Represent the information contained in the frequency table in pictorial form.
Pictorial form: pie charts, bar charts and line graphs

2.3 Use the arithmetic mean, the mode and the median and calculate their values from the distribution obtained.

Use of electronic calculators and answer checking

2.4 Limit any answer to a numerical problem to a reasonable number of significant figures.

2.5 Question the validity of any solution to a physical problem and reject an answer that is not feasible.

2.6 Estimate the approximate value of arithmetic expressions.

2.7 Repeat the calculation if results do not agree with the approximation obtained in 2.6.

2.8 Provide units (preferred SI) in an answer to a physical problem.

2.9 Use an electronic calculator to add, subtract, divide and multiply a sequence of numbers.

2.10 Use an electronic calculator to find powers, roots, reciprocals and logarithms of given numbers.

2.11 Use an electronic calculator to find sines, cosines and tangents of given angles and use the inverse function to find the angle when given the corresponding sine/cosine/tangent.

Knowledge requirements

The instructor must ensure the candidate is able to:

Number systems and indices

2.1 Express denary numbers in binary forms and binary numbers in denary forms.

2.2 Perform simple calculations involving addition, subtraction, multiplication and division of binary numbers.

2.3 Perform calculations applying rules of indices where *m* and *n* are positive integers.

Rules: $a^m a^n = a^{m+n}$, $a^m/a^n = a^{m-n}$, $(a^m)^n = a^{mn}$

2.4 State that $a^o = 1$ for all values of a.

2.5 Apply the rules where m and n are negative integers.

Rules: $a^m a^n = a^{m+n}$, $a^m/a^n = a^{m-n}$, $(a^m)^n = a^{mn}$

2.6 Apply the rules for fractional indices where m and n are positive integers, and recognise that $a^{l/n} = \sqrt[n]{a}$ *and that* $a^{m/n} = \sqrt[n]{a^m}$

2.7 Evaluate expressions that combine positive, negative and fractional indices.

Algebra

2.8 Factorise expressions by grouping and extraction of common factors.

2.9 Distinguish between an algebraic expression, an equation and an identity.

2.10 Maintain the equality of a given equation whilst applying any arithmetic operation.

2.11 Solve linear equations in one unknown including those involving brackets and fractions.

2.12 Form and solve linear equations.

2.13 Solve a pair of simultaneous linear equations in two unknowns by both substitution and elimination.

2.14 Evaluate formulae required in this and parallel units by substitution of given data.

2.15 Transpose simple formulae in which the subject is equal to an expression whose terms are connected by + or –.

2.16 Transpose simple formulae in which the subject is equal to an expression composed of two or more factors.

2.17 Transpose formulae that contain a root or power.

2.18 Transpose formulae in which the subject appears in more than one term.

2.19 Transpose formulae and evaluate using given data.

Geometry

2.20 Use given formulae to calculate areas and perimeters of plane figures.
Plane figures: triangle, square, rectangle, parallelogram, circle, semicircle

2.21 Use given formulae to calculate the surface area and volume of common solids.
Common solids: cube, prism, cylinder, pyramid, cone, sphere

2.22 Identify components of a circle.
Components: radius, diameter, circumference, area, chord, tangent, secant, sector, segment, arc

2.23 Solve simple problems relating to circumference, radius and diameter of circles.

2.24 State that the angle between a tangent and the radius of a circle at the point of contact is a right angle.

2.25 Define the radian in terms of π

2.26 Convert degree measure to radians and vice versa.

Trigonometry

2.27 State the angle sum of a triangle.

2.28 Identify the types of triangle.
Types: acute-angled, right-angled, obtuse-angled, equilateral, isosceles

2.29 Identify complementary angles.

2.30 Calculate the length of any third side of a right-angled triangle, given the length of the other two sides, using the theorem of Pythagoras.

2.31 State that any triangle whose sides are in the ratios 3:4:5 forms a right-angled triangle.

2.32 Compare two triangles for similarity or congruency.

2.33 Determine an unknown side or an angle of a second triangle applying the principles demonstrated in 2.32

2.34 State trigonometrical ratios and solve problems involving right-angled triangles.
Ratios: sine, cosine, tangent

Graphs

2.35 Choose suitable scales and plot graphs from experimental data.

2.36 Plot graphs of equations by forming a data table and plotting the points.
Equations: $y = mx + c$, $y = 1/x$, $y = x^2$

2.37 Read values from graphs and interpolate intermediate values between points.

2.38 Determine the intercept of a straight line on the y axis by extrapolation.

2.39 Determine the gradient of a straight-line graph.

2.40 Evaluate the law of a straight-line graph in the form of $y = mx + c$

2.41 Determine the roots of a quadratic equation from the intersections of the graph with the x axis.

2.42 Solve graphically a pair of simultaneous equations in two unknowns.

03 Introduction to the use of computer technology

Introduction

The aim of this section is to enable the candidate to:

a) apply information technology including databases, spreadsheets and word processing.

Notes:

1 It is suggested that about 12 guided learning hours should be given to this section.

Book list

Essential Computers: Creating Worksheets; Robert Dinwiddie.
Sams Teach Yourself Microsoft Access 2000 in 10 Minutes; Faithe Wempen.

Practical competences

The candidate must be able to do the following:

Load, save and print

3.1 Select a suitable software application for a given task.
Software: word processing, database, spreadsheet

3.2 Load applications software.

3.3 Load a data file.

3.4 Save a data file with an appropriate filename.

3.5 Print out all or part of a data file.

3.6 Exit application software to return to the operating system or graphical user interface (GUI).

Word processing

3.7 Open a new file and enter text.

3.8 Edit the contents of a document.
Edit: correct errors, insert word(s), delete word(s), insert paragraph breaks, delete paragraph breaks

3.9 Improve the appearance of a document.
Improve the appearance: embolden, centre

Editing a database

3.10 Edit data into an existing database file.
Edit: add, delete, amend data

3.11 Define and execute a single condition search using appropriate operators.
Appropriate operators: less than (<), greater than (>), equal to (=)

3.12 Sort a data file into numerical or alphabetical order.

Editing a spreadsheet

3.13 Identify and move the cell pointer to any row, column and cell within a spreadsheet using cursor keys or mouse control.
Cursor keys: up, down, left, right
Mouse control: point and click, use of scroll bars

3.14 Edit the contents of a cell in an existing spreadsheet file.
Edit: amend, replace, delete

3.15 Insert and delete columns and rows in a spreadsheet.

3.16 Insert formulae, containing cell addresses and numbers, to add, subtract, multiply and divide.

3.17 Use the sum function in spreadsheets to sum rows and columns.

3.18 Replicate formulae in a row or a column.

Knowledge requirements

The instructor must ensure the candidate is able to:

Hardware and software

3.1 Identify the four main components of a computer system.
Main components: main processor, input, output, storage

3.2 List the components of a microcomputer system.
Components: keyboard, mouse, central processing unit (CPU), visual display unit (VDU), disk drive, printer

3.3 State that software is a set of instructions that enables the computer to carry out operations.

3.4 Identify the main functions of commonly used software applications packages.
Packages/functions: spreadsheet (numerical analysis and manipulation), word processing (document production), database (file creation, updating, searching and sorting), computer aided design (line drawings used for architecture and engineering)

Data input and output

3.5 List different methods for inputting data and their applications.
Methods: direct entry (keyboard), optical character recognition (OCR), scanner, bar code reader, electronic file, remote data logger, electronic sensor (transducer)

3.6 List devices used to output data.
Devices: screen, printer, control devices, audio systems

3.7 Compare printers for output in terms of speed and cost.
Printers: ink-jet printer, laser printer, impact (dot matrix, daisy wheel)

Data storage

3.8 State typical media for storing data and programs.
Media: floppy disk, hard disk, CD-ROM, tape streamers, cassettes

3.9 State that computer memory (RAM) is volatile and that any data not stored will be lost.

3.10 State why floppy disks must be formatted before use and the effect on previously recorded data of formatting a disk.

04 Science and electronics

Introduction

The aim of this section is to enable the candidate to;

a) understand the basic principles of electronics as they are applied to telecommunication systems
b) gain a comprehensive understanding of electrical and electronic principles.

Notes:

1 The subjects in this section would benefit if an integrative approach is used.
2 It is important that health and safety issues are covered before candidates are permitted access to workshops and laboratories.
3 It is suggested that about 76 guided learning hours should be given to this section.

Book list

Basic Electrical and Electronic Engineering (4th edition); E.C. Bell & R.W. Whitehead.
Success in Electronics (2nd edition); Tom Duncan.

Practical competences

The candidate must be able to do the following:

Science and electronics

4.1 Use a tungsten filament lamp, ammeter, voltmeter and variable resistors to demonstrate the effect of temperature on resistance.

4.2 Use a voltmeter, ammeter, resistors and a d.c. power supply (or battery) to verify Ohm's law.

4.3 Use a voltmeter, ammeter, d.c. power supply (or battery) and combinations of

i) resistors in series

ii) resistors in parallel

to verify the laws for the total circuit resistance for series and parallel combinations of resistors.

Knowledge requirements

The instructor must ensure the candidate is able to:

SI units and symbols

4.1 Identify basic SI units.
SI units: metre (m), kilogram (kg), second (s), ampere (A), Kelvin (K)

4.2 Identify names and symbols for preferred SI prefixes.
Names and symbols: giga (G), mega (M), kilo (k), milli (m), micro(μ), nano (n) and pico (p)

Dynamics

4.3 Define speed, velocity and acceleration.

4.4 Identify waves and wave motion.
Waves: sound waves, electromagnetic waves

4.5 Define amplitude, wavelength (λ), frequency (f) and the unit of frequency (hertz).

4.6 State the relationship: velocity (v) = frequency x wavelength ($v = f\lambda$).

4.7 State that the velocity of an electro-magnetic radio wave in free space (c) is approximately 3×10^8 m/s.

4.8 State that the SI unit of energy (W) is the joule.

4.9 Identify forms of energy.
Forms: mechanical (potential and kinetic), heat, chemical, electrical

4.10 Identify the principle of conservation of energy and energy conversion.
Energy conversion: electrical to heat, electrical to chemical, electrical to mechanical, mechanical to electrical, mechanical to heat

4.11 Define 'efficiency' in terms of input and output energy.

Basic electricity (d.c.)

4.12 Use international standard symbols (SI) for electrical components when drawing circuit diagrams.

4.13 State the effects of an electric current.
Effects: heating, chemical, magnetic

4.14 State the difference between primary and secondary cells.

4.15 State the basic concept of a flow of electric current.

4.16 Distinguish between electrical conductors and insulators.

4.17 State the SI units of current (ampere), potential difference (volt) and resistance (ohm).

4.18 Define the coulomb, ampere, volt and ohm.

4.19 State Ohm's law and use the law to solve simple electrical circuit problems.

4.20 Explain the measurement of current and potential difference using an ammeter and a voltmeter, and show the relationship between potential difference and current, for

i) a single resistor

ii) a non-linear component such as a lamp.

4.21 Identify the formula for power in a resistive electrical circuit (power = voltage x current).

4.22 Show that power can also be calculated from $I^2 \times R$ and from V^2/R

4.23 Define the watt as the SI unit of power.

4.24 Identify the formula for energy in a resistive electrical circuit (energy = power x time).

4.25 Recognise, given a series circuit diagram, that

i) the current is the same in all parts of the circuit

ii) the sum of the voltages is equal to the total applied voltage.

4.26 Recognise, given a parallel circuit diagram, that

i) the sum of the currents in the resistors is equal to the total current flowing into the network

ii) the potential difference is the same across the resistors.

4.27 State the relationship between the resistance of a conductor and its length, cross-sectional area and resistivity.

4.28 Identify the potential difference of a source on no-load as its electromotive force (e.m.f.).

4.29 Define the internal resistance of a source of e.m.f.

4.30 State why a voltmeter should have a high internal resistance.

4.31 State why an ammeter should have a low internal resistance.

4.32 State the effect of load current on the terminal potential difference.

Resistor combinations

4.33 State that when resistors are connected in series the total resistance of the combination is the sum of the individual resistors

($R_T = R_1 + R_2 + R_3 + R_4 + \ldots$).

4.34 Calculate the value of a combination of resistors connected in series, given the values of the individual resistors.

4.35 State that when a number of resistors are connected in parallel the total resistance of the combination is given by the formula:

$1/R_T = (1/R_1 + 1/R_2 + 1/R_3 + 1/R_4 + \ldots)$

where R_T is the total resistance of the combination and R_1, R_2, R_3 and R_4 are the values of the individual resistors.

4.36 Calculate the value of a combination of resistors connected in parallel, given the values of the individual resistors.

4.37 State that when two resistors are connected in parallel the total resistance of the combination can be determined by dividing the product of the two resistors (R_1 x R_2) by the sum of the two resistors ($R_1 + R_2$).

4.38 Calculate the total resistance of resistors connected in series and parallel combinations.

Electromagnetism and inductance

4.39 Describe what is meant by a magnetic field.

4.40 State the principle of operation of electromagnetic devices.
Electromagnetic devices: electromagnet, relay and electric bell

4.41 Explain that an inductor consists of a coil of wire wound around a core of either air or a magnetic material such as iron.

4.42 State the SI unit for inductance (*L*) is the henry (*H*).

4.43 State that energy is stored in the electromagnetic field that exists around a coil.

4.44 State that the energy (*W*) stored in an inductor can be found from the formula:

$W = \frac{1}{2}LI^2$ Joules, where L is the inductance in henries and I is the current in amps flowing through the coil.

Capacitance

4.45 Describe what is meant by an electric field.

4.46 Explain that a capacitor consists of two sets (or more) of parallel metallic plates separated by a dielectric.

4.47 State that the SI unit of capacitance (*C*) is the farad (*F*).

4.48 State that the values of capacitors more commonly found are measured in microfarads

(μF), nanofarads (nF) or picofarads (pF).

4.49 Explain that the capacitance (C) of a capacitor is directly proportional to the overall surface area of the plates and is inversely proportional to the distance between the plates.

4.50 Explain that the electric charge (Q) stored in a capacitor is determined by the capacitance (C) and the potential difference (V) applied across the plates ie. $Q = CV$.

4.51 State that the energy (W) stored in a capacitor is given by the formula:

$W = \frac{1}{2}CV^2$ joules.

4.52 State that a capacitor blocks the flow of d.c. current.

4.53 Explain that when capacitors are connected in parallel the total capacitance of the combination is the sum of the capacitance of the individual capacitors

(ie $C_T = C_1 + C_2 + C_3 + \ldots$.)

4.54 Calculate the total capacitance of a combination of parallel-connected capacitors given the values of the individual capacitors.

