



ICON College of Technology and Management

Course Handbook
Computing and Systems Development
(CSD)

ICON COLLEGE
OF TECHNOLOGY AND MANAGEMENT



Unit 21-22,
 1-13 Adler Street
 London E1 1EG

Tel: +44 20 7377 2800 / 7247 7300
 Fax: +44 20 7377 0822
 Website: www.iconcollege.com
 E-mail: info@iconcollege.com

Pearson BTEC Level 5 HND in
Computing and Systems Development – CSD – (QCF)
Course Code: MN179

Unit Details

Unit No	Mandatory Core Units (Four Units, 65 Credit Value)	Unit Level	Unit Credit
1	Business Skills for e-Commerce	4	15
2	Computer Systems	4	15
3	Employability & Professional Development	4	15
4	Project Design, Implementation and Evaluation	5	20

Unit No	Specialist Units (Credit Value of 180)	Unit Level	Unit Credit
9	System Analysis and Design	4	15
18	Procedural Programming	4	15
19	Object Oriented Programming	4	15
23	Mathematics for Software Development	4	15
27	Network Operating Systems	4	15
33	Data Analysis and Design	5	15
34	Data Structures and Algorithms	5	15
35	Web Applications Development	5	15
41	Programming in Java	5	15
44	Local Area Networking Technologies	5	15
45	Wide Area Networking Technologies	5	15
46	Network Security	5	15



Faculty of IT & Engineering

Semester Structure of Pearson BTEC Level 5 HND in Computing and Systems Development (CSD) at ICON College of Technology and Management (QCF)

Semester One		Semester Two	
Unit 1*	Business Skills for e-Commerce (L4)	Unit 9	Systems Analysis and Design (L4)
Unit 2*	Computer Systems (L4)	Unit 19	Object Oriented Programming (L4)
Unit 3*	Employability & Professional Development (L4)	Unit 23	Mathematics for Software Development (L4)
Unit 18	Procedural Programming (L4)	Unit 27	Network Operating Systems (L4)
Semester Three		Semester Four	
Unit 33	Data Analysis and Design (L5)	Unit 4*	Project Design, Implementation & Evaluation (L5)
Unit 35	Web Applications Development (L5)	Unit 34	Data Structures and Algorithms (L5)
Unit 41	Programming in Java (L5)	Unit 45	Wide Area Networking Technologies (L5)
Unit 44	Local Area Networking Technologies (L5)	Unit 46	Network Security (L5)

Total Credits: 245

* Mandatory Core units

Alternative Unit(s)

- Unit 06 Management in IT (L4)
- Unit 08 Management of Projects (L4)
- Unit 14 Web Design (L4)
- Unit 15 Website Management (L4)
- Unit 17 Database Design Concepts (L4)
- Unit 24 Network Technology (L4)
- Unit 25 Routing Protocols (L4)
- Unit 26 Design a Small or Home Office (SOHO) Network (L4)
- Unit 29 e-Commerce Strategy (L5)
- Unit 34 Data Structures and Algorithms (L5)
- Unit 36 Internet Server Management (L5)
- Unit 43 Networking Infrastructure (L5)

Important Note

The College reserves the right to amend the above table as and when required without prior notice.

Course Specifications of Computing and Systems Development

Course title

BTEC Higher National Diploma (HND) in Computing and Systems Development

Awarding Institution

Pearson Educations Ltd

Teaching Institution

ICON College of Technology and Management

Accreditation

Pearson; Qualification Accreditation Number (QAN): **500/8253/X**

Approval from date: 18 February 2004

Approval to date: 31 December 2017

Final award

Pearson BTEC Level 5 HND in Computing and Systems Development

Progression

A progression path for Pearson BTEC HND students is to the second or third year of a degree or honours degree Course, depending on the match of the Pearson BTEC Higher National units to the Degree Course in question.

Progression from this qualification may also well be into or within employment in the IT and computing industry where learners may work towards British Computer Society (BCS), and Incorporated Engineer status.

Admission requirements

To meet the entry criteria for admission to level 5 HND Courses:

A candidate must have either:

- a level 3 qualification
- a level 2 qualifications and relevant work experience
- or substantial work experience related to the field of proposed study

and,

- Demonstrate capability in English equivalent to CEFR level B2 e.g. IELTS 5.5 (including 5.5 for reading and writing), PTE 51 or equivalent.

and,

- Demonstrate a Commitment to Study and a reasonable expectation of success on the Course

International qualifications at the appropriate level will also be accepted. The College will use UK NARIC to determine the equivalence of any international qualifications.

Where applicants do not have a formal qualification to demonstrate capability in English, they will be required to undertake the Colleges written English Language test before an offer of a place on a Course is made. Judgement of their capability in spoken English will be assessed by the Head of Department at the interview. Suitable alternative arrangements to written tests will be made where a student declares a disability, specific learning difficulty or long-term health condition on their application form, e.g. oral questioning, amanuensis etc.

Aims of Course

- equipping individuals with knowledge, understanding and skills for success in employment in the computing industry
- enabling progression to an undergraduate degree or further professional qualification in computing or a related area
- providing opportunities for specialist study relevant to individual vocations and contexts
- supporting individuals employed or entering employment in the computing industry
- developing the individual's ability in the computing industry through effective use and combination of the knowledge and skills gained in different parts of the Course
- developing a range of skills and techniques, personal qualities and attributes essential for
- successful performance in working life and thereby enabling learners to make an immediate contribution to employment
- providing flexibility, knowledge, skills and motivation as a basis for future studies and career
- development in computing.

Relevant external reference points

QAA benchmark standards for engineering undergraduate degree Course
Pearson Electrical and Electronic Engineering Specification – QCF level 5
British Computer Society (BCS)

Credit value

245 credits, See details in appendix A

Course learning outcomes

1. Knowledge and Understanding

Learners will be expected to gain the following knowledge during the Course of study:

- developing the knowledge, understanding and skills of learners in the field of computing and systems development
- equipping learners with knowledge, understanding and skills for success in employment in the computing industry
- communication through internet and multimedia tools and website design
- an understanding of the importance of networking including a basic understanding of architecture, operation and major design issues relating to network management systems
- providing opportunities for specialist study relevant to individual vocations and contexts
- developing the learner's ability in the computing industry through effective use and combination of the knowledge and skills gained in different parts of the Course
- developing a range of skills and techniques, personal qualities and attributes essential for successful performance in working life and thereby enabling earners to make an immediate contribution to employment

2. Skills

Learners will be expected to develop the following skills during the Course of study:

- analysing, synthesising and summarising information critically
- the ability to read and use appropriate literature with a full and critical understanding
- the ability to think independently and solve problems
- the ability to take responsibility for their own learning and recognise their own learning style
- obtaining and integrating several lines of subject-specific evidence to formulate and test hypotheses
- applying subject knowledge and understanding to address familiar and unfamiliar problems recognising the moral and ethical issues surrounding computing and IT
- the ability to understand the need for ethical standards and professional codes of conduct when designing, planning, conducting and reporting an investigations
- the ability to undertake investigations of computer systems in a responsible, safe and ethical manner
- an appreciation of the interdisciplinary nature of computing
- the capacity to give a clear and accurate account of a subject, marshal arguments in a mature way and engage in debate and dialogue both with specialists and non-specialists.

Teaching, learning and assessment strategies

The generic components of teaching and learning strategy normally involve a variety of approaches and include delivering many of the following:

- Regular use of formal lecture sessions in all courses.
- Regular assignment workshops and seminars in all Courses.
- Regular use of individual and/or team-based projects in all Courses.
- Regular use of self-directed and directed reading in all Courses.
- Regular use of library resources in all Courses.
- Regular use of tutor-and student-led discussion groups via e-learning platform; ICON VLE in many Courses.

The assessment of Pearson BTEC Higher National qualifications is criterion-referenced and learners' will be assessed against published learning outcomes and assessment criteria.

All units will be individually graded as 'Pass', 'Merit' or 'Distinction'. To achieve a pass grade for the unit learners must meet the assessment criteria set out in the specifications. This gives transparency to the assessment process and provides for the establishment of national standards for each qualification.

The units in Person BTEC Higher National qualifications all have a standard format which is designed to provide guidance on the requirements of the qualification for learners, assessors and those responsible for monitoring national standards.

The assessment process is rigorous and comprises both assigned and time constraint assessments. Standardizations are undertaken at assessment board meetings. Regular assignment progress monitoring sheet has been introduced to more closely follow student progress and aid success rate.

Course structures

All students take a total of 16 units over 2 years to gain an HND in Computing and Systems Developments. Units are at level 4 (8 units) and level 5 (8 units).

Mandatory Core Units – Four Units:

Business Skills for e-Commerce (L4)
Computer Systems (L4)
Employment & Professional Development (L4)
Project Design, Implementation and Evaluation (L5)

Specialist Units – Twelve Units:

System Analysis and Design (L4)
Procedural Programming (L4)
Object Oriented Programming (L4)
Mathematics for Software Development (L4)
Network Operating Systems (L4)
Data Analysis and Design (L5)
Data Structures and Algorithms (L5)
Web Applications Development (L5)
Programming in Java (L5)
Local Area Networking Technologies (L5)
Wide Area Networking Technologies (L5)
Network Security (L5)

Please see Appendix B for details.

Mode of Study

Full-time and Part-time.

Four semester taught full-time for all students, with minimum 15 hours study per week.

Assessment Regulations

CSD units will be assessed using a variety of assessment methods, including case studies, assignments and work-based assignments, together with projects, performance observation and time constrained assessment. All the assessment material should be valid, reliable and fit for purpose.

Formative assessment is an important means of developing students learning and this is recognised within the College.

It is college policy to allow a Course to take the form of time constrained assessment (TCA) and a student must pass the TCA. However the main assessment for the Course should take the form of assignments (case studies/projects, etc.) and overall grade of the unit will be based on the grade of the assignment.

Student support

The teaching philosophy at Icon requires students to be exposed to a range of learning methods and materials.

All tutors now support their classes by the use of "ICON VLE", a suite of electronic web-based materials that permits students to use the Icon intranet to access materials such as syllabi, Course plan, reading lists, reading assignments, and PowerPoint presentations for each of their Courses.

Student Survey is the primary method of obtaining and gauging student feedback at Icon. The evaluation forms are comprised of both qualitative and quantitative elements. Also Student and Staff Liaison Panel meetings, held each semester, to discuss Course issues and concerns is another way to support the student.