4.55 Explain that when capacitors are connected in series the total capacitance of the combination can be found from the formula

$1/C_T = 1/C_1 + 1/C_2 + 1/C_3 + \ldots$.

4.56 State that when two capacitors are connected in series the total capacitance of the combination can be determined by dividing the product of the two capacitors (C_1 x C_2) by the sum of the two capacitors ($C_1 + C_2$).

4.57 Calculate the total capacitance of two capacitors connected in series given the values of the individual capacitors.

a.c. circuits

4.58 Describe the relationships between peak, peak-to-peak, average and root-mean-squared (r.m.s.) values of sine waves.

4.59 Explain why r.m.s. values are important.

4.60 Calculate the r.m.s. value given the peak, peak-to-peak or average values and vice versa.

4.61 State that when an alternating current (a.c.) flows through an inductor it causes inductive reactance (X_L).

4.62 State that like resistance, inductive reactance (X_L) opposes the flow of current is measured in ohms and that the value of inductive reactance (X_L) can be found from the formula

$X_L = 2\pi fL$

(where f is the frequency of the alternating current in hertz (Hz) and L is the value of the inductance in henries (H).

4.63 State that when an alternating current (a.c.) flows through a capacitor it causes capacitive reactance (X_C).

4.64 State that like resistance and inductive reactance, capacitive reactance (X_C) opposes the flow of current is measured in ohms and that the value of capacitive reactance (X_C) can be found from the formula

$X_C = 1/(2\pi fC)$

where f is the frequency of the alternating current in hertz (Hz) and C is the value of the capacitance in farads (F).

4.65 State that for inductive reactance the current lags the voltage across the inductor by 90 degrees.

4.66 State that for capacitive reactance the current leads the voltage across the capacitor by 90 degrees.

4.67 State that when an alternating current (a.c.) flows through a resistor, the current and the applied voltage are in phase.

4.68 State that impedance (Z) is the total opposition to alternating current flow in a series circuit consisting of inductance, capacitance and resistance.

4.69 State that like resistance (R), inductive reactance (X_L) and capacitive reactance (X_C), impedance (Z) is also measured in ohms and can be found from the formula:

$Z = \sqrt{[(R^2) + (X_L \sim X_C)^2]}$

where ($X_L \sim X_C$) is the difference between the values of the inductive and capacitive reactance.

Resonance

4.70 State that series and parallel combinations of inductance and capacitance can be used to form series and parallel tuned circuits.

4.71 State that the 'resonant' frequency of a tuned circuit can be found from the formula:

$f = 1/[2\pi\sqrt{(LC)}]$

where f is the resonant frequency (Hz); L is the value of the inductance (H) and C is the value of the capacitance (F).

4.72 State that for series tuned circuits the impedance (Z) is a minimum at resonance.

4.73 State that for parallel tuned circuits the impedance (Z) is a maximum at resonance.

4.74 State that for resonant tuned circuits the current and voltage are in phase with each other.

Transformers

4.75 State that a transformer consists of two coils of wire called the *primary* and the *secondary*, which are wound around the same core but are not connected electrically.

4.76 State that when a current flows through the *primary* the resultant magnetic field induces a voltage into the *secondary*.

4.77 State that the value of the voltage induced into the *secondary* (V_s) is dependent on the voltage applied to the *primary* (V_p) and the ratio of the number of turns on the secondary winding compared to the primary winding (ie $V_s / V_p = n_s/n_p$).

4.78 Calculate the secondary voltage of a transformer given the voltage applied to the primary and the number of turns on the primary and secondary windings.

Semiconductors

4.79 State that a semiconductor has a resistance which is less than that of an insulator but greater than a conductor.

4.80 State that semiconductor materials can be 'doped' so as to form n-type semiconductor material (which have an excess of electrons) or p-type semiconductor material (which have a lack of electrons).

4.81 State that when a junction of p-type and n-type semiconductor materials is formed there is a lack of 'majority' current carriers at the junction.

4.82 State that p-n junctions can be constructed to form a 'diode'.

4.83 State that an ideal diode should allow current to pass in one direction only.

4.84 State that when a voltage is applied to a p-n junction, such that the p-ype semiconductor material (the anode) is positive and the n-type semiconductor material (the cathode) is negative, the diode is said to be *'forward biased'.*

4.85 State that when a voltage is applied to a p-n junction, such that the p-type semiconductor material (the anode) is negative and the n-type semiconductor material (the cathode) is positive, the diode is said to be *'reverse biased'.*

4.86 State that in an ideal diode current will flow through the diode when it is *forward biased.*

4.87 State that in an ideal diode no current will flow through the diode when it is *reverse biased.*

4.88 State that when a critical reverse bias voltage level is reached the p-n junction will break down and the diode will conduct in both directions.

4.89 State that large, slower acting diodes are termed *rectifier diodes* and small fast acting diodes are termed *signal diodes.*

4.90 Draw and recognise the international symbol for semiconductor diodes and be able to identify the anode and the cathode.

4.91 State that the transistor is a three terminal device.

4.92 State that there are two forms of transistor.
Transistors: bipolar junction transistor (BJT); field effect transistor (FET)

4.93 State that the bipolar transistor is a current-operated device.

4.94 State that the field effect transistor is a voltage-operated device.

4.95 State that there are two forms of bipolar transistor (p-n-p and n-p-n).

4.96 State that the three electrodes of the bipolar transistor are called emitter, base and collector.

4.97 State that there are two forms of field effect transistor (n-channel and p-channel).

4.98 State that the three electrodes of the field effect transistor are called *source, gate* and *drain.*

4.99 Draw and recognise the international symbols for transistors and be able to identify the three electrodes.

4.100 State that transistors can be used as electronic switches and amplifiers.

4.101 State that complete electronic circuits can be manufactured from a small slice of semiconductor material in the form of integrated circuits.

4.102 State the advantages of very large scale integration (VLSI).

4.103 State that linear integrated circuits are available for a variety of applications.
Applications: amplifiers, oscillators, comparators etc.

4.104 State that digital integrated circuits are available to provide a number of logical functions.
Logical functions: AND, OR, NOT, NAND, NOR, Exclusive-OR

4.105 State the logical output conditions for each of the above logic gates given the input conditions.

4.106 Recognise the international symbols for each of the above gates.

Assessment

Test Specification for Written Paper
Fundamentals of Electronic Communication 1 (2730-01-001)

This is a written examination paper lasting two hours and comprising sixty multiple choice questions. Candidates must answer **all** 60 questions.

The examination paper will cover the knowledge specifications:

Topic		Approximate % examination weighting
01	Health & Safety	10
02	Mathematics	22
03	Introduction to the use of computer technology	6
04	Science and electronics	62

002 Communication Systems and Digital Networks 1

05 Information transmission

Introduction

The aim of this section is to enable the candidate to understand the:

a) media used for both wired and wireless communications
b) properties of the systems used
c) types of signals used for information transfer.

Notes:

1 It is suggested that about 20 guided learning hours should be given to this section.

Book list

Technician's Guide to Electronic Communications; Frederick L. Gould.
Telecommunication Technologies; John Ross
Illustrated Telecom Dictionary – 3rd edition; Jade Clayton.

Practical competences

The candidate must be able to do the following:

5.1 Investigate various forms of media used for the communicating information.

5.2 Carry out tests and measurements accurately.

5.3 Access sources of reference accurately.

5.4 Produce an accurate report.

Knowledge requirements

The instructor must ensure the candidate is able to:

5.1 State the meaning of 'telecommunications'.

5.2 Identify basic communication systems.
Systems: information source (transmitter), information destination (receiver), transmission/ transfer link (communications channel), system impairments (noise, distortion, interference)

5.3 Outline the basic principles of line (wired) systems.
Principles: the source is directly connected to the receiver by means of wired links; attenuation is directly proportional to the distance travelled

5.4 Outline the basic principles of radio (wireless) systems.
Principles: the source is indirectly connected to the receiver by means of wireless links (eg radio or infrared); attenuation is directly proportional to the square of the distance travelled

5.5 List the sources of internal noise.
Sources: thermal/Johnson, shot, flicker

5.6 List the sources of external noise.
Sources: natural (eg sun, moon, sky, galactic, cosmic) artificial/man-made (eg ignition systems, rotating machinery)

5.7 State the sources of interference.
Sources: electromagnetic radiation and unwanted signals

5.8 List sources of distortion.
Sources: non-linearity, harmonics

5.9 Identify the properties of differing types of transmission links (channels).
Properties: typical attenuation in dB/km, susceptibility to interference, unwanted radiation of signals
Fixed links: wired (shielded and unshielded copper multipairs, shielded and unshielded copper twisted pairs, copper coaxial), optical fibre, waveguide, point-to-point wireless (line-of-sight), geostationary satellite
Mobile links: wireless (radio), infrared

5.10 Identify various methods of communicating over a channel.
Methods: simplex (one-way communication), duplex (two-way communication), half/semi-duplex (two-way communication but only one-way at any one time), broadcast, symmetric (equal split), asymmetric (unequal split), serial, parallel

5.11 Identify various types of information carried by telecommunication systems.
Types: eg sound, picture or data

5.12 State the systems available for communication.
Systems: eg telephone, radio and television

5.13 State what is meant by a signal.

5.14 Categorise signals into audio, video and data types.

5.15 State the difference between a.c. and d.c. signals.

5.16 Identify the following terms in relation to a.c. signals: frequency, amplitude, phase, wavelength, period, velocity, fundamental frequency, harmonics

5.17 Identify the main features of signal waveforms.
Features: amplitude, frequency, phase, wave shape, complex

5.18 State the differences between analogue and digital signals.

5.19 List various forms of analogue and digital signals.

5.20 State that complex waveforms can be considered as consisting of a combination of sinusoidal waveforms.

5.21 State the meaning of the bandwidth of a signal.

5.22 State the bandwidth of common analogue signals.
Signals: commercial speech, hi-fi music, sound broadcasting (l.f./m.f. and v.h.f.), monochrome (black-and-white television), colour television

5.23 State the meaning of the baseband of complex signals.

5.24 Distinguish between baseband and broadband.

5.25 State that analogue information may be converted to digital electrical signals and vice versa.

06 Simple telecommunication systems

Introduction

The aim of this section is to enable the candidate to:

a) describe the operations of simple telecommunication systems using appropriate terminology

Notes:

1 It is suggested that about 13 guided learning hours should be given to this section.

Book list

Technician's Guide to Electronic Communications; Frederick L. Gould.
Telecommunications Technologies; John Ross.

Practical competences

The demonstration of practical competences is not required for this section.

Knowledge requirements

The instructor must ensure the candidate is able to:

6.1 State that variation of the amplitude, frequency or phase of a carrier wave can be used to convey information.

6.2 Identify how sound waves are converted into electrical signals by means of a transducer (eg microphone).

6.3 Identify how electrical signals are converted into sound waves by means of a transducer (eg earpiece or loudspeaker).

6.4 Recognise the elements contained in a diagram of two local-battery telephones interconnected by a line to include telephone circuits with a simple arrangement involving a transmitter, receiver, battery, induction coil, cradle switch, calling generator and alerting bell circuit.

6.5 Identify the principles and advantages of central-battery working.

6.6 Determine the need for switching in telecommunication networks.

6.7 State that the number of links required to fully interconnect n users is given by the formula:

$l = \frac{1}{2} [n (n - 1)]$

where l is the number of links required to connect n users.

6.8 Explain that in the public switched telephone network (PSTN) switching is carried out at the exchange.

6.9 State that in some countries the local exchange is known as the 'central office'.

6.10 State the meaning of 'gain' in telecommunication systems.

6.11 State the meaning of 'attenuation' in telecommunication systems.

6.12 Explain why gain and attenuation are usually measured in decibels (dBs).

6.13 State that a power gain of x dB is approximately equal to a factor of y for the following values of x and y:

x	y
3	2
6	4
9	8
10	10
20	100
30	1000
60	1000000

6.14 Calculate, in dBs and as a power ratio, the overall gain and/or attenuation of simple systems given the gain/attenuation of the individual stages.

6.15 Explain that semiconductor devices such as transistors, and/or linear integrated circuits, can be used as amplifiers and oscillators in radio transmitters and receivers.

07 Optical fibre systems

Introduction

The aim of this section is to enable the candidate to:

a) explain the basic principles of communicating by light over optical fibres
b) describe the various forms of optical fibre
c) describe the range of light sources and receivers used for fibre optic communication systems.

Notes:

1 It is suggested that about 8 guided learning hours should be given to this section.

Book list

Introduction to Fibre Optics; John Crisp.
Telecom Factbook; Joseph A. Pecar and David A. Garbin.

Practical competences

The demonstration of practical competences is not required for this section.

Knowledge requirements

The instructor must ensure the candidate is able to:

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

7.2 Identify the component parts of an optical fibre used in communication systems.

7.3 Distinguish between the following types of optical fibre.
Types: single-mode, multimode, graded-index, stepped-index

7.4 State that the most commonly used wavelengths for optical line systems are 850nm, 1300nm, and 1550nm.

7.5 State that the most commonly used transmitting devices are light emitting diodes (LED) and the semiconductor laser diodes (SLD).

7.6 Distinguish between the basic properties of the LED and the SLD.

7.7 State the safe working practices when working with optical fibre and semiconductor laser diodes.

08 Principles of radio

Introduction

The aim of this section is to enable candidates to:

a) describe the principles involved when transmitting and receiving radio signals
b) explain how electromagnetic radio waves are propagated and the systems involved in the transmission and reception of radio signals
c) describe the essential stages of radio transmitter and receivers and explain the basic principles of operation.

Notes:

1 It is suggested that about 18 guided learning hours should be given to this section.

Book list

Basic Radio Principles & Technology; Ian Poole.
Audio, Video and Data Telecommunications; David Peterson.

Practical competences

The candidate must be able to do the following:

8.1 Investigate a given range of factors and terms relating to modulation and determine the effects of noise and interference on amplitude and frequency-modulated signals.

8.2 Carry out tests and measurements accurately.

8.3 Investigate modulation techniques in practical applications of broadcasting.

8.4 Produce an accurate report and give guidance to lay people.

Knowledge requirements

The instructor must ensure the candidate is able to:

8.1 State that a conductor carrying a high frequency alternating current radiates electro-magnetic energy.

8.2 State the velocity of radio waves in free space (c) is approximately 3 x10^8 m/s.

8.3 State that electromagnetic energy induces an e.m.f. in a conductor.

8.4 State the frequency bands used for low frequency broadcast (l.f.), medium frequency broadcast (m.f.), high frequency international broadcast (h.f.), very high frequency broadcast (v.h.f.) and ultra high frequency television (u.h.f.) services.