The Personal Tutorial System is an essential part of the College's Teaching and Learning and Assessment Strategy. It is also aimed at contributing to enhancement of the teaching and learning experience of the students. The College assigns every student a designated Personal Tutor who is available by appointment throughout the academic year as needed. The relationship between the student and the personal tutor is built on trust and confidentiality. Whether the problem is related to a financial hardship, accommodation matters, or learning disabilities and academic difficulties, the Personal Tutor is the first contact point at the College who would act as a mentor, and guide the student to the right person for further action.

Evaluation and revision

The Assessment Board evaluates the external examiner's reports every year and makes sure the action plans produced from their reports are well managed and the progress is reported to Academic Board. The College also conducts a feedback on assignments to students by a formative feedback (task-by-task) sheet which has been commended by standard verifiers of Pearson as supportive and effective.

Internal verification ensures that before any assignment brief is released to students, clear assessment criteria, and correct administrative information on assignment are included. Internal verifier teams identify what changes if any in the assignment brief are required and what corrective action should be taken by assessor and should ensure that it is fit for purpose. Internal verifiers check a range of assessment decisions for all assessors and modules by sampling some of the assignments. In case of unexpected assessment decisions, (e.g. everybody achieving Distinction in the assignment), additional sampling will be conducted on individual modules/assessors.

APPENDICES

Appendix A

**Pearson BTEC Level 5 HND in
Computing and Systems Development (QCF)
Course Code: MN179**

Unit Details

Unit No	Mandatory Core Units (Four Units, 65 Credit Value)	Unit Level	Unit Credit
1	Business Skills for e-Commerce	4	15
2	Computer Systems	4	15
3	Employment & Professional Development	4	15
4	Project Design, Implementation and Evaluation	5	20

Unit No	Specialist Units (Credit Value of 180)	Unit Level	Unit Credit
9	System Analysis and Design	4	15
18	Procedural Programming	4	15
19	Object Oriented Programming	4	15
23	Mathematics for Software Development	4	15
27	Network Operating Systems	4	15
33	Data Analysis and Design	5	15
34	Data Structures and Algorithms	5	15
35	Web Applications Development	5	15
41	Programming in Java	5	15
44	Local Area Networking Technologies	5	15
45	Wide Area Networking Technologies	5	15
46	Network Security	5	15

Total: 245 Credits

Appendix B

Unit Syllabus

Unit 1: Business Skills for e-Commerce

Unit code: Y/601/1244

QCF Level 4: BTEC Higher National

Credit value: 15

● Aim

To enable learners to apply the business skills needed to design an e-Commerce solution for an organisation.

● Unit abstract

Organisations of all sizes, structures and aims can benefit from the opportunities made available by the intelligent application of communication based technologies and there will always be a need for practitioners who have a good understanding of those technologies. E-Commerce has become a vital part of an organisation's ability to reach out to the marketplace and position itself to maximise commercial returns on investment.

Poor choices of technology and processes will result in poorly managed opportunities which could lose business, market position and profitability. Learners will investigate the values of business skills by exploring current, topical examples of e-Commerce practices. Learners will consider how to design an e-Commerce solution to the best advantage of the organisation and its stakeholders (for example employees, suppliers and customers). Learners will explore current legislation concerning e-Commerce based trading, organisational responsibilities and finance/payment systems.

The first part of the unit considers the structure and aims of organisations to better understand how they could benefit from an e-Commerce structure. Then follows an opportunity to investigate and evaluate the impact of e-Commerce systems on organisations and their stakeholders. Once these areas have been studied the learner will be in a position to examine the process of the development of an e-Commerce presence followed by the opportunity to design an e-Commerce system.

● Learning outcomes

On successful completion of this unit a learner will:

- 1 Understand the structure and aims of business organisations
- 2 Understand the impact of e-Commerce
- 3 Be able to design e-Commerce solutions.

Unit content

1 Understand the structure and aims of business organisations

Organisations: type eg private, public, voluntary, charitable business organisations; aims eg profit, market share, Return on Capital Employed (ROCE), sales; growth, customer service; Political, Economic, Social and Technological (PEST) analysis

Stakeholders: identification of stakeholders; satisfying stakeholder objectives; pluralist perspectives; the concept of corporate mission objectives and policies

Business functions: key internal business functions eg marketing, sales, accounting, administration; Management Information Systems (MIS), operations

2 Understand the impact of e-Commerce

Consumer impact: empowered customers eg online sales, direct communication with customers, greater choice, lower prices, availability of new products; global markets; new marketing models; on-line advertising

Business impact: global business and consumer markets; issues eg challenge of new technology, security issues, impact and implications of dealing with customers on-line, creating new distribution channels, greater competition, challenge to monopoly power, re-training of staff, lower overheads, new selling chains; legislation

3 Be able to design e-Commerce solutions

Objectives: business idea eg unique selling proposition, business-to-business opportunities, business to consumer markets; domain name

Market research: purpose of research eg identifying information sources, online and offline competition; types of research eg primary, secondary

Target markets: market analysis eg size, characteristics, dynamics, competitors, historical background, emerging trends, market share, market segmentation

Key processes: technology requirements eg hardware, software, security, maintenance, back end systems; supply sources; distribution channels

e-Commerce: payment systems eg electronic cheque, PayPal, NoChex, credit or debit cards; start-up capital; working capital; funding sources

Security: key areas eg prevention of hacking, viruses, identity theft, firewall, impact on site performance, Secure Sockets Layer (SSL), Secure HTTP (HTTPS), digital certificates, strong passwords, alternative authentication methods

Legislation: relevant legislation eg Data Protection Act 1998, Computer Misuse Act 1990, Consumer Credit Act 1974, Trading Standards, Freedom of Information Act 2000, copyright legislation

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the structure and aims of business organisations	1.1 assess an organisation's core business functions 1.2 evaluate an organisation's business aims and show how they relate to stakeholders
LO2 Understand the impact of e-Commerce	2.1 analyse the impact, including the risks, of introducing an e-Commerce system to an organisation 2.2 discuss the global impact of e-Commerce on society
LO3 Be able to design e-Commerce solutions	3.1 investigate market potential for an e-Commerce opportunity 3.2 evaluate current e-Commerce systems in use by organisations 3.3 discuss the financial implications of an e-Commerce solution 3.4 design an e-Commerce solution 3.5 evaluate the suitability of an e-Commerce solution.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 3: Information Systems	Unit 16: e-Commerce Technologies	Unit 29: e-Commerce Strategy
Unit 8: e-Commerce		Unit 30: Information Systems in Organisations
Unit 33: Exploring Business Activity		
Unit 34: Business Resources		

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Systems Analysis
- Systems Design
- Systems Development
- Change and Release Management
- Supplier Management.

Essential requirements

Learners must have access to a wide range of material covering current and proposed e-Commerce implementations encompassing a number of organisations from small start-ups to large multi-nationals. The material can be sourced online, for example organisation websites, journals, newspapers, broadcast material and visiting speakers who are experts in their subject area.

Resources

Books

Chaffey D – *E-business and E-Commerce Management, Fourth Edition* (FT Prentice Hall, 2009) ISBN 0273719602

Courtland B, Thill J – *Business in Action* (Pearson, 2010) ISBN 0132546884

Hall D, Jones R, Raffo C, Anderton A, Chambers I and Gray D – *Business Studies* (Causeway Press, 2008) ISBN 1405892315

Laudon K, Guercio Traver C – *E-Commerce 2010: International Version: Business, Technology, Society* (Pearson, 2009) ISBN 0135090784

Malmsten E, Leander K, Portanger E and Drazin C – *Boo Hoo: A Dot.com Story from Concept to Catastrophe* (Arrow Books Ltd, 2002) ISBN 0099418371

Rich J – *Design and Launch an eCommerce Business in a Week* (Entrepreneur Magazine's Click Starts) (Entrepreneur Press, 2008) ISBN 1599181835

Ridderstrale J and Nordstrom K – *Funky Business Forever* (Prentice Hall, 2007) ISBN 0273714139

Stanwick P, Stanwick S – *Understanding Business Ethics* (Prentice Hall, 2008) ISBN 013173542X

Vise D – *The Google Story* (Pan, 2008) ISBN 0330508121

Wood G and Mellahi K – *The Ethical Business: Possibilities, Challenges and Controversies* (Palgrave Macmillan, 2002) ISBN 0333949935

Journals

Business Review Magazine (Phillip Allan Publishers – see www.phillipallan.co.uk)

The Economist (The Economist Newspaper Group, Inc)

Employer engagement and vocational contexts

Any opportunity to study an existing e-Commerce implementation, either developing or mature would be advantageous.

Unit 2: Computer Systems

Unit code: L/601/0446

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To enable learners to understand computer systems and apply theoretical knowledge to practical application when building, configuring and maintaining computer systems.

- **Unit abstract**

Most IT professionals will at some stage have to set up, use, customise and maintain computer systems. In order to do so effectively they will need to understand how computer systems work. Learners will understand the theoretical aspects of computer systems, and how information is processed. This unit explores the hardware, software and peripheral components that make up a computer system.

There are many different manufacturers of computer systems and each manufacturer will produce a wide range of models with different specifications. Deciding which particular model is appropriate for a given situation depends on a variety of factors. Custom-built computer systems are also an advantage when meeting specialised requirements, whilst maintaining performance and keeping costs low. These aspects are explored in this unit so that learners can make informed choices when designing a computer system for a given purpose.

Learners will be able to apply their theoretical knowledge to practical application by building, configuring and testing a functional computer system which will meet a given specification.

Computer users also need the skills required to set up and carry out routine maintenance of computer systems. Although this unit does not extensively cover fault finding and repair, it includes the basic maintenance skills that would normally be expected of most computer users.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the function of computer systems
- 2 Be able to design computer systems
- 3 Be able to build and configure computer systems
- 4 Be able to undertake routine maintenance on computer systems.

Unit content

1 Understand the function of computer systems

Computer systems: microcomputers eg personal computers; mobile computers; minicomputers eg mid-range servers, workstations; mainframes eg large scale network systems; supercomputers eg high performance systems; models; multiprocessing

Environments: home, business, computer gaming, networking, real-time, communication

Function: main components (Arithmetic Logic Unit (ALU), control unit, memory and input/output devices), connection eg busses; Central Processing Unit (CPU) (control unit, arithmetic logic unit, registers, input/output); memory (Random Access Memory (RAM), Read Only Memory (ROM), registers, programmable, cache), auxiliary storage; computer architecture

Hardware: central processing unit; motherboard, power supply unit, cooling units, backing storage eg hard disc drive; controllers, ports, main memory, memory types, battery, specialised cards eg Peripheral Component Interconnect (PCI), Accelerated Graphics Port (AGP), network, graphics, modem, sound, optical drives; performance factors

Software: systems software eg operating systems, utility programs, library programs, translator programs; applications software eg special purpose software, be-spoke software; performance factors

Peripherals: printers, plotters, cameras, scanners; keyboard and mouse; monitors, display adapters; multimedia devices; storage media; networking; portable drives; plug and play components; performance factors

2 Be able to design computer systems

Needs analysis: client and system requirements, problems/limitations with current/new system, functionality, costs, timescales, resources, investigation/analytical techniques eg interviews, questionnaires

Selection: costs, client requirements, maintenance contracts, outputs required, compatibility; system integration eg home entertainment; storage capacity; accessibility; performance eg speed, time, power, efficiency, effectiveness, usability, alternative solutions

System specification: client requirements, system requirements, system components, configuration, time, tools and resources, alternatives eg processor types, backup options; security measures; documentation

3 Be able to build and configure computer systems

Health and safety: health and safety practices; electrostatic precautions eg antistatic mats, antistatic wrist straps

System installation: hardware: assemble and disassemble a computer system; install motherboard, processor, heat-sink and fan, memory, power supply unit and connect to internal components; install hard disc drive, optical drive; install specialised cards eg graphics, network, modem, audio; install and configure software eg operating system, application software, utility software; install peripheral devices eg printer, scanner, camera; install communication devices eg modem, router

System configuration: configure Basic Input Output System (BIOS) eg date/time, power management, security; install latest antivirus/security updates; update user profiles; configure desktop, icon size, font size, colour, background, customise menu; file management, files and folders, setting file/folder sharing permissions; peripheral devices, printer, scanner, camera; communication devices

System testing: fault detection, Power On Self Test (POST), diagnostic faults, troubleshoot devices; technical support documentation eg reference manuals, online manufacturer support; test hardware eg input/output devices, peripheral devices; test software; documentation eg test plan

4 Be able to undertake routine maintenance on computer systems

Software maintenance: upgrade software eg virus definition files; patches/updates; scheduling maintenance tasks; utility software eg defragmentation, clean-up, back-up, system profilers; other third party utility software eg compression utilities, spyware/malware removal

Hardware maintenance: upgrade hardware; install and configure new peripherals eg printers, scanners; install and configure additional or replacement devices eg hard drive, memory, graphics, sound, optical media, network; cleaning equipment

File management: manage files/folders; back-up procedures

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the function of computer systems	1.1 explain the role of computer systems in different environments 1.2 explain the hardware, software and peripheral components of a computer system 1.3 compare different types of computer systems
LO2 Be able to design computer systems	2.1 produce a system design specification to meet a client's needs 2.2 evaluate the suitability of a system design specification
LO3 Be able to build and configure computer systems	3.1 build and configure a computer system to meet a design specification 3.2 test and document a computer system
LO4 Be able to undertake routine maintenance on computer systems	4.1 perform routine maintenance tasks on a computer system 4.2 upgrade the hardware and software on a computer system.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 2: Computer Systems	Unit 24: Networking Technologies	Unit 47: IT Virtualisation
Unit 5: Managing Networks	Unit 28: IT Support for End Users	Unit 48: IT Security Management
Unit 9: Computer Networks		
Unit 12: IT Technical Support		
Unit 13: IT Systems Troubleshooting and Repair		
Unit 25: Maintaining Computer Systems		
Unit 29: Installing and Upgrading Software		

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Systems Architecture
- Systems Design
- IT/Technology Infrastructure Design and Planning
- Systems Development
- IT/Technology Solution Testing
- IT/Technology Service Operations and Event Management
- IT Application Management/Support
- IT/Technology Management and Support
- Technical Evaluation.

Essential requirements

Learners must have access to computer systems that they can disassemble, assemble and configure. They will also need a range of components and peripherals that they can install and configure.

Learners must understand the functions of computer systems before they can begin the practical aspects of this unit. It is important that the underpinning knowledge of computer systems supports the practical approach to building and configuring computer systems.

Centres must begin this unit by giving an overview of the topics that will be covered, and what benefits the unit will bring to those who aspire to get involved with IT support and networking. Centres must give a brief history of computer systems, and how they have evolved. The different generations of computer systems will be useful at this point. There are different types of computer systems, and this must be covered in detail in terms of their functionality, performance and where they are typically used (environments). The benefits and drawbacks of computer systems must also be discussed, particularly IT security. Centres must keep abreast of modern developments in computer systems, and must also present mobile computing technologies as well. The future of computer systems must also be covered in respect of emerging technologies.

Learners must explore the full range of hardware, software and peripheral components. Centres must demonstrate and explain the role of common components, including the central processing unit, memory, motherboard, power supply unit, optical drives, storage devices and specialised cards.

Centres must present a range of typical client and system requirements, and discuss the range of components needed to fulfil those requirements. The range of hardware, software and peripheral components covered in this unit is at the centre's discretion. However, these components must be available for practical activities to ensure that fully functional computer systems can be built.

Centres must cover health and safety guidelines before commencing any practical work, and ensure that the working environment is safe and hazard free. Learners must also practice using electrostatic equipment to prevent any damage to components. Centres must demonstrate (in stages) the processes involved with building, configuring and testing a functional computer system.

Computer systems at some stage will need to be monitored and maintained to ensure consistency, reliability and performance. Learners must be equipped with the skills to maintain computer systems and follow a recommended schedule of activities. Learners must also be able to upgrade a computer system.

Resources

Books

Anfinsin, D – *IT Essentials: PC Hardware and Software Companion Guide* (Cisco Press, 2010)
ISBN 158713263X

Dick, D – *The PC Support Handbook: The Configuration and Systems Guide* (Dumbreck Publishing, 2009) ISBN 9780954171131

MacRae K – *The Computer Manual: The Step-by-step Guide to Upgrading and Repairing a PC* (Haynes Group, 2002) ISBN 1859608884

MacRae K and Marshall G – *Computer Troubleshooting: The Complete Step-by-step Guide to Diagnosing and Fixing Common PC Problems, Second Edition* (Haynes Group, 2008)
ISBN 1844255174

White R and Downs T – *How Computers Work* (Que, 2003) ISBN 0789730332

Journals

Computer Weekly

Which? Computer

Websites

www.bized.co.uk

www.computerweekly.com

Employer engagement and vocational contexts

Working with a live system will present many risks, that the centre, employer and learner must be aware of using a current vocational context to deploy an additional or alternate solution will enhance the learners experience and enable understanding of wider technical application.

Unit 3: Employability and Professional Development

Unit code: M/601/1251

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with the opportunity to acquire employability skills required for effective employment and to manage their own personal and professional development.

- **Unit abstract**

All learners at all levels of education and experience require employability skills as a prerequisite to entering the job market. This unit gives learners an opportunity to assess and develop an understanding of their own responsibilities and performance in or when entering the workplace.

The unit considers the skills required for general employment such as interpersonal and transferable skills, and the dynamics of working with others in teams or groups including leadership and communication skills.

It also deals with the everyday working requirement of problem solving which includes the identification or specification of the 'problem', strategies for its solution and then evaluation of the results of the solution through reflective practices.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Be able to take responsibility for own personal and professional development
- 2 Be able to demonstrate acquired interpersonal and transferable skills
- 3 Understand the dynamics of working with others
- 4 Be able to develop strategies for problem solving.

Unit content

1 Be able to take responsibility for own personal and professional development

Responsibilities: own responsibilities eg personal responsibility, direct and indirect relationships and adaptability, decision-making processes and skills, ability to learn and develop within the work role; other eg employment legislation, ethics, employment rights and responsibilities

Performance objectives: setting and monitoring performance objectives

Individual appraisal systems: uses of performance appraisals eg salary levels and bonus payments, promotion, strengths and weaknesses, training needs; communication; appraisal criteria eg production data, personnel data, judgemental data; rating methods eg ranking, paired comparison, checklist, management by objectives; skills audit (personal profile using appropriate self-assessment tools); evaluating self-management; personal and interpersonal skills; leadership skills

Motivation and performance: application and appraisal of motivational theories and techniques, rewards and incentives; manager's role; self-motivational factors.

Development plan: current performance; future needs; opportunities and threats to career progression; aims and objectives; achievement dates; review dates; learning programme/activities; action plans; personal development plan

Portfolio building: developing and maintaining a personal portfolio

Transcripts: maintaining and presenting transcripts including curriculum vitae

2 Be able to demonstrate acquired interpersonal and transferable skills

Effective communication: verbal and non-verbal eg awareness and use of body language, openness and responsiveness, formal and informal feedback to and from colleagues; IT as an effective communication medium; team meetings

Interpersonal skills: soft skills eg personal effectiveness, working with others, use of initiative, negotiating skills, assertiveness skills, social skills

Time management: prioritising workloads; setting work objectives; using time effectively; making and keeping appointments; reliable estimates of task time

3 Understand the dynamics of working with others

Working with others: nature and dynamics of team and group work; informal and formal settings; purpose of teams and groups eg long-term corporate objectives/strategy; problem solving and short-term development projects; flexibility/adaptability; team player

Teams and team building: selecting team members eg specialist roles, skill and style/approach mixes; identification of team/work group roles; stages in team development eg team building, identity, loyalty, commitment to shared beliefs, team health evaluation; action planning; monitoring and feedback; coaching skills; ethics; effective leadership skills, eg, setting direction, setting standards, motivating, innovative, responsive, effective communicator, reliability, consistency

4 **Be able to develop strategies for problem solving**

Specification of the problem: definition of the problem; analysis and clarification

Identification of possible outcomes: identification and assessment of various alternative outcomes

Tools and methods: problem-solving methods and tools

Plan and implement: sources of information; solution methodologies; selection and implementation of the best corrective action eg timescale, stages, resources, critical path analysis

Evaluation: evaluation of whether the problem was solved or not; measurement of solution against specification and desired outcomes; sustainability

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Be able to take responsibility for own personal and professional development	1.1 reflect on own current skills and competencies against professional standards and organisational objectives 1.2 evaluate own development needs and the activities required to meet them 1.3 devise a personal and professional development plan based on identified needs 1.4 reflect on own development against original aims and objectives set in the personal and professional development plan
LO2 Be able to demonstrate acquired interpersonal and transferable skills	2.1 communicate in a variety of styles and appropriate manner at various levels 2.2 demonstrate effective time management strategies
LO3 Understand the dynamics of working with others	3.1 analyse team dynamics, discussing the roles people play in a team and how they can work together to achieve shared goals 3.2 discuss alternative ways to complete tasks and achieve team goals
LO4 Be able to develop strategies for problem solving	4.1 review tools and methods for developing solutions to problems 4.2 develop an appropriate strategy for resolving a particular problem 4.3 evaluate the potential impact on the business of implementing the strategy.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 1: Communication and Employability Skills for IT	Unit 3: Employability and Professional Development	Unit 4: Project Design, Implementation and Evaluation
		Unit 50: Work-based Experience

It also links with the following Asset Skills cross-sectoral Employability Matrix:

- Plan and manage time, money and other resources to achieve goals
- Find and suggest new ways to achieve goals and get the job done and achieve goals
- Plan for and achieve your learning goals
- Understand the roles people play in a group and how you can best work with them
- Lead or support and motivate a team to achieve high standards
- Find new and creative ways to solve a problem.