8.5 State that the low and medium frequency (day-time) broadcasts tend to follow the curvature of the earth.

8.6 State that long distance intercontinental coverage can be achieved by means of the ionosphere at high frequencies.

8.7 State that at v.h.f. and u.h.f. coverage is normally limited to only slightly more than the line-of-sight distance.

8.8 State that series and/or parallel combinations of inductance and capacitance, or piezo-electric crystals, can be used for filter circuits.

8.9 Draw the circuit symbols and state the meaning of different types of filter circuit.
Types: low-pass, high-pass, band-pass, band-stop

8.10 State that series and parallel tuned circuits can be used to determine the frequency of operation for radio frequency (r.f.), and intermediate frequency (i.f.), amplifiers.

8.11 State that series and parallel tuned circuits can be used to determine the frequency of operation for oscillators.

8.12 Recognise that modulation is effectively a mixing process which allows information to be conveyed by a sinusoidal carrier wave.

8.13 State that modulation may be achieved in a radio transmitter at a low (low-level) or high (high-level) power level.

8.14 State that by varying the amplitude of a radio wave, audio signals may be communicated (amplitude modulation).

8.15 State that by varying the frequency of a radio wave, audio signals may be communicated (frequency modulation).

8.16 Draw a simple block diagram of an amplitude-modulated medium frequency broadcast transmitter showing audio frequency, carrier frequency, modulator, driver, final stage power amplifier and antenna matching stages. State the function of each stage.

8.17 Draw a simple block diagram of an amplitude-modulated medium frequency broadcast receiver showing, antenna, radio frequency amplifier, mixer, local oscillator, intermediate frequency amplifier, demodulator (detector) and audio frequency stages. State the function of each stage.

8.18 State the meaning of the 'signal-to-noise ratio' in telecommunication systems.

8.19 Explain the meaning of 'noise figure' (noise factor) in radio receivers.

8.20 Explain the meaning of multiplexing in communication systems.

8.21 Explain the meaning of frequency division multiplexing (FDM).

8.22 Explain the meaning of time division multiplexing (TDM).

09 Mobile radio and cellular telephone systems

Introduction

The aim of this section is to enable the candidate to:

a) describe the basic principles and concepts involved in mobile radio and cellular telephone systems
b) describe the properties and applications of mobile radio and cellular telephone systems.

Notes:

1 It is suggested that about 16 guided learning hours should be given to this section.

Book list

Basic Radio Principles and Technology: Ian Poole.
Wireless Crash Course; Paul Bedell.

Practical competences

The candidate must be able to do the following:

9.1 Investigate the range of mobile radio and mobile phone systems available.

9.2 Access sources of reference.

9.3 Produce an accurate report.

Knowledge requirements

The instructor must ensure the candidate is able to:

9.1 Identify typical examples of users of private mobile radio (PMR).
Users: eg emergency services, public utilities, taxis

9.2 State the frequency bands used for PMR.

9.3 Explain the meaning of 'frequency re-use'.

9.4 Describe how 'frequency re-use' is achieved in mobile radio and cellular telephone systems.

9.5 Explain why PMR and cellular radio systems are limited to line-of-sight coverage.

9.6 State that PMR systems can use either analogue or digital techniques.

9.7 Draw a diagram of a simple PMR system, including one base station and a number of mobiles.

9.8 Explain that in a conventional two-frequency PMR system the mobiles cannot hear each other's transmissions.

9.9 Draw a diagram showing that in a cellular radio system the coverage area is divided into a number of linked cells, each with a base station.

9.10 State the frequency bands used for cellular telephone systems.

9.11 State that cellular telephone systems can use either analogue or digital techniques.

9.12 Explain that cellular telephone analogue systems are being replaced by digital systems.

9.13 Recognise that a cellular telephone can transmit and receive on all allocated channels.

9.14 Explain that a cellular telephone regularly identifies itself to the nearest base station, whether or not a call is in progress.

9.15 State that a cellular telephone is registered with a given 'home location register'.

9.16 State that the term 'roaming' is used when a cellular telephone is allowed access to other networks.

9.17 Explain that when a cellular telephone with a call in progress receives a stronger signal from another cell's base station, a handover takes place.

9.18 State typical cell repeat patterns.

9.19 Identify the factors that determine the maximum and minimum cell sizes.

9.20 State the need for cell splitting (and/or cell sectorisation) for increased traffic capacity.

10 Television

Introduction

The aim of this section is to enable the candidate to:

a) understand the basics of television

b) understand the systems required when information is to be transmitted in a video format.

Notes:

1 It is suggested that about 6 guided learning hours should be given this section.

Book list

Audio, Video and Data Telecommunications; David Peterson.

Practical competences

The demonstration of practical competences is not required for this section.

Knowledge requirements

The instructor must ensure the candidate is able to:

10.1 Describe the basic principle of operation of the cathode ray tube (c.r.t.).

10.2 Explain the basic principles of operation of a monochrome (black-and-white) television broadcast system.

10.3 State that a monochrome picture can be regarded as being composed of small elements of differing brightness.

10.4 State that line and field scan are required to compose a complete picture on the screen of a cathode ray tube.

10.5 State typical line and field scan periods.

10.6 State that in a television camera a spot of light produces a small electric charge on a prepared surface.

10.7 State that the distribution of charge on a prepared surface produced by a picture can be converted to a sequence of electrical signals by scanning.

10.8 State that the sequence of electrical signals generated by the camera must be processed in the receiver and converted to a visual display on the screen of a cathode ray tube.

11 Public switched telephone networks (PSTN)

Introduction

The aim of this section is to enable the candidate to:

a) understand the basic concepts of signalling, switching and transmission before considering new technologies

b) understand the process of analogue-to-digital conversion

c) understand the plesiochronous digital hierarchy (PDH) for multiplexing as a basis for understanding the synchronous digital hierarchy (SDH) used for the high speed networks.

Notes:

1 It is suggested that about 22 guided learning hours should be given to this section.

Book list

Telephone Installation Handbook – 2nd edition; Steve Roberts.
Telephone Switching Systems; Richard A Thompson.

Practical competences

The demonstration of practical competences is not required for this section.

Knowledge requirements

The instructor must ensure the candidate is able to:

11.1 Draw the simplified circuit diagram of a basic telephone instrument.

11.2 Recognise that telephone networks rely mainly on digital techniques for long distance and, increasingly, short distance working.

11.3 Explain the operation of a dual tone multi-frequency (DTMF) keypad.

11.4 State the need for concentrators and multiplexers in telephone networks.

11.5 Identify the structure of the public switched telephone network (PSTN) in terms of the local loop, street cabinets/footway boxes, distribution points, analogue local exchange or digital remote concentrator units (RCU), digital cell centre exchange (DCCE), digital main switching units (DMSU).

11.6 Recognise that in some countries the local exchange is called the 'central office' or 'switching office'.

11.7 Recognise that the PSTN is an example of a circuit-switched network.

11.8 Identify telephone numbering schemes for local, national and international calls.

11.9 State how analogue voice signals can be converted to digital signals by means of pulse code modulation (PCM).

11.10 Draw a diagram to show the essential stages of a pulse code modulator.
Stages: low-pass (anti-aliasing) filter, sample-and-hold, sampling frequency (clock), quantiser, encoder

11.11 Identify the need for the low-pass filter.

11.12 Explain the function of the quantiser.

11.13 State the need for non-linear quantisation for PCM voice signals.

11.14 State the typical sampling frequency for voice systems (8 kHz).

11.15 State the number of bits normally assigned for voice systems (8).

11.16 State the bit rate normally assigned for voice systems (64 kb/s).

11.17 State the bit rate for 32-channel PCM time division multiplexing system (2.048 Mb/s).

11.18 Describe the function of time slots 0 and 16 in the 32-channel PCM time division multiplexing system.

11.19 State the function of the regenerator in PCM networks.

11.20 State the difference between European and the United States 1st, 2nd and 3rd order multiplexing systems for the plesiochronous digital hierarchy (PDH).

11.21 Compare the bit rates and the effective number of channels carried for each of the first three levels of European and United States PDH multiplexing.

11.22 State the basic concepts of a stored program control (SPC) exchange.

11.23 Identify the need for space and time switching in digital telephone networks.

11.24 State the main function of a digital switching subsystem (DSS) in a system X exchange.

11.25 Identify the basic differences between the Integrated Services Digital Network (ISDN) and the PSTN.

11.26 State that digital 'backbone' networks use the synchronous digital hierarchy.

11.27 Recognise that 'Sonet' is a subset of the synchronous digital hierarchy.

12 Digital networks and data communication

Introduction

The aim of this section is to enable the candidate to:

a) understand the basic principles involved with conveying information in a digital format and the characteristics of data communication in order to gain an appreciation of modern high-speed multi-media networks

b) understand the basic principles of operation of digital networks and data communication

c) understand the various switching methods employed, protocols and hardware used and the characteristics of local, metropolitan and wide area data networks (LANs, MANs and WANs).

Notes:

1 It is suggested that about 27 guided learning hours should be given to this section.

Book list

Telecommunications Technologies; John Ross.

Telecom Factbook; Joseph A. Pecar and David A. Garbin.

Telecommunications Protocols; Travis Russell.

Practical competences

The candidate must be able to do the following:

12.1 Investigate the various standards used for telecommunications and digital networks.

12.2 Investigate the various protocols used for telecommunications and digital networks.

Knowledge requirements

The instructor must ensure the candidate is able to:

12.1 Explain the meaning of a network.

12.2 State that data networks allow computers or other data terminals to exchange information in a meaningful way.

12.3 State the advantages of digital communication over analogue methods.

12.4 State that digital networks carry binary information.

12.5 Distinguish between 'bits', 'bytes' and 'nibbles'.

12.6 Explain the meaning of 'serial' and 'parallel' working.

12.7 State the meaning of bit error rate (BER) and give typical figures for copper, optical fibre and mobile radio systems.

12.8 Identify the difference between automatic repeat request (ARQ) and the forward error correction (FEC) methods of dealing with errors.

12.9 Explain simple methods of error checking in digital communication networks.
Methods: eg loop-back and parity

12.10 State that protocols define the rules of procedure for computer communication.

12.11 State that computer information is sent in a binary format using an agreed transmission code.

12.12 State that there are two methods of transmitting data: serial and parallel.

12.13 Explain the advantages and disadvantages of transmitting data by serial and parallel methods.

12.14 Identify applications for serial data communication and parallel data communication.

12.15 Describe the two basic transmission techniques used for computer communication: asynchronous and synchronous.

12.16 List the characteristics of the two transmission techniques used.

12.17 State that remote computers can access other networks by means of leased lines or 'dial-up' (switched) lines.

12.18 State that 'kilostream' (64 kb/s) and 'megastream' (2.048 Mb/s) represent two examples of leased lines.

12.19 State that 'modems' are required for computer communication over analogue lines.

12.20 Describe the basic modulation techniques used by modems.

12.21 State that data networks can use three basic types of switching: circuit switching, message switching and packet switching.

12.22 List the relevant characteristics of each type of switching in 12.21 above.

12.23 State that there are two distinct methods of using packet switched networks: connectionless (datagram) and connection oriented (virtual circuit).

12.24 List the characteristics of both types of packet switched networks.

12.25 State that the ITU-T (formerly CCITT) standard X.25 is a protocol for packet switching.

12.26 State the International Standards Organisation (ISO) seven-layer Open Systems Interconnection (OSI) model can be used to identify the various protocols used for computer communication.

12.27 Identify the individual layers of the OSI model.

12.28 State that there are three main categories of computer networks:
local area (LAN), metropolitan area (MAN) and wide area networks (WAN).

12.29 Identify the basic topologies of computer networks.
Topologies: star, bus, ring

12.30 State the methods of gaining access to computer networks.
Access methods: carrier sense multiple access with collision detection (CSMA/CD) and token passing

12.31 Identify the transmission media used for local area networks.
Transmission media: coaxial cable (thin and thick), twisted pair (shielded and unshielded), optical fibre, radio, infrared

12.32 State the hardware used on local area networks.
Hardware: hubs, switches, file servers, repeaters, bridges, routers, gateways

Assessment

Test Specification for Written Paper
Communication Systems and Digital Networks 1 (2730-01-002)

This is a written examination paper lasting two hours and comprising sixty multiple choice questions. Candidates must answer **all** 60 questions.

The examination paper will cover the knowledge specifications:

Topic		Approximate % examination weighting
05	Information transmission	16
06	Simple telecommunication systems	10
07	Optical fibre systems	5
08	Principles of radio	14
09	Mobile radio and cellular telephone systems	13
10	Television	5
11	Public switched telephone networks (PSTN)	17
12	Digital networks and data communication	20

003 Telecommunication Systems Practice 1

Practical Assignments

Fundamentals of Electronic Communication 1

Assignment 003/1	Understanding health and safety
Assignment 003/2	Safety in the workshop
Assignment 003/3	Using safe working practices
Assignment 003/4	Carry out a statistical survey
Assignment 003/5	Creating and editing a document
Assignment 003/6	Editing a database
Assignment 003/7	Editing a spreadsheet
Assignment 003/8	Demonstrate the effect of heat on the resistance of a conductor

Communications Systems and Digital Networks 1

Assignment 003/9	Investigating the various forms of communications media
Assignment 003/10	Investigating modulation systems
Assignment 003/11	Investigating global and national mobile radio and telephone systems communication technologies
Assignment 003/12	Investigating protocols, standards and standards development bodies

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/1 Understanding health and safety

1 OBJECTIVE REFERENCES

1.6 – 1.11

2 PREPARATION

2.1 *Location of the test*

The training centre workshop or other venue where supervision and appropriate workshop equipment is available.

2.2 *Requirements*

Standard workshop equipment relevant to the syllabus.

2.3 *Instructor notes*

This assignment is designed as a workplace based activity for those candidates who are already employed in the telecommunications or related industries. The aim of the assignment is to introduce candidates to

a) safe working within their own area of work
b) the recognition of risks and hazards.

Note: the term 'workplace' as used throughout this section refers to a specific place in which the candidate is located and which is itself a place of work. The candidate cannot achieve the standards necessary to be awarded a pass without being able to refer to specific examples in a specific location.

The candidates' reports must be countersigned by their immediate workplace supervisor. The individual responsible for health and safety issues at the candidate's place of work should endorse the candidate's report stating that the report contains a true record of the facts.

Where appropriate, simulated work activities may be used. Except in the case of simulated accidents, where simulation is used to demonstrate competence, the visiting verifier must agree that this is acceptable and realistic.