Essential requirements

Access to a range of work-related exemplars (for example appraisal and development systems, team health checks, job descriptions, action plans, communication strategies, etc) would be of assistance in delivering this unit. Case studies based on relevant sectors, workshops, career talks and work-based mentors would also be useful in the teaching and learning aspect of the unit.

Learners can generate assessment evidence through a range of possible activities including individual work placements, project management, research reports, development of case studies, the process of working with others (eg employee – supervisor roles, teamwork, group work) and everyday communication within the workplace.

Resources

Books

NCCER – *Basic Employability Skills: Trainee Guide 00108-09* (Prentice Hall, 2009) ISBN 013609919X

Thompson Leigh, L – *Making the Team: A Guide for Managers* (Pearson Education, 2008)
ISBN 9780136037767

Websites

www.prospects.ac.uk

www.stemnet.org.uk/resources/employability_skills_guide.cfm

Unit 4: Project Design Implementation and Evaluation

Unit code: L/601/0995

QCF level 5: BTEC Higher National

Credit value: 20

- **Aim**

To develop learners' skills of independent enquiry by undertaking a sustained investigation of direct relevance to their vocational, academic and professional development.

- **Unit abstract**

This unit provides opportunities to develop skills in decision making, problem solving and communication integrated with the skills and knowledge developed in many of the other units within the programme to complete a realistic project.

It requires the learner to select, plan, implement and evaluate a project and finally present the outcomes, in terms of the process and the product of the project. It also allows learners to develop the ability to work individually and/or with others, within a defined timescale and given constraints, to produce an acceptable and viable solution to an agreed brief.

If this is a group project, each member of the team must be clear about their responsibilities at the start of the project and supervisors must ensure that everyone is accountable for each aspect of the work and makes a contribution to the end result.

Learners must work under the supervision of programme tutors or work-based managers.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Be able to formulate a project
- 2 Be able to implement the project within agreed procedures and to specification
- 3 Be able to evaluate the project outcomes
- 4 Be able to present the project outcomes.

Unit content

1 Be able to formulate a project

Project selection: researching and reviewing areas of interest; literature review; methods of evaluating feasibility of projects, initial critical analysis of the outline specification, selection of project option, initiating a project logbook/diary, estimating costs and resource implications, identifying goals and limitations; value of project, rationale for selection, agree roles and allocate responsibilities (individually with tutor/supervisor and within project group if appropriate)

Project specifications: developing and structuring a list of requirements relevant to project specifications eg costs, timescales, scale of operation, standards, legislation, ethics, sustainability, quality, fitness-for-purpose, business data, resource implications

Procedures: planning and monitoring methods; operating methods; lines of communication; risk analysis; structure of groups and collaborative working eg learner groups or roles and responsibilities within a work-based project; targets and aims

Project plan: production of a plan for the project including timescales, deliverables, milestones, quality assurance systems and quality plans; monitoring progress

2 Be able to implement the project within agreed procedures and to specification

Implement: proper use of resources, working within agreed time scale, use of appropriate techniques for generating solutions, monitoring development against the agreed project plan, maintaining and adapting project plan where appropriate

Record: systematic recording of relevant outcomes of all aspects and stages of the project to agreed standards

3 Be able to evaluate the project outcomes

Evaluation techniques: detailed analysis of results, conclusions and recommendations; critical analysis against the project specification and planned procedures; use of appropriate evaluation techniques; application of project evaluation and review techniques (PERT); opportunities for further studies and developments

Interpretation: use of appropriate techniques to justify project progress and outcomes in terms of the original agreed project specification

Further consideration: significance of project; application of project results; implications; limitations of the project; improvements; recommendations for further consideration

4 Be able to present the project outcomes

Record of procedures and results: relevant documentation of all aspects and stages of the project

Format: professional delivery format appropriate to the audience; appropriate media

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Be able to formulate a project	1.1 formulate and record possible outline project specifications 1.2 identify the factors that contribute to the process of project selection 1.3 produce a specification for the agreed project 1.4 produce an appropriate project plan for the agreed project
LO2 Be able to implement the project within agreed procedures and to specification	2.1 match resources efficiently to the project 2.2 undertake the proposed project in accordance with the agreed specification 2.3 organise, analyse and interpret relevant outcomes
LO3 Be able to evaluate the project outcomes	3.1 use appropriate project evaluation techniques 3.2 interpret and analyse the results in terms of the original project specification 3.3 make recommendations and justify areas for further consideration
LO4 Be able to present the project outcomes	4.1 produce a record of all project procedures used 4.2 use an agreed format and appropriate media to present the outcomes of the project to an audience.

Guidance

Links

This unit is suitable for use in all sectors and should utilise the full range of skills developed through study of other units in the programme. These include planning, practical work, data handling and processing, analysis and presentation skills. The knowledge applied may link to one particular unit or to a number of other units.

Essential requirements

The required resources will vary significantly with the nature of the project. The identification of the equipment and materials required, and their availability, is a vital part of the planning phase. Learners should therefore have access to a wide variety of physical resources and data sources relevant to the project. Tutors should ensure that learners do not embark on work that cannot succeed because of lack of access to the required resources.

Employer engagement and vocational contexts

Centres must establish relationships with appropriate organisations in order to bring realism and relevance to the project.

Unit 9: Systems Analysis and Design

Unit code: K/601/1281

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with the knowledge and skills needed to undertake a systems analysis investigation by following a recognised methodology.

- **Unit abstract**

The systems life cycle provides a comprehensive framework for initially capturing data and information through a feasibility study and the use of recognised fact-finding techniques. Learners will be encouraged to identify and consider a full set of stakeholder interests to be sure that the wider implications of any development are considered.

To provide perspective, learners will examine different life cycle models and appreciate their particular strengths and weaknesses and to which situations they are most appropriate. Theoretical understanding will be translated into practical skills through actual systems investigations and learners will become confident in the use of particular tools and techniques relevant to the methodology chosen. Although for practical purposes, it is likely that one particular methodology and related tools and techniques will be chosen for practical work, it is important that learners understand that others are available.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand different systems life cycles
- 2 Understand the importance of a feasibility study
- 3 Be able to perform a systems investigation.

Unit content

1 Understand different systems life cycles

Lifecycle models: examples eg Systems Development Life Cycle (SDLC), Rapid Applications Design (RAD), Spiral, Agile, Dynamic Systems Design Methodology (DSDM), Waterfall and Prototyping

Lifecycle procedure/stage: lifecycle stages within different models; lifecycle stages examples eg (feasibility study, analysis, design, implementation, testing, review) or (analysis, design, implementation, maintenance, planning)

2 Understand the importance of a feasibility study

Fact-finding techniques: eg, interviews, observation, investigation of documentation, questionnaires, focus groups

Feasibility criteria: issues eg legal, social, economic, technical, timescales; organisational constraints

Components: purpose; structure; intended audience; outcomes

3 Be able to perform a systems investigation

Identify requirements: stakeholders; requirements identification; requirements specification eg scope, inputs, outputs, processes and process descriptors; consideration of alternate solutions; quality assurance required

Constraints: specific to activity eg costs, organisational policies, legacy systems, hardware platforms

Report documentation: structure eg background information, problem statements, data collection process and summary, recommendations, appendices

Systems analysis terminology and tools: data stores and entities; data flows; process representation techniques relationships – 1:1, 1:Many (1:M) and Many: Many (M:M)

Investigation: eg upgrading computer systems, designing new systems

Techniques: examples relevant to methodology chosen eg Context Diagrams, Data Flow Diagrams (DFDs), Entity Relationship Diagrams (ERDs); Business Systems Options (BSOs); Technical Systems Options (TSOs); quality considerations eg Total Quality Management (TQM)

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand different systems life cycles	1.1 evaluate different systems lifecycle models 1.2 discuss the importance of following a procedural/staged lifecycle in a systems investigation
LO2 Understand the importance of a feasibility study	2.1 discuss the components of a feasibility report 2.2 assess the impact of different feasibility criteria on a systems investigation
LO3 Be able to perform a systems investigation	3.1 undertake a systems investigation to meet a business need 3.2 use appropriate systems analysis tools and techniques to carry out a systems investigation 3.3 create documentation to support a systems investigation 3.4 evaluate how user and systems requirements have been addressed.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 11: Systems Analysis and Design	Unit 1: Business Skills for e-Commerce	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Systems Analysis.

Essential requirements

Learners must have access to a range of systems environments, in addition to more traditional texts, journals and case studies. Learners must also keep up to date with current systems developments in the field.

Learners must be encouraged to investigate a range of systems analysis methodologies and practices. Realistic business scenarios must be chosen wherever possible to provide as wide a perspective as possible. It is important for learners to consider all stakeholders in any activity because failure to do so is often one of the reasons why new systems do not fulfil the stated requirements.

The feasibility study is one of the most important stages in the lifecycle. If data and information is not obtained from users about the existing environment, problems, or requirements for a new or revised system then the investigation will be flawed. Delivery must therefore reflect this and expose learners to a range of information collecting techniques and their appropriateness in certain environments. Learners must also be encouraged to use a good variety of information collecting devices.