3 CANDIDATES' INSTRUCTIONS

3.1 Ensure that you understand all the requirements of the assignment and follow them precisely. If you are in any doubt ask the instructor.

3.2 Your task is to produce a short report with the title 'Safety in the Workplace'.

The report should include:

3.2.1 The names and locations of people responsible for health and safety in the workplace.

3.2.2 The names and locations of documents that refer to health and safety in the workplace.

3.2.3 A description of the possible causes of risk or accident in the workplace.

3.2.4 A description of the methods of accident prevention for a specific job role.

3.2.5 The location of health and safety equipment in the workplace.
Equipment to include: fire extinguishers, first-aid equipment, safety instruments and clothing, safety installations, eg fire exits, extractor fans

3.2.6 A description of the range of protective clothing available and when and where it should be used.

3.3 Make sure that your name is clearly shown on your report and have it countersigned by your workplace supervisor and endorsed by the individual responsible for safety in your workplace before handing it to the instructor.

4 MARKING

The candidate's report must include the following:

4.1	The names and locations of people responsible for health and safety in the workplace.	[ ]
4.2	The names and locations of documents that refer to health and safety in the workplace.	[ ]
4.3	A description of the possible causes of risk of accident in the workplace.	[ ]
4.4	A description of the methods of accident prevention for the specific job role.	[ ]
4.5	The location of health and safety equipment in the workplace.	[ ]
4.6	A description of the range of protective clothing available and when and where it should be used.	[ ]
4.7	Countersigned and endorsed report handed in on time to the instructor.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ].

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/2: Safety in the workshop

1 OBJECTIVE REFERENCES

1.6 – 1.11

2 PREPARATION

2.1 *Location of the test*

The training centre workshop or other venue where supervision and appropriate workshop equipment is available.

2.2 *Requirements*

Standard workshop equipment relevant to the syllabus.

2.3 *Instructor notes*

This assignment is conducted in two parts.

Part 1:
The instructor tours the workshop with the candidates indicating where the health and safety facilities are located and giving instructions on their correct use. The tour should include the following facilities: emergency fire exits, fire extinguishers, electricity emergency 'stop' buttons, first-aid facilities and procedures, use of protective clothing and equipment, clearways throughout the workshop, ventilation provision, location of cleaning facilities, etc.

During the tour the instructor should highlight potential hazards which are associated with each type of machine tool or bench operation. Please note that all machinery must be isolated during the undertaking of the assignment.

Part 2:
The candidates prepare a report relating to the tour of the workshop. The candidates are allowed to revisit the workshop, under supervision, to make further observations. The report, which should include a labelled drawing (not drawn to scale), must list the potential hazards associated with specialist equipment and typical bench operations.

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for writing this assignment is 2 hours.

Part 1
Ensure that you understand all the requirements of the assignment and follow them precisely. If you are in any doubt ask the instructor.

3.2 The instructor will show you around the workshop pointing out a) the location of the safety facilities and b) the potential hazards relating to workshop machinery and equipment.

3.3 Take notes and make sketches during the tour of the workshop.

Part 2

3.4 Produce a short report with the title 'Safety in the workshop'. The report should include:

3.4.1 A labelled diagram (not to scale) of the workshop

3.4.2 Location of the safety facilities

3.4.3 Correct use of safety facilities

3.4.4 The names and locations of people responsible for health and safety

3.4.5 The names and location of documents relating to health and safety

3.4.6 Hazards associated with typical workshop equipment, machinery and the work environment.

For example:

- General layout of the workshop
- Safe working practices
- Drilling machines
- Bench operations (eg soldering and assembly)
- Portable equipment.

3.5 Make sure that your name is clearly shown on your work and hand the work to the instructor.

4 MARKING

4.1 The assignment completed in 2 hours. ( )

4.2 Tour of workshop with instructor undertaken. [ ]

4.3 Notes and sketches produced. ( )

4.4 Report produced including:

4.4.1 A labelled diagram (not to scale) of the workshop ( )

4.4.2 Location of the safety facilities [ ]

4.4.3 Correct use of safety facilities [ ]

4.4.4 The names and locations of people responsible for health and safety [ ]

4.4.5 The names and locations of documents relating to health and safety [ ]

4.4.6 Hazards associated with

- General layout of the workshop [ ]
- Safe working practices [ ]
- Drilling machines ( )
- Bench operations (Soldering and assembly) [ ]
- Portable equipment. [ ]

4.5 Report handed to the instructor. [ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least two of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/3: Using safe working practices

1 OBJECTIVE REFERENCES

1.1 – 1.5, 1.12 – 1.25

2 PREPARATION

2.1 *Location of the test*

The training centre workshop or other venue where supervision and appropriate workshop equipment is available.

2.2 *Requirements*

Standard workshop safety equipment relevant to the syllabus.

2.3 *Instructor notes*

The aim of this assignment is to introduce candidates to

a) the reinforcement of safe working within their own area of work
b) the taking of action to prevent and report risks and hazards.

Note: the term 'workplace' as used throughout this section refers to a specific place in which the candidate is located and which is itself a place of work. Where appropriate, simulated work activities should be used.

The assignment consists of a series of simulated exercises involving role-play activities. At least one of the exercises will involve a simulated electric shock. All candidates must be involved in a full range of roles in order that they are able to complete all of the activities listed below. Instructors must complete an observation sheet for each candidate. It is suggested that the marking list be used as the observation sheet. Further evidence in the form of video recordings of the candidates' performance is encouraged.

2.3.1 Observation of candidates

The candidate must be able to do the following:

i) Report a risk and a simulated accident to the correct person responsible for health and safety in the workplace at the correct time.

ii) State to a qualified supervisor situations for a specific job role that require immediate action after first aid has been given, that require reporting at the earliest opportunity and state why action taken will be different according to the situation.

iii) Select and use protective clothing and equipment for a specific job role.

iv) Use good housekeeping practices at all times for a specific job role.

v) Use correct health and safety procedures to demonstrate under observation by a qualified supervisor, all the activities for a job role that could be harmful to the worker or to others observing correct health and safety procedures.

vi) State to a qualified supervisor the specific actions taken to reduce risk and accident whilst demonstrating activities.

vii) Walk to and/or retrieve as appropriate health and safety equipment in the workplace.

viii) Participate in emergency procedures.

ix) Be fully aware of the procedures for dealing with accidents involving electric shock.

x) Demonstrate the correct use of a fire extinguisher.

xi) Demonstrate basic first-aid procedures relevant to the job role or call a qualified first aider to the location of an accident.

(Note: calling a qualified first aider to the location can meet this competence if the candidate is not trained to carry out first-aid procedures).

xii) Complete a written accident report or dictate a report to another person and send the report to the person responsible.

xiii) Complete a written fault report or dictate a report to another person and send the report to the person responsible.

xiv) Use all equipment, powered or hand operated, safely and in accordance with national standards.

xv) Correctly wire appliance plugs.

xvi) Use low-level access and lifting equipment safely and in accordance with national standards.

3 CANDIDATES' INSTRUCTIONS

This assignment consists of a series of simulated workplace activities involving health and safety issues. You will be directly involved in a number of role-play activities which you should treat in a realistic manner. Your instructor and/or other observers will monitor your performance during these activities.

4 MARKING

The candidate must be able to do the following:

4.1 Report a risk and a simulated accident to the correct person responsible for health and safety in the workplace at the correct time. [ ]

4.2 State to a qualified supervisor situations for a specific job role which require:

4.2.1 Immediate action ( )

4.2.2 Immediate action after first aid has been given ( )

4.2.3 Reporting at the earliest opportunity ( )

4.3 State why the action taken will be different according to the situation. ( )

4.4 Select and use protective clothing and equipment for a specific job role. [ ]

4.5 Use good housekeeping practices at all times for a specific job role. [ ]

4.6 Use correct health and safety procedures to demonstrate under observation by a qualified supervisor all the activities for a job role which could be harmful to the worker or to others observing correct health and safety procedures. [ ]

4.7 State to a qualified supervisor the specific actions taken to reduce risk and accident whilst demonstrating activities. [ ]

4.8 Walk to and/or retrieve, as appropriate, health and safety equipment in the workplace. [ ]

4.9 Participate in emergency procedures. [ ]

4.10 Be fully aware of the procedures for dealing with accidents involving electric shock. [ ]

4.11 Demonstrate the correct use of a fire extinguisher. [ ]

4.12 Demonstrate basic first-aid procedures relevant to the job role or call a qualified first aider to the location of an accident. [ ]

4.13 Complete a written accident report or dictate a report to another person, and send report to person responsible. ( )

4.14 Complete a written fault report or dictate a report to another person, and send report to person responsible. ( )

4.15 Use all equipment, powered or hand operated, safely and in accordance with national standards. [ ]

4.16 Correctly wire appliance plugs. [ ]

4.17 Use low-level access and lifting equipment safely and in accordance with national standards. [ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 3 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/4: Carry out a statistical survey

1 OBJECTIVE REFERENCES

2.1 – 2.3

2 PREPARATION

2.1 *Location of test*

The training centre and appropriate locations for the collection of data.

2.2 *Requirements*

Plain paper, graph paper, ruler, compass, pencil, pen.

2.3 *Instructor notes*

Instructors must provide guidance to candidates in the selection of an appropriate assignment. Candidates must conduct a survey and produce the results in a frequency table and in pictorial form.

Candidates should be able to collect at least 50 items of data.

3 CANDIDATES' INSTRUCTIONS

3.1 You need to agree the assignment that you are doing with your instructor before starting the assignment.

3.2 Conduct a survey and collect at least 50 items of data.

3.3 Present the results of the survey in the form of a frequency table.

3.4 Produce a bar chart or pie chart to represent this information.

3.5 Produce a line graph to represent this information.

3.6 From the distribution obtained calculate:

3.6.1 the mean

3.6.2 the mode

3.6.3 the median.

3.7 Ensure that you put your name on all your work and hand it in to the instructor.

4 MARKING

4.1	Assignment agreed with the instructor.	[ ]
4.2	A survey conducted with at least 50 items of data.	[ ]
4.3	The results of the survey presented in the form of a frequency table.	[ ]
4.4	A bar chart or pie chart produced to represent this information.	( )
4.5	A line graph produced to represent this information.	( )
4.6	From the distribution obtained	
4.6.1	the mean	( )
4.6.2	the mode	( )
4.6.3	the median are calculated	( )
4.7	All materials produced are handed in.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 4 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/5: Creating and editing a document

1 OBJECTIVE REFERENCES

3.1 – 3.10.

2 PREPARATION

2.1 *Location of test*

The training centre or other venue where a supervisor and appropriate working conditions will be provided.

2.2 *Requirements*

Computer system providing access to word processing, database and spreadsheet software connected together and switched on.

Software user manuals.

Printer with paper loaded.

Formatted floppy disk and disk labels (work may be saved onto candidate's area of the network).

Copy of section 6.

Pen, pencil.

2.3 *Instructor notes*

For simplicity, this assignment is written for use with floppy disks to save electronic files for marking. Time allowed for this assignment is 1½ hours.

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for this assignment is 1 hour and 30 minutes. In this assignment you are requested to create a business letter and amend it.

You are advised to read all of the instructions before commencing work. Ensure that you understand all the instructions and follow them precisely. If you are in any doubt, ask the instructor.

Unless otherwise instructed by your instructor, all files are to be saved on the floppy disk provided.

3.2 On your computer system you have word processing, database, graphics and spreadsheet software available. Access the appropriate software for this task.

3.3 You are required to create a new document which should be typed exactly as shown in section 6.1.

3.4 Save the document as LETTER on the floppy disk provided and print a copy.

3.5 You are now going to make the following changes to the letter:

3.5.1 Centre justify the first 5 lines (the address).

3.5.2 Centre justify the line containing 'Order no. CC145' and make the text bold.

3.5.3 In the first paragraph of the letter, delete the word 'old'.

3.5.4 In the last paragraph of the letter, insert the word 'latest' before the word 'model'.

3.5.5 Insert 4 more blank lines between 'Yours sincerely' and 'G Marlow'.

3.5.6 Enter your own name in the document next to 'copy to'.

3.6 Save the file with the filename LETTER1 on your floppy disk and print a copy.

3.7 Exit the software to return to your usual operating environment.

3.8 Write your name, the date and the number of this assignment on the print-outs of the letter and hand them together with the floppy disk to your instructor.

4 MARKING

4.1	Assignment completed in 1 hour and 30 minutes.	( )
4.2	Word processing software accessed.	[ ]
4.3	Text typed as given in section 6.1 (3 errors allowed).	[ ]
4.4	Copy of LETTER saved and printed.	[ ]
4.5.1	First 5 lines centred.	( )
4.5.2	'Order number CC145' centred and bold.	( )
4.5.3	Word deleted as specified.	( )
4.5.4	Word inserted as specified.	( )
4.5.5	Blank lines inserted as specified.	( )
4.5.6	Candidate name entered.	( )
4.6	Copy of LETTER1 saved and printed.	[ ]
4.7	Document processing software exited correctly.	( )
4.8	Disk and print-outs handed in.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 4 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

6 ASSIGNMENT DOCUMENTATION

Note to candidate: you should use the set default values for margins and fonts. If your default margins and font are different from those used in this document then your text may wrap around at different points to those presented below.

6.1 Document to be entered by candidates

Mr D Green
Carlton Computers Plc
14 Milton Road
BISHOP'S STORTFORD
Hertfordshire BS8 1UR

23 April 2001

Dear Mr Green

Order no. CC145

With reference to your order number CC145 received today, I am writing to inform you that this old printer has been replaced with the model NR-90.

Please contact me if you are interested and I can arrange for our salesperson to call and demonstrate this model to you.

Yours sincerely

G Marlow
Sales Manager

Copy to (candidate's own name)

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/6: Editing a database

1 OBJECTIVE REFERENCES

3.1 – 3.6, 3.10 – 3.12

2 PREPARATION

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Computer system providing access to database software, connected together and switched on.

Database software user manual.

Printer with paper loaded.

Floppy disk containing the database file STORES (see 2.3 below).

Pen, pencil, paper.

2.3 *Instructor notes*

For simplicity, this assignment is written for use with floppy disks to save electronic files for marking. Candidates may, however, work in the user area of the network.

You are required to create a new database to hold the data for candidates to use in the assignments. You should set up the database as follows:

Field name	Data type	Field length
Component	text	14
Cost	number	5 (2 decimal places)
Re-order	number	3
Quantity	number	4

Enter all the data into the file. Save the file with the filename STORES.