Resources

Books

Dennis A and Haley Wixom B – *Systems Analysis and Design* (John Wiley & Sons Ltd, 2009)
ISBN-10: 0470400315

Lejk M and Deeks D – *An Introduction to System Analysis Techniques, 2nd Edition* (Addison Wesley, 2002) ISBN-10: 0201797135

Websites

www.freetutes.com/systemanalysis/

Employer engagement and vocational contexts

To further enrich the content of this unit and to provide more of a vocational context it would be beneficial to bring in analysts or employers from organisations that have had exposure to systems analysis.

Unit 18: Procedural Programming

Unit code: D/601/1293

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with an understanding of the principles of procedural programming and to enable them to design and implement procedural programming solutions.

- **Unit abstract**

Irrespective of framework or delivery platform, the development of procedural code is still at the core of many commercial application development projects. Event driven systems and object oriented platforms all use procedural code for the critical command content of their objects, events and listeners.

This unit allows learners to become familiar with the underpinning principles of procedural programming. Many languages have the capacity to develop procedural code and it is not important which language is chosen for this unit.

Ideally, for learners who are new to programming, this unit would be considered the starting point before progressing onto one (or all) of the many programming units. Whilst the learner is not expected to develop any complex code in this unit, the foundations will enable the development of their programming skills.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the principles of procedural programming
- 2 Be able to design procedural programming solutions
- 3 Be able to implement procedural programming solutions
- 4 Be able to test procedural programming solutions.

Unit content

1 Understand the principles of procedural programming

Characteristics of programming: low-level languages; high-level languages; generations eg first, second, third, fourth, fifth; programs; applications; instructions; algorithms

Types of language: procedural languages; object-oriented; event-driven; others eg script and mark-up languages; simple overviews and uses

Reasons for choice of language: organisational policy; suitability of features and tools; availability of trained staff; reliability; development and maintenance costs; expandability

Data structures: variables eg naming conventions, local and global variables, arrays (one-dimensional, two-dimensional); file structures; loops eg conditional (pre-check, post-check, break-points), fixed; conditional statements; case statements; logical operators; assignment statements; input statements; output statements

Data types: constants and literals; integer; floating point; byte; date; boolean; others eg character, string, small int; choice of data types eg additional validation, efficiency of storage

Programming syntax: command rules, variable declaration, *Standards:* use of comments, code layout, indentation

2 Be able to design procedural programming solutions

Requirements specification: inputs, outputs, processing, user interface; constraints eg hardware platforms, timescales for development; units; data; file structures.

Program design: tools eg structure diagrams, data flow diagrams, entity relationship models, flow charts, pseudo code

Technical documentation: requirements specification; others as appropriate to language eg form design, flowcharts, pseudo code, structured English, action charts, data dictionary, class and instance diagrams

3 Be able to implement procedural programming solutions

Modular design: elements eg functions, procedures, method, widgets, Graphical User Interface (GUI) components, symbols

Software structures: as appropriate to language chosen eg iteration, decisions, units, functions, procedures; control structures; conditional commands

Parameters: data types, passing data, return values

Scope of variables: global, local, static, overloaded results, instance

Programming: use of programming standards; relationship to program design

4 Be able to test procedural programming solutions

Mechanisms: valid declarations, debugging code, checking naming conventions; checking functionality against requirements, error detection, error messages, compiler errors, runtime errors, in code response, dry running

Supportive documentation: test plan; test results; programmer guidance; user guidance; onscreen help

Review: design against specification requirements, interim reviews

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the principles of procedural programming	1.1 discuss the principles, characteristics and features of procedural programming
LO2 Be able to design procedural programming solutions	2.1 identify the program units and data and file structures required to implement a given design 2.2 design a procedural programming solution for a given problem
LO3 Be able to implement procedural programming solutions	3.1 select and implement control structures to meet the design algorithms 3.2 correctly use parameter passing mechanisms 3.3 implement a procedural programming solution based on a prepared design
LO4 Be able to test procedural programming solutions	4.1 critically review and test a procedural programming solution 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback on a developed procedural programme solution and make recommendations for improvements 4.4 create onscreen help to assist the users of a computer program 4.5 create documentation for the support and maintenance of a computer program.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 6: Software Design and Development	Unit 19: Object Oriented Programming	Unit 35 Web Applications Development
Unit 14: Event Driven Programming	Unit 20: Event Driven Programming Solutions	Unit 39: Computer Games Design and Development
Unit 15: Object Oriented Programming	Unit 21: Software Applications Testing	Unit 40: Distributed Software Applications
Unit 16: Procedural Programming	Unit 22 Office Solutions Development	Unit 41: Programming in Java
	Unit 23: Mathematics for Software Development	Unit 42: Programming in .NET

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Software Development.

Essential requirements

Whilst some procedural languages are commercially available, there are also free languages available incorporating a diverse range of commands, commonly deployed on many platforms. Centres must ensure that in the case of mobile platforms the applicable free emulators are available or where security policies dictate, local work stations are equipped with virtualised operating systems containing the programming environment.

Learners must have access to facilities, which allow them the opportunity to fully evidence all of the criteria of the unit. If this cannot be guaranteed then centres should not attempt to deliver. The learner must develop a procedural program that can work on a range of platforms, therefore it may be command line, web based, Graphical User Interface (GUI) based, games console or a deliverable for a mobile platform amongst many other solutions.

To ensure success centres must keep the delivery to one language. However, as many procedural languages now allow development in multiple platforms, learners may access this if it is locally realistic.

Centres must use a range of design methodologies, ensuring that the method selected is suited to the environment selected as well as the programming language of choice.

Implementation must be based on a suitably structured problem that ensures the use of modular elements, control structures and conditional commands.

Centres must select a programming activity, or use an external source (employer, commissioner, open source). The design of the programming solution does not need to be a standalone application and may be an enhancement or extension to existing work.

Resources

Books

Davis S R – *C++ for Dummies* (Wiley, 2009) ISBN-10: 0470317264

McBride P K – *Turbo Pascal Programming Made Simple* (Made Simple, 1997) ISBN 0750632429

McGrath M – *C Programming in Easy Steps* (In Easy Steps Limited, 2009) ISBN 184078363X

Parkin A and Yorke R – *Cobol for Students* (Butterworth Heinemann, 1995) ISBN 0340645520

Websites

<http://library.thinkquest.org/27297/>

www.cplusplus.com/doc/tutorial/

www.cprogramming.com/

www.csis.ul.ie/cobol/

Employer engagement and vocational contexts

Working with a local programming-based organisation or using internet-based open source projects would enhance the learners' experience and offer a relevant vocational context.

Unit 19: Object Oriented Programming

Unit code: K/601/1295

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with an understanding of the principles of object oriented programming as an underpinning technological concept in the field of programming, data management and systems development.

- **Unit abstract**

Object oriented programming is an industry-proven method for developing reliable modular programs and is popular in software engineering and systems development. Consistent use of object oriented techniques can lead to shorter development life cycles, increased productivity, adaptable code, reuse of different technologies, the interaction of different systems using common platforms and therefore lower the cost of producing and maintaining systems.

The development of systems with objects simplifies the task of creating and maintaining complex applications. Object oriented programming is a way of modelling software that maps programming code to the real world.

In terms of impact, object oriented technology can be found in many systems, from commercial operating systems to mobile phones and in many multimedia applications. The majority of programming languages are object oriented in focus, with the exceptions preferring to offer specialist programming resources. It is dominant in Visual Studio, C++, Java, the Microsoft .Net environment, Action Script and many other systems.

Learners taking this unit will have the opportunity to develop their understanding of the object oriented paradigm and develop code suited to a range of platforms using the object oriented methodology.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the principles of object oriented programming
- 2 Be able to design object oriented programming solutions
- 3 Be able to implement object oriented programming solutions
- 4 Be able to test and document object oriented programming solutions.

Unit content

1 Understand the principles of object oriented programming

Characteristics of objects: types eg constructors, destructors; classification; features eg inheritance, polymorphism, encapsulation, public classes, private classes, public methods, private methods, message passing; interpreted, open source, common libraries

Variables: public instance variables; private instance variables; static references

Software engineering: features eg modularity, encapsulation, reuse, method overloading, instance variables, classes, abstract classes, interfaces

Classes: characteristics eg identification attributes, control of scope of attributes and methods, inheritance, aggregation, association, polymorphism

2 Be able to design object oriented programming solutions

Development: selection eg identification of programming language, identification of programming libraries, selection of development environment

Design methodology: options eg reuse of existing system, adaptation of code, use of open source

Design method: tools eg class responsibilities collaboration cards, class diagram, identification of dependencies and inheritances, data and file structures.

System delivery: style eg scripted, interpreted, compiled

Programming platform: types eg GUI, script, command line

Delivery environment: types eg mobile, handheld, web based, desktop, dedicated device

Interaction: considerations eg exchange of data with other systems, compliance, compatibility, recognition of standards employed

Design refinement: clarification of a design using principles of maximum coherence and minimum coupling between the classes

3 Be able to implement object oriented programming solutions

Coding: use of conventional language commands; pre-defined eg class library, downloaded, imported, reversion code

Control structures: types eg subroutines, branching, iteration, interrupts, signals

Complexity: inclusion of eg multiple classes, application of inheritance in created code, reuse of objects

IDE: typical elements eg source code editor, compiler, interpreter, build automation tools, debugger

4 Be able to test and document object oriented programming solutions

Testing: mechanisms eg valid declarations, debugging code, comment code, naming conventions, checking functionality against requirements; documentation

Errors: handling eg management of extremes, use of system imposed statements

Impact testing: types eg range testing, input testing, load testing, system compatibility

Onscreen help: methods eg pop-ups, help menu, hot-spots

Documentation: technical documentation to include eg designs, delivery system, platform, environment, file structures, coding, constraints, maintenance requirements

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the principles of object oriented programming	1.1 discuss the principles, characteristics and features of objected oriented programming
LO2 Be able to design object oriented programming solutions	2.1 identify the objects and data and file structures required to implement a given design 2.2 design an object oriented programming solution to a given problem
LO3 Be able to implement object oriented programming solutions	3.1 implement an objected oriented solution based on a prepared design 3.2 define relationships between objects to implement design requirements 3.3 implement object behaviours using control structures to meet the design algorithms 3.4 make effective use of an Integrated Development Environment (IDE), including code and screen templates
LO4 Be able to test and document object oriented programming solutions	4.1 critically review and test an object orientated programming solution 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback on a developed object oriented programme solution and make recommendations for improvements 4.4 create onscreen help to assist the users of a computer program 4.5 create documentation for the support and maintenance of a computer program.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 6: Software Design and Development	Unit 18: Procedural Programming	Unit 35: Web Applications Development
Unit 14: Event Driven Programming	Unit 20: Event Driven Programming Solutions	Unit 39: Computer Games Design Development
Unit 15: Object Oriented Programming	Unit 21: Software Applications Testing	Unit 40: Distributed Software Applications
Unit 16: Procedural Programming	Unit 22: Office Solutions Development	Unit 41: Programming in Java
	Unit 23: Mathematics for Software Development	Unit 42: Programming in .NET

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Software Development.

Essential requirements

Many of the object oriented programming languages are free and accessible. Centres may need to ensure that in the case of mobile platforms the applicable free emulators are available or where security policies dictate, local workstations are equipped with virtualised operating systems containing the programming.

Learners must have access to facilities, which allow them the opportunity to fully evidence all of the criteria of the unit. If this cannot be guaranteed then centres should not attempt to deliver this unit.

Resources

Books

Kaldahl B – *EZ Flash MX: Animation, Action Script and Gaming for Macromedia Flash* (Trafford Publishing, 2004) ISBN 1412006171

Lemay L and Cadenhead R – *Sams Teach Yourself Java 2 in 21 Days, 4th Edition* (Sams, 2004) ISBN 0672326280

Schildt H – *C++: A Beginner's Guide, 2nd Edition* (McGraw-Hill Education, 2003) ISBN 0072232153

Templeman J and Olson A – *Microsoft Visual C++ .NET Step by Step: Version 2003* (Microsoft Press US, 2003) ISBN 0735619077

Websites

<http://java.sun.com/docs/books/tutorial/>

<http://msdn.microsoft.com/en-us/visualc/default.aspx>

Employer engagement and vocational contexts

Working with a local programming-based organisation or using internet-based open source projects would enhance the learners' experience and offer a relevant vocational context.

Unit 23: Mathematics for Software Development

Unit code: D/601/0466

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with an understanding of the underlying mathematical concepts that support the diverse fields supported by software engineers.

- **Unit abstract**

This unit is an introduction to some of the mathematical concepts and techniques that will be required by software engineers. To develop the mathematical skills necessary for software engineering learners must gain a range of mathematical skills, which are often applied in the creation of coded solutions to everyday problems.

The unit will allow the learner to appreciate and prepare for the more advanced concepts of mathematics required in relation to software engineering.

Learners taking this unit will explore areas of mathematics that are used to support programming. It will cover conditional statements, graphics and gaming (geometry and vectors), relationships in databases, the calling of methods (or procedures), matrices in the handling of arrays, large datasets and mapping, statistics, calculus and set theory.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand core mathematical skills for software engineers
- 2 Understand the application of algebraic concepts
- 3 Be able to apply the fundamentals of formal methods
- 4 Be able to apply statistical techniques to analyse data.

Unit content

1 Understand core mathematical skills for software engineers

Algebra: basic notation and rules of algebra; multiplication and factorisation of algebraic expressions involving brackets, algebraic equations and simultaneous linear equations, quadratic equations involving real roots

Geometry: types and properties of triangles, Pythagoras' Theorem, geometric properties of a circle; trigonometry: eg sine, cosine and tangent functions, angular measure

Vectors: representation of a vector by a straight line, equal and parallel vectors, magnitude of a vector, vector addition and subtraction, scalar multiplication, linear transformations, rotations, reflections, translations, inverse transformations, axioms of a vector space

2 Understand the application of algebraic concepts

Relations: domain, range, Cartesian product, universal relation, empty relation, inverse relation, reflexive, symmetric and transitive properties, equivalence relations

Matrices: addition and subtraction, scalar multiplication, matrix multiplication, properties of addition and multiplication of matrices, transpose of a matrix, determinant, identify matrix, inverse of a matrix, condition for a matrix to be singular, solution of simultaneous linear equations

Application in programming: use of variables and operators, using mathematics based commands, arrays, conditional statements, pseudo code, demonstration code

3 Be able to apply the fundamentals of formal methods

Sets: definitions of set and element, representation of sets using Venn diagrams, universal and empty sets, finite and infinite sets, N , Z and R , operations on sets, subsets, notation, predicates; laws of set theory; idempotent, associative, commutative, distributive, identity, involution, complement, De Morgan's laws

Propositional calculus: simple and compound propositions, conjunction, disjunction, negation, implication and bi-implication, truth tables, validity, principle of mathematical induction, logical argument and deductive proof

Boolean laws of propositional calculus: idempotent, associative, commutative, distributive, identity, involution, complement, De Morgan's Laws

4 Be able to apply statistical techniques to analyse data

Techniques: frequency distribution, mean, median, variance, deviation, correlation probability, factorial notation, permutations and combinations, laws of probability, conditional probability, Bayesian Networks

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand core mathematical skills for software engineers	1.1 design a programming solution to a given algebraic problem 1.2 design a programming solution to a given geometric problem 1.3 implement code that presents a range of vectors
LO2 Understand the application of algebraic concepts	2.1 explain how relations link to technologies used in programming 2.2 design a programming solution to solve a given matrix manipulation
LO3 Be able to apply the fundamentals of formal methods	3.1 discuss the application of set theory in computing 3.2 design a programming solution to a given propositional calculus problem
LO4 Be able to apply statistical techniques to analyse data	4.1 design a programming solution to solve a given statistical analysis technique.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 6: Software Design and Development	Unit 18: Procedural Programming	Unit 35: Web Applications Development
Unit 14: Event Driven Programming	Unit 19: Object Oriented Programming	Unit 39: Computer Games Design Development
Unit 15: Object Oriented Programming	Unit 20: Event Driven Programming Solutions	Unit 40: Distributed Software Applications
Unit 16: Procedural Programming	Unit 21: Software Applications Testing	Unit 41: Programming in Java
Unit 26: Mathematics for IT Practitioners	Unit 22: Office Solutions Development	Unit 42: Programming in .NET

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Software Development.

Essential requirements

The programming environment(s) selected must be based on systems already used by the learners so that they are familiar with the systems and commands used.

Learners must have access to facilities, which allow them the opportunity to fully evidence all of the criteria of the unit. If this cannot be guaranteed then centres should not attempt to deliver this unit.

It is important that learners understand the mathematical concept as well as its relationship to software development.

The centre delivering the unit must present suitable geometric, algebraic, matrix, calculus and statistics problems. Problems must support the learning outcomes. Some of these problems may be used as assessment in other programming units, where the problem presented to learners explores a more complex scenario, drawing on the relevant skills.

Evidence for learning outcomes must be achieved through well-planned coursework, assignments and projects.

Resources

Books

Press W et al – *Numerical Recipes 3rd Edition: The Art of Scientific Computing* (Cambridge University Press, 2007) ISBN-10: 0521880688

Press W et al – *Numerical Recipes Source Code CD-ROM 3rd Edition: The Art of Scientific Computing* (Cambridge University Press, 2007) ISBN-10: 0521706858

Golub G, Van Loan C – *Matrix Computations (Johns Hopkins Studies in the Mathematical Sciences)* (John Hopkins University Press, 1996) ISBN-10: 0801854148

Haggarty R – *Discrete Mathematics for Computing* (Addison Wesley, 2001) ISBN-10: 0201730472

Schwartz JT et al – *Set Theory for Computing: From Decision Procedures to Declarative Programming with Sets (Monographs in Computer Science)* (Springer 2001) ISBN-10: 0387951970

Rothenberg R – *Basic Computing for Calculus* (McGraw Hill, 1985) ISBN-10: 007054011X

Websites

www.mathsandcomputing.com/

Employer engagement and vocational contexts

In supporting the outcomes from other units, this unit can be used to support the creation of a software application in a vocational context where part of the application may use one (or more) of the mathematical outputs from this unit.

Unit 27: Network Operating Systems

Unit code: K/601/0468

QCF Level 4: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with the knowledge, skills and techniques necessary to install, configure, troubleshoot and maintain a reliable network operating systems service.

- **Unit abstract**

Modern enterprise organisations rely on the use of a range of network operating systems (NOS), to establish the networking services necessary to run their IT infrastructure. Supporting a NOS is considered one of the primary roles of a professional network administrator. It is part of their duties to identify the NOS as required, undertake the installation and deployment of network servers, and configure, support and maintain the NOS. This may also involve routine administration, the management of systems and user security policies as well as more specific specialist tasks.

This unit will allow learners to install, configure, support and maintain complex NOS and servers. They will learn the skills and knowledge to use the NOS, to provide enterprise users access to the services and resources, in a secure environment, making sure that business data is protected against internal and external attacks or disasters.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand network operating systems principles
- 2 Be able to plan the implementation of network operating systems
- 3 Be able to implement network operating systems
- 4 Be able to manage network operating systems.