Component	Cost per item	Minimum re-order level	Order quantity per item
Inductors	0.50	400	2000
Fuses	0.20	400	2000
Resistors	0.10	400	2000
Transistors	5.00	50	200
Diodes	3.00	50	250
Transformers	10.00	10	50
Capacitors	2.50	25	150
Clips	1.50	40	200
Knobs	2.00	40	200

Copy the file STORES to the candidates disks or to the user area of the network.

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for this assignment is 1 hour 30 minutes. In this assignment you are required to edit and search a database.

You are advised to read all of the instructions before commencing work. Ensure that you understand all the instructions and follow them precisely. If you are in any doubt ask the instructor.

Unless otherwise instructed by your instructor, all files are to be saved on the floppy disk.

3.2 Access the database software.

3.3 Load the data file STORES.

3.4 Sort the file so that the components are in alphabetical order and print out the file.

3.5 Search the file for minimum re-order level = 400 and print out a list of all these records.

3.6 The following changes need to be made to the data:

3.6.1 The cost of clips has gone up from 1.50 to 1.90. Change the cost.

3.6.2 Delete the record containing Diodes.

3.6.3 Add the following component to the file:

Component	Cost per item	Minimum re-order level	Order quantity per item
Locknuts	0.80	300	1500

3.7 Print out a copy of the amended database.

3.8 Save the database with the name STORES2

3.9 Exit the database software to return to your usual operating environment.

3.10 Ensure your name, the date and the number of this assignment are on all print-outs and the floppy disk and hand them to your instructor.

4 MARKING

4.1	Assignment completed in 1 hour 30 minutes.	( )
4.2	Database software accessed	[ ]
4.3	Database file STORES loaded.	[ ]
4.4	Table sorted alphabetically and printed out.	[ ]
4.5	File searched as specified and selected records printed.	[ ]
4.6.1	Cost amended as specified.	( )
4.6.2	Record deleted as specified.	( )
4.6.3	New record added as specified.	( )
4.7	Amended file printed.	[ ]
4.8	STORES2 files saved on disk.	[ ]
4.9	Database software exited correctly.	( )
4.10	Disk and print-outs handed in.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 2 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/7: Editing a spreadsheet

1 OBJECTIVE REFERENCES

3.1 – 3.6, 3.13 – 3.18

2 PREPARATION

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Computer system providing access to spreadsheet software, connected together and switched on.
Spreadsheet software user manual.
Printer with paper loaded.
Floppy disk containing the data file LABOUR (see 2.3 below).
Pen, pencil, paper, calculator.

2.3 *Instructor notes*

For simplicity, this assignment is written for use with floppy disks to save electronic files for marking. Candidates may, however, work in the user area of the network. You are required to create a spreadsheet for the candidates as specified below. Save the file under LABOUR and copy it to candidates disks or user network area.

	A	B	C	D	E	F	G
1	LABOUR UTILISATION	*Candidate name*					
2	Month	JAN	FEB	MARCH	APRIL	MAY	TOTAL
3	Work days/month	21	20	21	20	23	
4	No. of operators	70	65	68	73	71	
5	Max. days for production	91					

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for this assignment is 1 hour 30 minutes. In this assignment you are required to edit and carry out calculations on a small spreadsheet. You are advised to read all of the instructions before commencing work. Ensure that you understand all the instructions and follow them precisely. If you are in any doubt ask the instructor.

Unless otherwise instructed by your instructor, all files are to be saved on the floppy disk provided.

3.2 Access the spreadsheet software.

3.3 Load the data file LABOUR

3.4 Enter your name in the spreadsheet where it says 'candidate name'.

3.5 Insert a column before the TOTAL column and enter the following data:

JUNE
22
68

3.6 You are required to make further amendments to your spreadsheet as specified below:

3.6.1 Change the value in cell F4 from 71 to 73.

3.6.2 Replace the value in cell D3 with 40.

3.6.3 Delete the contents of cell B5.

3.7 Use the sum function in cell H3 to calculate the total number of work days.

3.8 Use the sum function in cell H4 to calculate the total number of operators.

3.9 To calculate the maximum days for production insert the formulae B3 x B4 in cell B5.

3.10 Copy this formula across the spreadsheet to the other months (column C to G).

3.11 Save the amended spreadsheet with the filename LABOUR1. Print a copy of the whole spreadsheet on a single sheet of paper. Write your name, the date and the details of this assignment on a disk label and put the label on your floppy disk.

3.12 Exit the spreadsheet software to return to your usual operating environment.

4 MARKING

4.1	Assignment completed in 1 hour and 30 minutes.	( )
4.2	Spreadsheet software accessed.	[ ]
4.3	Data file loaded.	[ ]
4.4	Name entered in correct position.	[ ]
4.5	Column inserted correctly and new data entered	[ ]
4.6.1	Cell content amended as specified.	( )
4.6.2	Cell content replaced as specified.	( )
4.6.3	Cell content deleted as specified.	( )
4.7	Sum function in H3 entered correctly.	( )
4.8	Sum function in H4 entered correctly.	( )
4.9	Sum function in B5 entered correctly.	( )
4.10	Sum function copied across the spreadsheet.	( )
4.11	Amended spreadsheet printed and saved as LABOUR1.	[ ]
4.12	Spreadsheet software exited correctly.	( )
4.13	Disk and print-outs handed in.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 3 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Fundamentals of Electronic Communication 1

Practical assignment 003/8: Demonstrate the effect of heat on the resistance of a conductor

1 OBJECTIVE REFERENCES

4.1 – 4.3.

2 PREPARATION

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Access to appropriate reference sources.
Power pack or battery of several cells.
Ammeter with ranges of 0-10A and 0-1A.
Voltmeter with a range of 0-5 V.
Two variable resistors (rheostats): one with 20 ohm maximum resistance and another with 10 ohm maximum resistance.
Electrical circuit connectors.
Filament lamp (tungsten) 2.5 V.

2.3 *Instructor notes*

Candidates may undertake assignments in pairs, provided results analysis is undertaken independently by each candidate.

Candidates must be familiar with Ohm's law, electrical circuits and the functions of resistors, ammeters and variable resistors.

Health and safety issues must be explained to candidates in the context of the use of electric currents. It may be useful for the instructor to undertake a dummy run demonstration of the procedures before allowing the candidates to proceed. It is particularly useful to check that the filament lamp will display a non-ohmic relationship at reasonable voltage values.

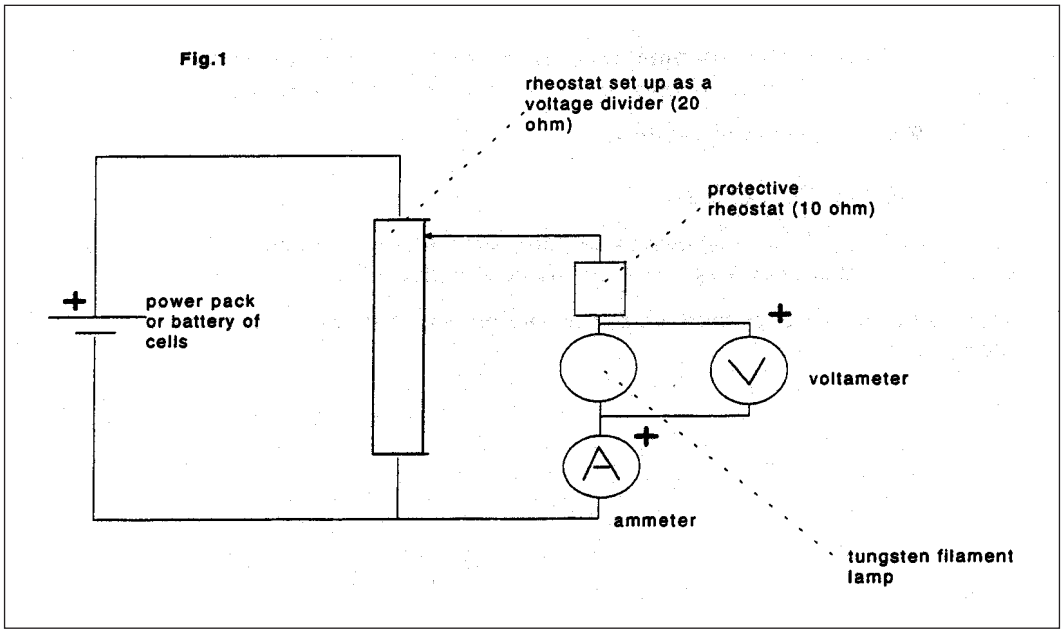
The writing up of this assignment may be done outside the two-hour practical session.

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for this assignment is 2 hours not including the time needed to write up your report. You are advised to read all the instructions before commencing work. If you do not understand all the instructions then please ask your instructor.

3.2 In this experiment you will investigate the electrical conduction characteristics of a conductor device (eg a filament lamp). You will use a variable resistor as a 'voltage divider' to give a smooth increase in voltage from zero to positive values.

Set up the electrical circuit as shown in Fig. 1. but **DO NOT** switch on the circuit until your instructor has had a chance to see that it is correctly set up.



3.3 Set up the ammeter to read at the higher range of 0-10A. Switch on the circuit. If the current reading is too small then change to the 0-1A setting. The reason for carrying out this procedure is that ammeters are sensitive devices which can be damaged by high throughput of current.

3.4 Adjust the voltage divider so that a range of voltage readings are produced,

eg 0, 0.5V, 1.0V, 1.5V, 2.0V, 2.5V, 3.0V, 3.5V, 4.0V, 4.5V, 5.0V

For each voltage reading, record the current in amperes.

3.5 Plot the change in current with voltage.

3.6 Describe the relationship between the voltage and current for the conductor (filament lamp).

3.7 Refer to a textbook to identify why the filament lamp behaves in a way that does not follow Ohm's law at higher voltage values.

3.8 Look up textbooks (or obtain information from your instructor) on how other types of conductors that do not obey Ohm's law have application in circuit design.

3.9 Write up this assignment, ensure that your name is on your work and hand it in to the instructor.

4 MARKING

4.1	Assignment completed in 2 hours (excluding write up).	( )
4.2	Electrical circuit set up as advised.	[ ]
4.3	A range of voltage and current readings taken.	[ ]
4.4	Graph of current against voltage plotted.	[ ]
4.5	Relationship between current and voltage for the conductor correctly described.	[ ]
4.6	Relationship correctly identified as non-ohmic and due to increase in resistance due to heating effects.	[ ]
4.7	Application of non-ohmic properties in other conductor devices in use in electrical circuits appreciated in a very general way.	( )
4.8	Work handed in to the instructor.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 1 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Communication Systems and Digital Networks 1

Practical assignment 003/9: Investigating the various forms of communications media

1 OBJECTIVE REFERENCES

5.1 – 5.4

2 PREPARATION

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Samples of a range of transmission media.

Access to a range of catalogues (paper based and CD Rom/web based) and appropriate reference sources.

2.3 *Instructor notes*

2.3.1 Candidates may undertake assignments in groups, provided results analysis is undertaken independently by each candidate.

2.3.2 The writing up of this assignment may be done outside the two-hour practical session.

2.3.3 Range of transmission media to be investigated at least 8 items from:

- Twin copper wire
- Twisted pairs (shielded and unshielded)
- Coaxial cables
- Multi-core cables
- Ribbon cable
- Optical fibres
- Wave guide
- Infra-red free space radiation
- Line-of-sight microwave radio links
- Satellite links
- Bluetooth
- Firewire (IEEE 1394)

2.3.4 Factors to be considered:

- Cable diameter
- Resistance per kilometre
- Capacitance
- Impedance
- Attenuation
- Cost
- Available bandwidth
- Susceptibility to interference
- Advantages and disadvantages

3 CANDIDATES' INSTRUCTIONS

3.1 Use reference books and catalogues etc., to obtain information on at least eight items of transmission media from the range listed. You have 2 hours to complete this research.

3.1.1 Range of transmission media to be investigated:

- Twin copper wire
- Twisted pairs (shielded and unshielded)
- Coaxial cables
- Multi-core cables
- Ribbon cable
- Optical fibres
- Wave guide
- Infra-red free space radiation
- Line-of-sight microwave radio links
- Satellite links
- Bluetooth
- Firewire (IEEE 1394)

3.1.2 Factors to be considered:

- Cable diameter
- Resistance per kilometre
- Capacitance
- Impedance
- Attenuation
- Cost
- Available bandwidth
- Susceptibility to interference
- Advantages and disadvantages

3.2 Produce a report which includes a table showing comparison of relevant factors/characteristics of the media investigated, and a concluding paragraph which considers the main advantages and disadvantages of at least 4 of the media investigated.

3.3 Write up this assignment, ensure that your name is on your work and hand it in to the instructor.

4 MARKING

4.1	Assignment completed in 2 hours (excluding write up).	( )
4.2	Reference sources used accurately.	[ ]
4.3	Report produced and includes at least 8 items.	[ ]
4.4	Report includes table showing a comparison of the media investigated.	[ ]
4.5	Table includes relevant factors (attenuation, cost, available bandwidth, susceptibility to interference, etc).	( )
4.6	Report includes concluding paragraph which considers the main advantages and disadvantages of at least 4 of the investigated media.	( )
4.7	Work handed in to the instructor.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 1 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Communication Systems and Digital Networks 1

Practical assignment 003/10: Investigating modulation systems

1 OBJECTIVE REFERENCES

8.1 – 8.4

2 PREPARATION

The objective of this experiment is to investigate the properties of amplitude and frequency modulation when subjected to interference (external electrical noise).

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Hairdryer (or portable electric drill).

Television set (portable type with loop antenna preferred).

Multi-band radio receiver.

2.3 *Instructor notes*

Candidates may undertake assignments in pairs, provided results analysis is undertaken independently by each candidate.

Candidates must be familiar with modulation theory, noise sources and interference and with the basic principles of operation of television and radio receivers.

Health and safety issues must be explained to candidates in the context of the use of electrical appliances. Care should be taken when using the hairdryer (heat hazard) or electric drill. It may be useful for the instructor to undertake a dummy run demonstration of the procedures before allowing the candidates to proceed.

The writing up of this assignment may be done outside the two-hour practical session.

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for this assignment is 2 hours not including the time needed to write your report in Part 1 and your letter in Part 2. You are advised to read all the instructions before commencing work. If you do not understand all the instructions then please ask your instructor.

3.2 Part 1
In this experiment you will investigate the effects of noise and interference caused by electrical apparatus (eg electric motors) on other electrical apparatus (eg television and radio receivers).