Unit content

1 Understand network operating systems principles

NOS: types eg standalone, infrastructure based, cluster based

NOS services: types eg file, web, print, remote access, proxy, terminal services, firewall, access control, infrastructure management, ecommerce

Disaster recovery: backup methodology, data recovery, mirrored systems, virtualisation, UPS (Uninterruptible Power Supply), backup-power supply, off site management, high availability, fault tolerance

NOS selection: open source, proprietary, general purpose, task specific

NOS security: management of updates/patches, anti-virus protection, physical access policies, service access policies, user access policies, policy management, user audits, group audits, continual vetting of access, authentication policies and practice, password policy

2 Be able to plan the implementation of network operating systems

Naming system: method eg registration of server on directory service, infrastructure requirement, issue of local name for server

Addressing: method eg allocation of addresses for NOS services

Installation: preparation eg selection of hardware, memory requirement, standalone, infrastructure, virtual server, storage requirement, disk partitioning, RAID allocation

Service: selection eg file, web, print, remote access, proxy, terminal services, firewall, access control, infrastructure management, ecommerce

Security: policy eg patch management, anti-viral management, access requirement, administrative rights, authentication, password policy

Disaster recovery: policy eg backup methodology, mirrored services, virtualisation, UPS, backup-power supply, off site management, high availability, fault tolerance

3 Be able to implement network operating systems

NOS: installation: eg selection of media, application of NOS to selected installation environment, application of naming system, application of addressing

Service: installation: eg file, web, print, remote access, proxy, terminal services, firewall, access control, infrastructure management, ecommerce

Security: configuration eg installation of updates, installation of anti-viral management, setting of administrative rights, setting of authentication policy, setting of password policy

Disaster recovery: configuration eg mirrored services, virtualisation, UPS, backup-power supply, off site management, high availability, fault tolerance services

Testing: eg access to network, other devices able to access services

4 **Be able to manage network operating systems**

Performance: baseline eg establishing normal performance without load, establishing performance with load

Monitor: performance eg setting up and monitoring event logs, optimising server performance, using performance tools

Updating NOS: eg implementing a security policy and auditing system, applying patches, security updates, reviewing user access, adding new services

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand network operating systems principles	1.1 evaluate types of NOS and NOS services 1.2 discuss the benefit of disaster recovery and NOS security 1.3 critically compare a selection of current NOS's in use
LO2 Be able to plan the implementation of network operating systems	2.1 plan the implementation of a NOS for a required service to meet a given specification 2.2 evaluate the plan and analyse user feedback
LO3 Be able to implement network operating systems	3.1 implement a NOS service based on a prepared plan 3.2 test the NOS to meet user requirements 3.3 document and analyse test results against expected results
LO4 Be able to manage network operating systems	4.1 establish and justify a performance baseline 4.2 monitor NOS performance against the baseline 4.3 justify performance optimisation and update to NOS.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 5: Managing Networks	Unit 2: Computer Systems	Unit 36: Internet Server Management
Unit 9: Computer Networks	Unit 24: Networking Technologies	Unit 43: Networking Infrastructure
Unit 10: Communication Technologies	Unit 25: Routing Concepts	Unit 44: Local Area Networking Technologies
Unit 32: Networked Systems Security	Unit 26: Design a Small or Home Office Network	Unit 45: Wide Area Networking Technologies
	Unit 28: IT Support for End Users	Unit 46: Network Security

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- IT/Technology Infrastructure Design and Planning
- Systems Development
- IT Application Management/Support
- IT/Technology Management and Support.

Essential requirements

Learners must have access to a live or 'detached' network environment to create the network infrastructure and develop their skills; this may also be successfully accomplished using virtual machines.

This is a technical unit, which requires that learners are provided with an appropriate networking environment to allow them to practice all the skills and techniques outlined in the criteria, and to produce the required evidence to prove their competence.

Learners need to be provided with the opportunity to build a computer systems network of at least one client and one server, so they will be in position to install the NOS and configure it for client's access. Learners must also install the networking services and configure them as required. This may be in a contained environment and could be via a training LAN or may be on one system using multiple virtual machine images.

Resources

Books

Barrett D – *Linux Pocket Guide (Pocket Guide: Essential Commands)* (O'Reilly Media, 2004)
ISBN-10: 0596006284

Cisco Inc – *Cisco Networking Academy Program: IT Essentials II - Network Operating System Engineering Journal and Workbook* (Cisco Press, 2003) ISBN-10: 1587130955

Corp – *Microsoft Windows 2000 Network and Operating System Essentials* (iUniverse, 2001)
ISBN-10: 059514814X

Watson R – *Introduction to Operating Systems and Networks* (Prentice Hall, 2003)
ISBN-10: 0131118943

Websites

www.cisco.com

www.howstuffworks.com/operating-system.htm/printable

www.microsoft.com

Employer engagement and vocational contexts

Working with a live system will present many risks, that the centre, employer and learner must be aware of. In using a current vocational context to deploy an additional or alternate solution will enhance the learners' experience and enable understanding of wider technical application.

Unit 33: Data Analysis and Design

Unit code: H/601/1991

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with the knowledge and skills needed to understand, design, query and implement database systems.

- **Unit abstract**

An understanding of database tools and technologies is key to many of today's industries. Database systems are predominant in the world of IT, and continue to demand more complex data structures and interface, as applications get increasingly sophisticated.

Databases provide the infrastructure to many organisations, and they offer support to key business applications and information systems. The most common database model used commercially is the relational one.

The aim of this unit is to provide a knowledge and understanding of database systems including design principles, practical implementation and development skills for both the system designer and software engineer. The importance of structured query languages should be stressed, in terms of how they can be used to manipulate data and how they are used for a variety of tasks including querying and report writing.

On completion of this unit the learner should be able to understand, design, query and implement a database(s). Learners will also have a theoretical insight into the requirement for designing a database that meets a given user or system requirement and that is functional, user friendly and robust.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand data models and database technologies
- 2 Be able to design and implement relational database systems
- 3 Be able to use manipulation and querying tools
- 4 Be able to test and document relational database systems.

Unit content

1 Understand data models and database technologies

Data models: Hierarchical; Network; Relational; data manipulation languages; data definition languages; data independence; data redundancy issues; data integrity; schema; eg tables fields relationships, views, indexes; conceptual scheme; physical scheme, data dictionary.

Approaches: top down and bottom up; tools and techniques eg entity analysis, Entity Relation Diagrams (ERDs), determinancy diagrams, data flow diagrams; entities; attributes and key identifiers; relationship types and enterprise rules; degrees of relationships; functional dependency; first, second and third normal forms

New developments: dynamic storage; data mining and data warehousing; web enabled database applications; other developments eg multimedia databases, document management systems, digital libraries

2 Be able to design and implement relational database systems

Designs: data types; entity and referential constraints; conversion of logical database design to a physical implementation; tools and techniques; issues around the degree of normalisation chosen; verification and validity checks; data definition; control mechanisms

Requirements: requirements specification; relational requirements; other requirements eg need to integrate with legacy systems, future requirements, timescales, costs.

User interface: requirements eg functionality, reliability, consistency, performance, menu driven, HCI interface

3 Be able to use manipulation and querying tools

Data manipulation: query languages; visual tools; typical tasks eg for database maintenance, inserts, updates and amendments

Queries and reporting: query languages and query by example (QBE); formatting; functions/formulae; report writing tools

4 Be able to test and document relational database systems

Control mechanisms. example systems eg TQM(Total Quality Management); connection to requirements specification; sign off procedures.

Testing procedures: test plans; test models eg white box, black box; test documentation; other eg organisational requirements; user documentation eg help menu, pop-ups, hot-spots

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand data models and database technologies	1.1 critically compare different data models and schemas 1.2 critically discuss the benefits and limitations of different database technologies 1.3 analyse different approaches to database design
LO2 Be able to design and implement relational database systems	2.1 design a relational database system to meet a given requirement 2.2 build a relational database system based on a prepared design 2.3 apply a range of database tools and techniques to enhance the user interface
LO3 Be able to use manipulation and querying tools	3.1 explain the benefits of using manipulation and query tools in a relational database system 3.2 implement a query language into the relational database system 3.3 critically evaluate how meaningful data has been extracted through the use of query tools
LO4 Be able to test and document relational database systems	4.1 critically review and test a relational database system 4.2 create documentation to support the implementation and testing of a relational database system 4.3 create user documentation for a developed relational database system 4.4 explain how verification and validation has been addressed 4.5 explain how control mechanisms have been used.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 21: Data Analysis and Design	Unit 17: Database Design Concepts	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Data Analysis
- Data Design.

Essential requirements

Learners must have access to database software.

Resources

Books

Avison D and Fitzgerald G – *Information Systems Development: Methodologies, Techniques and Tools* (McGraw Hill Higher Publishing Company, 2006) ISBN 0077114175

Chao L – *Database Development and Management* (CRC Press, 2006) ISBN 0849392381

Connolly T and Begg C – *Database Systems: A Practical Approach to Design, Implementation and Management* (Addison Wesley, 2004) ISBN 0321210255

Howe D – *Data Analysis for Database Design* (Butterworth-Heinemann Ltd, 2001) ISBN 0750650869

Kroenke D – *Database Concepts, 2nd Edition* (Prentice Hall, 2004) ISBN 0131451413

Ponniah P – *Database Design and Development: An Essential Guide for IT Professionals: Visible Analyst Set* (John Wiley & Sons Inc, 2006) ISBN 0471760943

Ritchie C – *Relational Database Principles* (Thomson Learning, 2002) ISBN 0826457134

Websites

www.deeptraining.com/litwin/dbdesign/FundamentalsOfRelationalDatabaseDesign.aspx

www.geekgirls.com/menu_databases.htm

www.smart-it-consulting.com/database/progress-database-design-guide/

Employer engagement and vocational contexts

To further enrich the content of this unit and to provide more of a vocational context it would be beneficial to bring in guest speakers, such as database designers, end users and administrators to discuss their role within an organisation(s) and the importance of good database design.

Unit 34: Data Structures and Algorithms

Unit code: H/601/1456

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

This unit provides learners with an understanding of how data structures are used in algorithms and enables them to design and implement data structures.

- **Unit abstract**

The unit starts by introducing abstract data types and explores their use in data structures. Based on this knowledge and understanding, learners should be able to develop solutions, using data structures for a range of commercial needs. Data structures may be implemented using a variety of programming paradigms and learners may use one or more areas for their implementations.

Finally, learners will research commercial applications that incorporate data structures and evaluate their use.

On completion of this unit the learner should be able to design and implement a variety of data structures and be able to evaluate different algorithms that implement data structures.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand data structures and algorithms
- 2 Be able to implement data structures and algorithms
- 3 Understand how strings are structured and processed.

Unit content

1 Understand data structures and algorithms

Data structures: array; set; stack; queue; list; tree; types eg active, passive, recursive.

Operations: types eg create, empty, push, pop, insert, delete, search, sort.

Design specification: using non-executable programme specification language eg pseudo code; issues eg complexity in software development; interfaces; information hiding.

Creation: pre-conditions, post-conditions, error-conditions.

Algorithms: sort eg insertion, quick, shell, merge, heapsort, selection sort; search eg linear, binary, binary search tree; recursive eg binary tree traversals (preorder, inorder, postorder).

2 Be able to implement data structures and algorithms

Implementation: sorting, searching and recursive algorithms; using eg arrays (single and/or multi dimensional), handle, pointer, class, methods; using an executable programming language.

3 Understand how strings are structured and processed

String: structure eg sequence of characters, data type, character encoding.