Procedure:
3.2.1 Switch on the television set.
3.2.2 Turn down the sound.
3.2.3 Switch on the hair dryer.
3.2.4 Move the hair dryer towards the television and observe the screen.
3.2.5 Note the effects of external man-made 'noise' on the picture.
3.2.6 Repeat the experiment with the sound channel turned on.
3.2.7 This time note the effects on the sound channel and on the screen.
3.2.8 Replace the television receiver with the multi-band radio receiver and repeat the experiment. Tune the radio receiver across all of its wave-bands taking care to note the frequencies/wavelengths where maximum interference occurs.
3.2.9 Write a report that covers your observations and conclusions including the properties of various types of modulation when subjected to noise and interference.

3.3 Part 2
Your favourite Aunt (Aunt Sarah), who lives in Mombassa, would like to know why her local radio station (Radio Mombassa) uses double sideband amplitude modulation (d.s.b./a.m.) for its broadcasts on the medium wave band (1485 kHz), and frequency modulation (f.m.) for broadcasts on the v.h.f. band (95.9 MHz).

3.31 TASK.
Write Aunt Sarah a letter, using language which she can easily understand, explaining the difference between the various forms of amplitude and frequency modulation and which justifies the radio station's choice of modulation for each waveband. Advise her which station (medium wave or v.h.f.) will give the best reception of music programmes. You should also tell her that there is another system, with which she is familiar, which uses a composite transmission comprising of both amplitude and frequency modulated signals.
Explain to her why both types of modulation are used in the same transmission.

3.3.2 Hand the letter, and the report for part 1 of this assignment, to your instructor by the given deadline.

4 MARKING

Part 1

4.1	Assignment completed in 2 hours (excluding write up).	( )
4.2	Electrical tests and measurements carried out accurately	( )
4.3	Report and letter handed in on time.	[ ]
4.4	Interference effects noted on both sound and vision channels	[ ]

Part 2

4.5	Properties of amplitude modulation covered accurately	( )
4.6	Properties of frequency modulation covered accurately	( )
4.7	Realistic conclusions drawn	[ ]
4.8	Additional transmission system covered accurately	( )
4.9	Complex terms explained in language appropriate to the task	( )

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all items marked with a [ ] and at least 2 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Practical Assignments – Communication Systems and Digital Networks 1

Practical assignment 003/11: Investigating global and national mobile radio and telephone systems communication technologies

1 OBJECTIVE REFERENCES

9.1 – 9.3

2 PREPARATION

The aim of this assignment is to encourage candidates to investigate the global and national mobile radio and telephone systems that are active in the region in which the candidate is based

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Access to a range of catalogues and newspaper/magazine articles (paper based and CD Rom/web based) and appropriate reference sources.

2.3 *Instructor notes*

Candidates may undertake assignments in pairs, provided results analysis is undertaken independently by each candidate.

Candidates should be allowed to access a range of catalogues and newspaper/magazine articles (paper based and CD Rom/web based) and appropriate reference sources.

The writing up of this assignment may be done outside the two-hour practical session.

3 CANDIDATES' INSTRUCTIONS

3.1 The time allowed for this assignment is 2 hours not including the time needed to write your report.

3.2 This assignment involves a survey into the various global and national mobile radio and telephone networks that are active within your region. Use catalogues and newspaper/magazine articles (paper based and CD Rom/web based) and appropriate reference sources to obtain information on at least 10 issues relating to mobile telephone networks that are listed in section 6. Use this list to prompt your investigation.

3.3 The presentation of your report will be enhanced by the use of the tables, pie charts and/or bar charts for the statistical information.

3.4 Write up this assignment, ensure that your name is on your work and hand it in to the instructor.

4 MARKING

4.1	Assignment completed in 2 hours (excluding write up).	( )
4.2	Report produced and includes at least 10 issues.	[ ]
4.3	Reference sources used accurately.	[ ]
4.4	Tables and charts included.	( )
4.5	Work handed in to the instructor.	[ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if successful in all questions in items marked with a [ ] and at least 1 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

6 ASSIGNMENT DOCUMENTATION

Issues relating to mobile telephones

i) How many mobile telephone networks are there in your region?

ii) What are their names?

iii) Which network has the most users?

iv) Approximately what percentage of the people in your country own a mobile telephone?

v) What approximate percentage of the country does each network cover?

vi) What approximate percentage of the population does each network cover?

vii) Do all/any of the service providers offer pre-pay facilities – or is it all on a contract basis?

viii) What is the difference between a mobile phone and a cordless phone?

ix) How many manufactures of mobile phones are you aware of? Name them.

x) Does the make of mobile phone determine which network it uses? Why?

xi) Can all mobile phones be used in other countries? If not, why not?

xii) Are there any truly international systems? Can you name them?

xiii) What future systems are you aware of? Name them.

xiv) What frequency bands are allocated in your country for use by the mobile telephone networks?

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Practical Assignments – Communication Systems and Digital Networks 1

Practical assignment 003/12: Investigating protocols, standards and standards development bodies

1 OBJECTIVE REFERENCES

12.1, 12.2

2 PREPARATION

The aim of this assignment is to encourage candidates to investigate the issues relating to the protocols and standards required for international communication and to discover the bodies responsible for their development. The resultant protocols and standards come in a variety of forms and have been developed by a wide variety of bodies. They are classified in many ways and carry varying degrees of authority, for example:

- voluntary/mandatory
- de jure/de facto
- recommendations
- functional

2.1 *Location of test*

The training centre or other venue where supervision and appropriate working conditions will be provided.

2.2 *Requirements*

Access to a range of reference sources (paper based and CD Rom/web based) and appropriate textbooks.

2.3 *Instructor notes*

Candidates should be introduced to the relevant protocols and standards as part of their normal learning experience.

Candidates should be encouraged to discuss the issues raised by this assignment with each other. However, it is important that reports should be submitted, and assessed, on an individual basis.

Candidates should be allowed to access a range of trade journals and magazine articles (paper based and CD Rom/web based) and relevant reference sources including the Internet.

The timescale for this assignment is likely to extend well beyond the normal two hour period allocated to other assignments. Instructors are encouraged to issue this assignment at an early stage in the teaching process prior to covering section 12 of unit 002. A realistic deadline should be set for the handing in of the assignment on completion of section 12.

The writing up of this assignment may be done outside the normal classroom session.

The range of standards bodies considered should include:

- The International Telecommunications Union (ITU) and its sub-committees ITU-T, ITU-R, ITU-D

- The International Standards Organisation (ISO) with particular reference to the Open Systems Interconnection (OSI) reference model
- Institute of Electrical and Electronic Engineers (IEEE) with particular reference to the networking standards and protocols.

3 CANDIDATES' INSTRUCTIONS

Your task is to:

3.1 determine the various protocols and standards required to establish voice and data communication over telecommunications networks

3.2 discuss these issues with your tutors and others.

3.3 Present your findings, in the form of a personal report, which must be handed in to your tutor by the agreed deadline. Among the issues which your report should cover are:

3.3.1 the various standards and protocols involved in communicating voice and data

3.3.2 the national/regional/international bodies responsible for standards development

3.3.3 the need for conformance to standards

3.3.4 the need for cooperation between the standards setting bodies for data communication

3.3.5 the difference between de jure and de facto standards

3.3.6 examples of typical standards and protocols.

4 MARKING

4.1 The candidate has determined a wide range of protocols and standards required to establish voice and data communication over telecommunications networks. [ ]

4.2 The candidate has discussed the relevant issues with your tutors and others. ( )

4.3 The candidate has presented their findings, in the form of a personal report [ ]

4.4 Issues covered include:

4.4.1 the various standards and protocols involved in communicating voice ( )

4.4.2 the various standards and protocols involved in communicating data ( )

4.4.3 the national/regional/international bodies responsible for standards development ( )

4.4.4 the need for conformance to standards ( )

4.5 The need for cooperation between the standards setting bodies for data communication ( )

4.6 The difference between de jure and de facto standards [ ]

4.7 Examples of typical standards and protocols [ ]

4.8 Report handed in to instructor by the agreed deadline [ ]

5 ASSIGNMENT COMPLETION

The candidate will have satisfactorily completed this assignment if they have produced a report which satisfactorily addresses all of the issues marked with a [ ] and at least 4 of the items marked with a ( ).

A period of seven days must elapse before an unsuccessful candidate may retake this assignment.

Appendix A

Entry Level Mathematics

Introduction

The aim of this module is to provide the entry level of mathematics required by candidates wishing to take the assessments for the Technician Certificate in Telecommunication Systems.

Knowledge requirements

Instructors must ensure that candidates are able to:

Numeracy

1 Perform calculations involving the four operations of addition, subtraction, multiplication and division applied to whole and decimal numbers.

2 Perform calculations involving the four arithmetic operations applied to positive and negative numbers, using the rules relating to directed numbers.

3 Perform calculations to convert decimal fractions to a percentage and a percentage to a fraction.

4 Perform calculations to express one quantity as a percentage of another.

5 Perform calculations to divide various amounts into given ratios.

6 Perform calculations involving two quantities in direct proportion to each other.

7 Perform calculations involving two quantities in inverse proportion to each other.

8 Deduce estimated solutions to arithmetic calculations, expressing the results to both a given number of significant figures and to a given number of decimal places.

9 Express denary numbers in binary form and binary numbers in denary form.

10 Define the terms base, index, power, reciprocal and square root.

Algebra

11 Represent quantities by symbols and translate phrases involving quantities into algebraic expressions.

12 Simplify algebraic expressions involving symbols and numbers using a range of methods.
Methods: collect like terms using addition and subtraction; multiply and divide using the rules for directed numbers where applicable; remove brackets where applicable; apply the priority order precedence rules relating to arithmetic operations

13 Factorise expressions by extracting common factors, eg $ax + ay = a(x + y)$ and grouping, $ax - ay + bx - by = (a + b)(x - y)$

14 Construct and solve simple linear equations using appropriate data.

15 Evaluate formulae by substituting appropriate data.

Geometry

16 Identify a range of plane figures.
Plane figures: square, rectangle, triangle and circle

17 Calculate the perimeter and area of the plane figures.
Plane figures: square, rectangle, triangle and circle

18 Construct triangles from given information.
Given information: the lengths of three sides, the lengths of two sides and the magnitude of the included angle, the length of one side and the magnitudes of two angles

19 Identify the Theorem of Pythagoras and apply it to determine the length of the unknown side of a right-angled triangle given the length of the other two sides.

Graphs

20 Identify the point of origin for horizontal and vertical axes including positive and negative co-ordinates.

21 Determine suitable scales to be applied to the axes to enable given data to be plotted.

22 Plot graphs from given data.

23 Read values of y for given values of x and values of x for given values of y from a graph and interpolate intermediate values between points.

Appendix B

Resource requirements

City & Guilds has identified a list of minimum requirements for the Technician Certificate in Telecommunication Systems. You should use this list to make sure that you have the necessary resources to offer the programme.

The visiting verifier should also use this list to check that all candidates have access to the resources needed to be successful. You do not have to provide all the resources in one location, for example you may have teaching rooms in one location and you may use a different location (such as a workshop and laboratories) to provide access to resources that are not in the teaching rooms.

This list is intended to be appropriate to a wide range of locations. For example, electronic component catalogues may come from Internet sources that originate from the local or worldwide market.

Certificate – resource list

Accommodation

- Teaching rooms, workshops and laboratories.
- Layout of premises to allow for good work flow.

Equipment and tools

- First aid kit (for demonstration purposes)
- Fire fighting equipment (for demonstration purposes)
  - *Equipment:* fire extinguishers (water, CO_2, foam, powder), sand/water bucket, fire blanket, fire hose
- Protective clothing and safety equipment
  - *Protective clothing*: overalls, ear defenders, safety boots, gloves, safety helmet (hard hat), particle masks, glasses/goggles/visors
  - *Equipment*: safety barriers, hazard notices, permits to work, machine guards, residual current devices, earth sticks
- Accident report forms (for demonstration purposes)
- Permit-to-work forms (for demonstration purposes)
- Low-level access equipment (ladders etc.,)
- Lifting equipment (hoists, jacks etc.,)
- General workshop machinery
  - *Machinery:* Drilling equipment, portable equipment, soldering facilities
- Scientific calculators
- Personal computers
- Printers
- Storage media
- Software applications
  - *Software:* word processing, database, spreadsheet
- Electronic components
  - *Components:* tungsten filament lamps (2.5 volt), variable resistors (including 20 ohm and 10 ohm), resistors, capacitors, inductors, transformers, electromagnetic relays, semiconductor diodes, transistors (bipolar and field-effect), integrated circuits (linear), logic gates (AND, OR, NAND, NOR, Exclusive OR), connectors
- Electrical/electronic equipment
  - *Equipment:* power supplies, ammeters, voltmetres, oscilloscopes, radio receivers (multi-band), loudspeakers, microphones, television receivers, hair dryers, electric drills, telephone instruments
- Communications media
  - *Media:* twin, multi-core/ multi-pair, ribbon cable, twisted pair (shielded and unshielded), coaxial cables, waveguide, optical fibres (mono-mode, multi-mode, graded-index)
- Electronic component catalogues
  - *Catalogues:* eg Farnell Electronic Components (http://www.farnell.com/), RS Components (www1.rswww.com), Combined Precision Components (http://www.cpc.co.uk/), Maplin electronics (www.maplin.co.uk)
  - Electronic component catalogues from (local) national or other international suppliers may be considered equivalent.
- Reference books: See recommended reading list.

Appendix C

Practical Assignments

Two assessment methods are used in the 2730 Technician Awards in Telecommunication Systems programme – written questions and practical assignments.

Practical assignments

Each unit or component in the certificate level of this programme has one or more related practical assignments. These assignments may call on skills covered in other sections but reference is only made to the objectives covered by the marking criteria. Wherever relevant, the option is given to you to use local names, local standards, alternative measures and paper sizes, or to design an alternative assignment. Where this option is taken **the assignment must be of a comparable standard** to ensure consistency between centres using this programme. The assignment must be documented and available to the visiting verifier. ALL assignments must be successfully completed.

The assignments may be administered at any time convenient to the instructor and to the candidate.

The practical assignments in this publication are intended to be photocopied.

Instructor notes

It is essential that you read these before attempting to administer the practical assignment. Practical assignments usually require you to prepare material for the assignment.

Candidate instructions

Make sure every candidate has a copy of these before beginning the practical assignment.

Marking

The marking is based on performance criteria or outcomes related to the practical assignment, to which the answer will always be either 'yes' – the candidate achieved this or 'no' – the candidate did not achieve this. Credit is given for those performance objectives for which the answer is 'yes' – the candidate achieved this.

Supervision

All assignments require supervision and you must make sure that the results reflect only the individual candidate's own work. You must keep all assessment documentation and material in a file for each candidate until the results have been agreed by the visiting verifier and until confirmation of the result has been received from City & Guilds.

Records, results and certification

Successful completion of the related practical assignments for each unit or component needs to be recorded and then sent to City & Guilds. We suggest that you keep a record of each individual's achievement that may then be transferred to the entry forms. A model is given at the end of this section but you may use any form of record keeping that is convenient and accessible.

In order to gain certification, results for successfully completed practical assignments must be sent to City & Guilds. Results for practical assignments are entered onto *Form S* that must be countersigned by the visiting verifier and sent to us. A sample *Form S* is included in appendix D.

An advantage of this programme is that candidates who successfully complete the practical assignments for a single unit or component may, if they wish, claim a certificate of unit credit. This may be beneficial for those candidates who only wish to complete part of this programme. Send these claims to us at any time provided the visiting verifier has countersigned the *Form S*.

Candidates wishing to gain the full award (certificate, diploma or advanced diploma) must successfully complete all forms of assessment. We recommend that the practical results are sent at the time of, or shortly before, the date of the written examinations.

Visiting verifier

The operation of this programme requires the appointment of a visiting verifier. **The visiting verifier must countersign the results of the practical assignments on *Form S*.** The visiting verifier should also be able to inspect records and candidates' work to verify the results before submission. A full description of the role of the visiting verifier is in appendix D.

Technician Certificate in Telecommunication Systems **Candidate assessment record**	
Candidate's name and number	
Centre name and number	

Assessment reference	**Date completed**	**Instructor signature**	**Instructor name**
003/1 Understanding health and safety			
003/2 Safety in the workshop			
003/3 Using safe working practices			
003/4 Carry out a statistical survey			
003/5 Creating and editing a document			
003/6 Editing a database			
003/7 Editing a spreadsheet			
003/8 Demonstrate the effect of heat on the resistance of a conductor			
003/9 Investigating the various forms of communications media			
003/10 Investigating modulation systems			
003/11 Investigating global and national mobile radio and telephone systems communication technologies			
003/12 Investigating protocols, standards and standards development bodies			

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Appendix D

City & Guilds Approval and Administration Procedures

We have an administration system for working with organisations internationally. This system is designed to assure the integrity of the assessment process, make communication easier, and ensure that our records are accurate. If you wish to use City & Guilds assessments you must do two things – apply for approval to offer a specific assessment programme and apply for approval to become an examination centre.

As a centre approved to offer a specific assessment programme such as the Technician Awards in Telecommunication Systems you are agreeing to organise courses of instruction in preparation for examinations in this subject.

As an approved examination centre, you will be responsible for registering individual candidates for each part of the assessment programme, including external candidates if they apply to your centre, conducting assessments, reporting results to us, and presenting our certificates and certificates of unit credit to successful candidates. A certificate of unit credit shows partial completion of the requirements for a full certificate or diploma as described in this syllabus.

City & Guilds reserves the right to suspend an approved centre, or withdraw its approval from an approved centre or for an approved centre to conduct a particular City & Guilds scheme or particular City & Guilds schemes, for reason of debt, malpractice or for any reason that may be detrimental to the maintenance of authentic, reliable and valid qualifications or that may prejudice the name of City & Guilds.

The next section shows the specific procedures you must follow to get approval, register candidates, and send results. Copies of all necessary forms are included in this appendix, with notes added where we think these may be helpful. The copies show sample candidate entry forms for 2730 Technician Certificate in Telecommunication Systems.

For this programme your attention is drawn to the following:

1 For assessment of practical work send us the form for the visiting verifier, *Form INT/APP 2*. If we accept your nomination we will write and tell you that the nomination has been accepted, and that you may accept candidates for the practical part of the assessment.

2 Send the *Dated Entry and Results Submission (Form S)* in time to reach us by the time stated in the *International Directory of Examinations and Assessments* for examinations in this subject. *A separate Form S must be used for each complex level; ie entries for 2730-**01**-001 must be on a separate sheet from entries for 2730-**02**-011. Form S* and other forms require the use of subject and other numbers that are part of our internal administrative procedure.

For the *Technician Awards in Telecommunication Systems* the numbers are as follows:

The subject number is 2730

The award number is 2730-01 for entries for the certificate level.

The component numbers are the numbers used to identify each unit in this programme. These are listed on page 8. Subject, complex and component numbers are also used in the syllabus for each unit.

These numbers may have to be changed from time to time, in which case we will let you know about the changes.

After receiving the completed *Form S* we will send you a list of registered candidates to check that the details are correct. Before the actual examination date, we will send the required number of written tests and multiple-choice answer sheets *(Form MA)* and any other materials you need for the examinations.

NOTE. If you represent a school, college or other organisation making entries through a separate examination centre, such as a branch office of a local education department, you must make sure that sufficient time is allowed to complete these procedures.

Examination materials are returned to us immediately after the examination, using the fastest possible route. This avoids delay in processing results.

3 Your results for practical assessments are sent to us with the completed *Results Submission (Form S)*. Prompt return of *Form S* avoids delay in processing results.

We will send details of candidates' examination results to the examination centre and certificates of unit credit and/or certificates, diplomas and advanced diplomas for successful candidates.

4 We also give guidance on these procedures in the current edition of the *International Directory of Examinations and Assessments* which is automatically distributed to registered examination centres.

City & Guilds International

Guidance INT/APP 1

Guide to getting approval guidance notes

Introduction

Centre approval is available to any college, company or training centre. You must apply to become a City & Guilds International Approved Centre if you wish to offer our programmes.

Programme approval is required if you wish to operate a programme, and examination centre approval is required in order to submit candidate entries and carry out examinations.

- Programme approval – complete Section 2 of the Application Form (INT/APP1).
- Examination centre approval – complete Section 3 of the Application Form (INT/APP1).
- Programme and examination centre approval – complete all of the Application Form (INT/APP1).

Procedures

1 Please choose the programme(s) that you wish to offer. A full list appears in the International Handbook. Before completing the form you must **read the relevant syllabus and regulations**. These publications are available from our Branch Offices or from head office. You will find an order form for publications in the International publications list. Additional requirements for the programme are detailed in the International Handbook.

Please Note: 'Syllabus and Regulations' is the new term for 'Scheme Pamphlet'.

2 The relevant forms should be completed and returned to either City & Guilds Customer Services International or the appropriate Branch Office in your area.

3 A separate form must be completed for each programme application. The request for examination centre approval need only be made once.

Please Note: If you intend to make a number of applications, please photocopy the application form.

4 **Programme Application**

You will receive formal notification from City & Guilds International including:

- an invoice for the approval fee(s)
- programme approval centre document(s)
- a presentation pack of International publications
- an International Directory of Examinations and Assessments
- Form S – registration, dated entry and results submission

Please Note: Approval for most of our programmes requires the appointment of a suitably qualified and experienced Visiting Verifier. Please refer to the International Handbook for details. You are required to make nominations for the role of your Visiting Verifier (see Form INT/APP2) **at the time of application for approval to offer the programme**. Appointments are made by City & Guilds International after considering the suitability of the nominees. Nominees should be suitably qualified and experienced but **NOT an employee from your centre**. People from industry or the public services and who are in a supervisory or management role would be appropriate. You and your nominee must read the criteria for appointment and the role and duties of a Visiting Verifier on page 7.

5 **Examination Centre Approval**

You will receive formal notification from City & Guilds International when your application is successful. A centre number will be allocated. No entries may be made until you are given this number.

You will receive:

- an invoice for the required fees.
- an examination centre approval document.
- an International Directory of Examinations and Assessments.
- examination entry forms.

Please Note: Centres in some countries are required to enter all candidates for City & Guilds International examinations through their local government education department who will be an approved examinations centre.

City & Guilds International

INT/APP 1

Application form for approval to offer a City & Guilds international programme and/or examinations

Programme number: 2730	Level: Cert/Dip/Adv Dip
Programme title: Telecommunication Systems	
Section 1 **Centre details:**	
Name of centre:	
City & Guilds centre number (if known):	
Address for **all** correspondence (ie. Postal): Post Code: Country:	
Location address (if different from above): Country:	
Telephone number:	
Fax number: e mail:	
Signature of head of section/department/faculty/principal:	
Name: Position:	Date:

Section 2		INT/APP 1
Programme approval statements of competence:		
Please read the following statements carefully then tick all the boxes that apply to the programme for which approval is requested.		
a)	**I have read the Syllabus and Regulations and assure City & Guilds International that the syllabus and assessments are appropriate for the candidates and that the teaching will be undertaken by suitably qualified and experienced staff.**	
b)	**The centre has the practical equipment necessary for the delivery and assessment of this programme.**	
	*** City & Guilds International reserves the right to request details of staffing and equipment. (See Forms INT/APP3 and INT/APP4 on pages 13 and 14).**	
c)	The teaching staff understand the concept of coursework and practical assessment and assure City & Guilds International that all practical assessments will be undertaken at appropriate times under examination conditions and, where applicable, supervised by senior staff members.	
d)	I enclose a completed notification form for the Visiting Verifier (if required for this subject) and both the Visiting Verifier and myself understand the responsibilities. (Please refer to the International Handbook for details).	
e)	I hereby accept and agree to abide by the rules and regulations of City & Guilds International as set out in the Directory of Examinations and Assessments.	

Name:	Position:
Signature of head of section/department/ faculty/principal:	Date:
Name:	Position:
Signature of local examination secretary:	Date:

Section 3	INT/APP 1
Examination centre approval statements of competence:	
This section need only be completed by applicants who do not already have a City & Guilds examination centre number:	
a) I certify that the centre has the necessary facilities for written examinations. All question papers will be held unopened in a secure place until the time of the examination. All examinations will be invigilated according to the rules and regulations of City & Guilds International as set out in the International Directory of Examinations and Assessments. I also understand that a representative of City & Guilds International has the right to visit the centre during tuition, training and examination times. Submissions/entries for coursework/practicals can only be made if the centre also holds necessary programme approval (see Section 2, Page 4).	
b) I attach a reference from the centre's bank for credit and exchange purposes.	
Name:	Position:
Signature of principal/managing director/ government authority:	Date:

Section 4	INT/APP 1
Approval fees:	
a) I understand that my organisation will be invoiced for centre approval fees and I hereby agree to pay promptly. I understand that failure to do so may result in suspension of approval.	
Name:	Position:
Signature of principal/managing director/ government authority:	Date:

When completed please return to City & Guilds Customer Services International, or the appropriate Branch Office.

For office use only:		
Date received:	Date forwarded (as appropriate):	Date logged:

Action Taken:	
Additional information:	Date requested:
Check centre records:	Date:
Armchair assessor:	Date sent:
Approved:	Date:
Copy to Head Office/Officer/Branch Office:	Date:

Criteria for the nomination of Visiting Verifier

Professional

1 Understanding of the nature of the programme and the type of student group.

2 Knowledge of the content of the programme and assessments required.

3 Evidence of experience in the subject field, either through employment or through responsibility for placement supervision over a period of time.

4 Knowledge and understanding of City & Guilds International provision of programmes in the subject field.

Personal

1 Good communication and inter-personal skills.

2 Willingness to support and advise the course team.

3 Willingness and ability to write reports which provide objective recommendations that will enable City & Guilds International to identify strengths/weaknesses of the work being done – thus maintaining the required standards.

4 Commitment to maintaining the quality of practical assessments.

5 Ability to work with the centre in a fair and impartial manner.

Commitment Required

1 Accept responsibility for a centre for a minimum of 2 years.

2 Carry out Visiting Verifier responsibilities as agreed with the centre and City & Guilds International. (As detailed below)

3 Support to centre by telephone/correspondence/visits.

4 Familiarisation with City & Guilds International aims and philosophy as detailed in City & Guilds documentation.

The role and duties of the Visiting Verifier

It is City & Guilds International policy to ensure the reliability, credibility and validity of our awards. We do this by appointing Visiting Verifiers to monitor the standards of assessments being carried out by staff in approved centres.

The centre is responsible for the assessment of the candidates' practical ability. The Visiting Verifier is responsible for verifying that the assessments carried out by the centre and the results obtained are in accordance with the required standards.

It is essential for the success of the programme that the centre and Visiting Verifier develop a good working relationship through regular and open communication.

It is the responsibility of the centre to nominate a potential Visiting Verifier. Please ensure that the completed application form is sent with the centre approval form. **The Visiting Verifier must not be employed by the centre**.

The Visiting Verifier will be paid a fee by City & Guilds International.

City & Guilds International is not responsible for paying the Visiting Verifier's travel expenses. These must be paid by the centre.

The course may start once approval has been granted. The Visiting Verifier will be informed of the approval by City & Guilds International, we will request that he/she contact you to discuss a visit and their role and duties.

The main duties of the Visiting Verifier are to monitor, evaluate and approve the assessments by means of a visit arranged on a mutually convenient date to ensure that:

- proper procedures have been followed
- practical and written assessments have been correctly administered
- all the candidates who have met the required standard are recorded as successful
- only the candidates who have met the required standard are recorded as successful.

In order to do this the Visiting Verifier will need to:

- meet staff responsible for practical and written assessments and maintaining assessment records
- examine the centre's assessment records
- observe practical assessments taking place
- refer to centre approval documentation
- have access to tutors' and work placement supervisors' notes and schedules.

The Visiting Verifier will contact the centre as soon as possible after the programme has started to verify that the assessment procedures are fully understood. Occasionally a visit may be required at this stage to solve problems. At least one visit will be made annually, usually towards the end of the course.

It is not possible for the Visiting Verifier to monitor every assessment that takes place. A sample of 5 - 8% should be sufficient to establish the existence of satisfactory procedures.

The Visiting Verifier may request that a particular group of candidates be present during his/her visit but should be prepared to be flexible. It is not the individual candidate who is being assessed but the centre's ability to assess to the specified standards. Verification of these standards may be carried out on any candidate.

Candidates should not be expected to attempt formal assessment until they are ready.

When candidates have been successful in the assessed components the ICMs (Invigilation Certificates/Marksheets) or Form S – whichever is being used – can be submitted to City & Guilds for Certification. If the Visiting Verifier has not made his/her annual visit by this stage, he/she must be consulted before the submission. This is in order to check that assessment procedures were satisfactory and any problems arising during the course have been resolved. At this stage the Visiting Verifier can complete and submit the Visiting Verifier Report Form and countersign the ICM/Form S.

Visiting Verifiers are required to satisfy themselves that the resources at each centre enable candidates to experience all aspects of the syllabus. Where such provision falls short of the specified standards and where candidates' work is clearly below the required standard, recommendations for improvement will be made and reported to City & Guilds International.

City & Guilds International

INT/APP 2

Application for the post of visiting verifier

Please complete in **block capitals** or typescript.		
Name of centre:		Centre no: (if known)
Application for the post of visiting verifier for (programme title & number): 2730 Telecommunication Systems		
Section 1 **Personal details:**		
Surname: First name:		Mr/Mrs/Miss/Ms:
Date of birth: (Day/Month/Year)		
Home postal address:		
Home telephone number:		
Business postal address:		
Business telephone number:		
Business fax number:	Business e mail:	
Please ✓ address to be used for correspondence:	Home:	Business:
Please ✓ telephone number to be used:	Home:	Business:

Section 2		INT/APP 2
Employment history:		
Present/most recent employment:		
Please give details as follows:		
Work experience: (most recent first, including part-time)		
Employer:	Position held:	Dates: (from – to)
Teacher/trainer experience: (most recent first, including part time)		
Employer:	Position held:	Dates: (from – to)
Examining/verifying experience: (most recent first)		
Employer:	Position held:	Dates: (from – to)

Section 3 INT/APP 2 **Educational history:**		
Please give details of relevant qualifications and courses attended:		
Subject:	Qualification/ centre:	Date of award/ course:

Section 4 **Experience of subject:**		
Please ✓ as appropriate:		
Are you currently involved in teaching/training of the programme:	Yes:	No:
For how long?	1 – 2 years:	3+ years:
In what capacity?		

Section 5 **Other involvements with City & Guilds:**		
List any other work which you undertake on behalf of City & Guilds:		
Programme/subject:	Role: (Committees/ Examiner/Verifier etc.)	Dates: (from – to)

Section 6 INT/APP 2 **Referee:**	
Please provide the names and addresses of two persons of standing in the local community whom we may invite to testify to the quality of your experience in the education and training field.	
Name:	
Business address:	
Business telephone no:	
Signature: Date:	

Name:	
Business address:	
Business telephone no:	
Signature: Date:	

Equipment details		INT/APP 3
Please provide details of equipment relevant to the programme for which approval is being requested:		
Item No	Description	Qty
Note: Copies of inventories may be attached.		

Staffing details		INT/APP 4
Please provide details and experience of teaching staff (relevant to your programme approval application)		
Name	Qualifications	Experience
Note: Prospectus or CV's may be submitted if correct and accurate.		

Form S

Form S has been designed to make your job easier by replacing forms BC, D, and M. You can start using Form S immediately.

The following pages show examples of Form S completed for *2730 Telecommunication Systems* at certificate level. The first example shows Form S completed for making entries for the written paper. The second example shows Form S completed for making entries for the practical assessment at certificate level.

There is also a blank copy of Form S with the guidance notes for its completion, which you can photocopy and use for your own purposes. Some of the guidance notes are specific to centres in the UK. Therefore please note the following additional information for centres outside the UK.

Ethnic background

You are not required to complete this section.

(L)TEC Code

You are not required to complete this section.

Counter signature

Form S MUST be countersigned by the visiting verifier when you use Form S to send us results of practical assessments.

If you have any questions about how to fill in Form S you should contact:

International Operations Department
City & Guilds International
1 Giltspur Street
London EC1A 9DD

Tel: +44 (0) 20 7294 2885
Fax: +44 (0) 20 7294 2403
E-mail: international@city-and-guilds.co.uk

City & Guilds

Form S – registration, dated entry and results submission

This form will be scanned. Please use BLOCK CAPITALS.
Do not staple, clip, fold or fax this form.
Please send this form to: City & Guilds, Data Processing, 1 Giltspur Street, London EC1A 9DD.
If you have any questions about how to fill in this form, please phone Entries and Results Customer Support on 020 7294 2787.
Please read the guidance notes over the page before you fill in this form.

Registration	TICK
Dated entry for	MONTH OF TEST: JUN (SEE CODE OVERLEAF)
Results submission	TICK

Centre number	Sub	Name
899999		PRETORIA TECHNICAL INSTITUTE

Award number	Award title	Syllabus code
273001	TECHNICIAN CERTIFICATE IN TELECOMMUNICATION SYSTEMS	

Centre contact	Phone number	Purchase order number or customer reference
IAN NOLAN	875 3217 4492	

Insert enrolment number if known (use BLOCK CAPITALS)	The candidate's name is not necessary when you have given the enrolment number. (Please use BLOCK CAPITALS.)	Sex	Date of birth	Ethnic background	Particular requirements	(L)TEC code	Duplicate to above	Continue on next line
ENR	SUSAN BAILEY	F	260352	CODE OVERLEAF				
COMP NO. 001 / 002								
ENR	GEORGE UMTALI	M	110770	CODE OVERLEAF			✓	
ENR	SAMUEL SIBLEY	M	131269	CODE OVERLEAF			✓	
ENR	VICTORIA BROWN	F	050572	CODE OVERLEAF			✓	
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF				
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF				
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF				
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF				
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF				
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF				

FR-00-3209

I confirm that the candidates above are entered in line with City & Guilds regulations.

Your signature: [signature] Page 1 of 1 Date: 16/1/02 Counter signature (if needed) ....

Send the top copy to City & Guilds. Keep the second copy for your own records.

ST69173 E-00023324 11/00 Version 1.1

City & Guilds

Form S – registration, dated entry and results submission

This form will be scanned. Please use BLOCK CAPITALS.
Do not staple, clip, fold or fax this form.
Please send this form to: City & Guilds, Data Processing, 1 Giltspur Street, London EC1A 9DD.
If you have any questions about how to fill in this form, please phone Entries and Results Customer Support on 020 7294 2787.
Please read the guidance notes over the page before you fill in this form.

Registration	TICK
Dated entry for	MONTH OF TEST: SEE CODE OVERLEAF
Results submission	TICK ✓

Centre number	Sub	Name
899999		PRETORIA TECHNICAL INSTITUTE

Award number	Award title	Syllabus code
273001	TECHNICIAN CERTIFICATE IN TELECOMMUNICATION SYSTEMS	

Centre contact	Phone number	Purchase order number or customer reference
IAN NOLAN	875 3217 4492	

Insert enrolment number if known (use BLOCK CAPITALS)	The candidate's name is not necessary when you have given the enrolment number. (Please use BLOCK CAPITALS.)	Sex	Date of birth	Ethnic background	Particular requirements	(L)TEC code	Duplicate to above	Continue on next line
ABC1234	SUSAN BAILEY	F	260352	CODE OVERLEAF			✓	✓
COMP NO. 003 GRADE P								
DEF6789	SAMUEL SIBLEY	M	131272	CODE OVERLEAF			✓	✓
COMP NO. 003 GRADE P								
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓
ENR	CANDIDATE NAME	M/F	DDMMYY	CODE OVERLEAF			✓	✓

FR-00-3209

I confirm that the candidates above are entered in line with City & Guilds regulations.

Your signature: [signature] Page 1 of 1 Date: 27/05/02 Counter signature (if needed) [signature: L. J. Abbott]

Send the top copy to City & Guilds. Keep the second copy for your own records.

ST69173 E-00023324 11/00 Version 1.1

City & Guilds

Form S – registration, dated entry and results submission

This form will be scanned. Please use BLOCK CAPITALS.
Do not staple, clip, fold or fax this form.
Please send this form to: City & Guilds, Data Processing, 1 Giltspur Street, London EC1A 9DD.
If you have any questions about how to fill in this form, please phone Entries and Results Customer Support on 020 7294 2787.
Please read the guidance notes over the page before you fill in this form.

Registration	TICK
Dated entry for	MONTH OF TEST / SEE CODE OVERLEAF
Results submission	TICK

Centre number	Sub	Name		
Award number	Award title		Syllabus code	
Centre contact	Phone number	Purchase order number or customer reference		

Insert enrolment number if known (use BLOCK CAPITALS)	The candidate's name is not necessary when you have given the enrolment number. (Please use BLOCK CAPITALS.)	Sex	Date of birth	Ethnic background	Particular requirements	(L)TEC code	Duplicate to above	Continue on next line
E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE								
E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE								
E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
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E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE								
E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE								
E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE, COMP NO. GRADE								
E N R	C A N D I D A T E N A M E	M/F	D D M M Y Y	CODE OVERLEAF			✓	✓
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FR-00-3209

I confirm that the candidates above are entered in line with City & Guilds regulations.

Your signature: .... Page ....of.......... Date:....../....../...... Counter signature (if needed) ....

Send the top copy to City & Guilds. Keep the second copy for your own records.

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Guidance notes for the registration, dated entry and results submission form

Please refer to the City & Guilds Directory when you fill in this form.

Please fill in this form in black in **BLOCK CAPITALS**. We will only accept the original copy. Please do not send photocopies or faxes. Please do not fold or staple the form.

Important – each form must contain one type of transaction only, either for registration, dated entry or results submission. For example, if you want to make five registrations and five results submissions for the same award number, the registration **must** be listed on a separate form to the results submissions. You can only tick one box on each form.

Registration (old form R) – please tick this box if you are registering candidates, otherwise leave it blank.

Dated entry (old form D) – this refers to examinations that take place on a set date. Please enter the first three letters of the month of the test, for example, JUN = June.

Results submission (old form M) – please tick this box if you are sending us candidates' results for processing and certification, otherwise leave it blank.

Centre number – please enter the six-figure centre number, for example, 023452. Some centres have a single letter, for example, A, which acts as a sub-centre code. Where this applies, please enter this letter in the sub box.

Centre name – please enter the full name of your centre.

Award number – please enter the six-figure award number, for example, 3777-01 (scheme and complex).

Award title – please enter the full title of the award using BLOCK CAPITALS, for example, AIRCRAFT MAINTENANCE ENGINEERING LEVEL 3.

Syllabus code – this applies to dated entry for some centre-devised syllabuses only. Individual centres will have been told about the centre-devised syllabus and the title and code letters which apply. The details of codes are published in our document called 'Centre Devised Syllabus and Question Paper: Notes for Guidance'.

Centre contact – this is usually the name of the Centre Co-ordinator or Examinations Secretary and should be the person signing this form.

Phone number – please include the area code. International centres should also include the country code.

Purchase order number or customer reference – if centres choose to use this section this will be on invoices and nominal roll reports.

Enrolment number – this number has three letters and four digits, for example, DBS2345, and you must quote it if you know it. If the candidate is still waiting for this number, please leave this section blank.

Candidate name – you only need to fill in this section if the candidate is still waiting for their enrolment number. There is space for 30 letters and longer names should be abbreviated. Do **not** include the candidate's title, for example, Mr, Mrs, Dr and so on.

Sex – you must always fill this in. Please say whether the candidate is male (M) or female (F).

Date of birth – this takes the form of DDMMYY, for example, 5 July 1975 will be written as 050775.

Ethnic background – this section is not currently being used.

Particular requirements – codes are available in our document called Access to Assessment for Candidates with Particular Requirements. You can get this, free of charge, from Sales on 020 7294 2850.

LEC and TEC code – although space is available for three numbers, please use the existing two-number code for any TEC or LEC-funded candidates.

Component numbers – some schemes need component numbers to be registered. Please check the directory. For dated entry, please give the components needed. For results submission, please give the components needed and insert a grade.

Duplicate to above – if a few candidates are being submitted for an **identical** set of components, you should give the component set for the first candidate and then you can tick this box for other candidates.

Continue on next line – if a candidate's component entries need more than one line, please tick this section and continue on the next line. You do not need to fill in candidate details again.

Signature/counter signature – the person who signs this should be the contact person at the centre who is referred to in the centre contact section. A counter signature may be necessary for some qualifications or if an internal or external verifier is carrying out a quality assurance check.

Please return this form to Data Processing, City & Guilds, 1 Giltspur Street, London EC1A 9DD.

E-mail: entries@city-and-guilds.co.uk
Website: www.city-and-guilds.co.uk

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Appendix E

The levels of our awards

Progressive structure
Achieving maximum potential

All City & Guilds qualifications are part of an integrated, progressive structure of awards arranged over seven levels, allowing people to progress from foundation to the highest level of professional competence. Senior awards, at levels 4 to 7, recognise outstanding achievement in industry, commerce and the public services. They offer a progressive vocational, rather than academic, route to professional qualifications. An indication of the different levels and their significance is given below.

City & Guilds level	*Qualification/Programme*	
7	**Fellowship (FCGI)**	*the highest level of technological and managerial experience.*
6	**Membership (MCGI)**	*professional or managerial status, at the level of Master's degree.*
5	**Graduateship (GCGI)/Associateship (ACGI)* NVQ5**	*requires the ability to master and apply complex principles and techniques in a variety of contexts and to assume significant responsibility for human and plant resources, at the level of first degree.*
4	**Full Technological Diploma (FTD), Full Technological Certificate (FTC), Advanced Technician Diploma (IVQ), Licentiateship (LCGI), NVQ4**	*demands specialist or technical expertise and the ability to undertake professional work, at the level of Master Craftsman in Europe.*
3	**Technician Diploma (IVQ), Advanced Vocational Diploma (IVQ), Vocational (non NVQ/IVQ) Level 3 NVQ3**	*denotes skilled work of a complex nature and the ability to undertake a supervisory role.*
2	**Technician Certificate (IVQ), Vocational Diploma (IVQ), Vocational (non NVQ/IVQ) Level 2, NVQ2**	*recognises competence in a more demanding range of activities which require a degree of individual responsibility.*
1	**Vocational Certificate (IVQ), Vocational (non NVQ/IVQ) Level 1 Foundation GNVQ NVQ1**	*indicates the ability to perform basic or routine activities which provide the broad foundation for progression.*

* Only graduates of the City & Guilds College, Imperial College of Science, Technology and Medicine, are awarded the Associateship (ACGI).

NVQ – National Vocational Qualifications IVQ – International Vocational Qualifications

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International Vocational Qualifications

IVQs currently available:

- 1100 Skills Certificate in Health and Safety
- 1104 International Certificate in Training Skills
- 1104 International Diploma in Teaching and Training
- 1105 International Assessor Award
- 1121 Retailing
- 1122 Awards in Hairdressing
- 1123 Awards in Beauty Therapy
- 1155 Awards in Engineering Skills
- 2565 Technician Awards in Engineering
- 2730 Technician Awards in Telecommunication Systems
- 3905 Motor Vehicle Engineering
- 4865 International Tourism
- 6161 Construction Industry
- 6165 Construction Industry Technician
- 7065/6/7/8 Hospitality & Catering (Revised Syllabus)
- 7235 Applied Information Technology
- 8030 (2000) Electrical and Electronic Engineering

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http://www.cityandguilds.com

City & Guilds is a registered charity established to promote education and training

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