Operations: types eg concatenation, find character, length, lowercase, substring, trim.

Algorithms: processing eg string searching, string sorting, string manipulation.

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand data structures and algorithms	1.1 produce design specification for data structures explaining the valid operations that can be carried out on the structures 1.2 explain the operation and performance of sorting and search algorithms 1.3 explain the operation of recursive algorithms and identify situations when recursion is used
LO2 Be able to implement data structures and algorithms	2.1 implement data structures in an executable programming language in the context of well-defined problems 2.2 implement opportunities for error handling and reporting 2.3 test results to enable comparison with expected results
LO3 Understand how strings are structured and processed	3.1 explain common string operations and their practical applications 3.2 demonstrate the outcome of string operations in specified algorithms.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
	Unit 18: Procedural Programming	Unit 40: Distributed Software Applications
	Unit 19: Object Oriented Programming	Unit 41: Programming in Java
	Unit 20: Event Driven Programming Solutions	Unit 42: Programming in .NET
	Unit 21: Software Applications Testing,	
	Unit 22: Office Solutions Development	
	Unit 23: Mathematics for Software Development	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Data Design
- Software Development.

Resources

Books

Goodrich M, Tamassia R – *Data Structures and Algorithms in C++* (Wiley, 2010)
ISBN-10: 0470383275

Goodrich M, Tamassia R – *Data Structures and Algorithms in Java* (Wiley, 2005)
ISBN-10: 0471738840

Melhorn K, Sanders P – *Algorithms and Data Structures: The Basic Toolbox* (Springer, 2008)
ISBN-10: 3540779779

Websites

<http://ww3.datastructures.net>

<http://www.itl.nist.gov/div897/sqg/dads/>

Employer engagement and vocational contexts

To further enrich the content of this unit and to provide more of a vocational context it would be beneficial to bring in programmers or designers from organisations that have engaged with data structures and algorithms within their systems.

Unit 35: Web Applications Development

Unit code: K/601/1510

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

To enable learners to understand the concepts of web applications and apply the skills to develop and test web applications using server-side technologies.

- **Unit abstract**

The internet has emerged as a dominating area of IT development. The ever-expanding applications within the global community that communicates, trades and exchanges information (seamlessly) has meant that the Internet and its associated technologies is a rapidly growing and changing area that requires in-depth knowledge as well as a wide range of skills. These web technologies have also been used to develop e-Commerce, intranet, extranet and social networking systems to meet the needs of modern businesses and associations.

Learners should already be familiar with website design and management, and will be able to apply their own web development skills to this unit. Learners will enjoy extending their web-development skills by understanding the concepts of web-based applications using server-side technologies. This unit takes client-side web-development one step further by introducing server-side application development. This unit focuses on server-side technologies and how server-side scripting can be used to create sophisticated web-based applications.

Learners will understand the concepts of web-based applications using one or more different server-side scripting languages, such as ASP, JSP and PHP. Many web-based systems also include database systems, which enables data to be processed dynamically. Learners will gain experience of developing web-enabled database systems, using SQL statements combined with server-side scripts to manage the process of information.

Learners will develop skills in specific techniques and also able to select when and where they are most appropriate, basing this decision on client and user needs. They will also ensure that their applications comply with the relevant legislation and guidelines.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the concepts of web application development
- 2 Be able to design web applications
- 3 Be able to implement web applications
- 4 Be able to test web applications.

Unit content

1 Understand the concepts of web application development

Users: types eg expert, regular, occasional, novice, special needs; requirements, eg psychological, cultural, social and environmental, health and safety, education and work

Site analysis: purpose eg communication, real-time information, commercial, government, education, business, entertainment, downloading/uploading, web storage; fit for purpose, eg meets organisational and site objectives; planning, eg storyboarding, structure, hypermedia linkage, search engine key words, graphical design, user interface, audio/video sources, animation, text design; maintenance, eg plans, logs, disaster recovery, testing

Accessibility: features eg alternative text, resizable fonts, support for screen readers, adjustable fonts

Legislation: laws, guidelines and standards, eg Disability Discrimination Act, Data Protection Act, E-Commerce Regulations Act, W3C validation, copyright and intellectual property rights

Functionality: functions, eg shopping cart, reserve order, manage user profile, web content management, upload files

Scripting languages: server-side eg ASP (Active Server Pages), ASP.NET, PHP (Hypertext Preprocessor), JSP (Java Server Pages), Cold Fusion, Perl, Java Applet, Flash; advantages eg faster processing time, data processing, data storage; client-side eg JavaScript, VBScript

Security: security requirements, eg user accounts, account restrictions, procedures for granting and revoking access, terms of use, system monitoring

2 Be able to design web applications

Identification of need: nature of interactivity eg online transactions, static versus dynamic; client needs and user needs, eg image; level of security, eg user/administrator access; development timescales, support and maintenance contracts, costs, visibility on search engines; end user need eg appropriateness of graphics, complexity of site, delivery of content

Design tools: concept designing, eg mood boards, storyboarding; layout techniques eg frames, tables, block level containers (DIV), inline containers (SPAN); templates; colour schemes; screen designs, use case diagrams, pseudo code; other eg outline of content; database design, eg data flow diagrams, entity relationship diagrams

Database design: documenting the design; back end design, eg defining relationships, normalisation, naming conventions; front end design, eg user interface, security measures

3 Be able to implement web applications

Structure: layout of pages; navigation; format of content and cascading style sheets (CSS); page elements, eg headings, rules, frames, buttons, text and list boxes, hyperlinks/anchors, graphical images, clickable images/maps; interactive features, eg catalogue of products, shopping cart; images and animation

Content: proofed, correct and appropriate; reliability of information source; structured for purpose, eg prose, bullets, tables

Development: mark-up languages eg HTML (Hypertext Mark-up Language), DHTML (Dynamic Hypertext Mark-up Language); client-side scripting languages eg JavaScript, VBScript; features and advantages of software languages; web authoring software tools

Tools and techniques: navigation diagram eg linear, hierarchy or matrix; building interactivity tools, eg pseudo-code for client-server scripting; adding animation and audio/visual elements; ensuring compliance with W3C; meta-tagging; cascading style sheets

Server-side interaction: manage and process data, eg client, server; action events, action responses, login/logout

Server-side scripting languages: ASP, JSP, PHP, Cold Fusion, Perl

Database connectivity: common methods of using/accessing databases on a web server eg SQL (Structured Query Language), MySQL, ODBC (Open Database Connectivity), JDBC (Java Database Connectivity), ADODB (ActiveX Data Objects).

Web-programming concepts: objects, eg response, request, application, session, server, error, file system, text stream, drive, file, folder, dictionary, ADO; components, eg email, file, file uploads, date/time; syntax, variables, procedures, forms, cookies, sessions, applications.

4 Be able to test web applications

Review: functionality testing (user environments, links and navigation); content; check against user requirements; user acceptance; audit trail of changes.

Mechanisms: browser compatibility testing, platform testing, script-language testing; valid HTML, server-script and database-script code; checking functionality against requirements, check internal and external hyperlinks to other web pages and media content (web files, web documents, images), error detection, error messages, dry running.

Feedback: record feedback, eg surveys, questionnaire, interviews; analyze feedback; present results

Supportive documentation: test plan (test data, expected results, actual results); test results; programmer guidance; user guidance (instructions)

Testing by: types eg administrator, user, automated scripts.

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the concepts of web application development	1.1 critically evaluate the functions and advantages of web applications 1.2 critically compare different types of server-side and client-side scripting languages 1.3 examine web security concerns and make recommendations for security improvements
LO2 Be able to design web applications	2.1 design a web application to meet a given requirement 2.2 synthesise client-side and server-side functionality in a web application 2.3 apply a database design for use in a web application 2.4 evaluate alternative designs and solutions to meet a given requirement
LO3 Be able to implement web applications	3.1 implement a web application to a prepared design using client-side and server-side scripting languages 3.2 implement a web-enabled database management system to store, retrieve and manipulate data in a web application 3.3 identify and implement opportunities for error handling and reporting
LO4 Be able to test web applications	4.1 critically review and test a web application using a web-enabled database management system 4.2 analyse actual test results against expected results to identify discrepancies 4.3 critically evaluate independent feedback on a developed web application and make recommendations for improvements 4.4 create user documentation for a developed web application.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
	Unit 14: Website Design	Unit 39: Computer Games Design and Development
	Unit 15: Website Management	Unit 40: Distributed Software Applications
	Unit 18: Procedural Programming	Unit 41: Programming in Java
	Unit 19: Object Oriented Programming	Unit 42: Programming in .NET
	Unit 20: Event Driven Programming Solutions	
	Unit 21: Software Applications Testing	
	Unit 22: Office Solutions Development	
	Unit 23: Mathematics for Software Development	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Human Computer Interaction
- IT/Technology Infrastructure Design and Planning
- Software Development.

Essential requirements

Learners will need access to a web server with any required software installed and configured eg Apache, PHP, IIS, ASP, in and outside of a classroom environment.

Learners must have access to facilities which will give them the opportunity to fully evidence all of the criteria in the unit. Learners must already be equipped with the fundamental skills of website design, development and management using client-side technologies.

Learners must be introduced to the fundamentals of web-based programming, and see examples of how web-based applications are developed using different server-scripting languages, such as ASP, JSP or PHP. Learners must also understand how data is processed between client, server and database systems, and recognise the flow of information. Database systems are also a fundamental aspect of web-application development, and learners must know how these systems are integrated.

Once the understanding and knowledge coverage has been achieved, learners are in a position to start developing their own web-based applications. Similarly to website development, learners need to be able to show that they can apply design skills first before building a web-based application.

Learners must be taught the required programming and database skills given in the unit content to enable them to develop a web-based application, which fulfils the assessment criteria. Learners will need to understand the fundamentals of SQL, and integrate a database system into their web-based application.

Evaluation and review continues to be an important theme throughout the web development units, and learners must be encouraged to evaluate throughout the entire process of creating a web-based application. Thorough testing must be performed on their web-based application, to ensure that it is fit for purpose and meets the requirements/specification.

Resources

Books

Hurwitz D, MacDonald B – *Learning ASP.NET 3.5* (O'Reilly Media, 2008) 978-0596518455

Nixon R – *Learning PHP, MySQL, and JavaScript* (O'Reilly Media, 2009) 978-0-596-15713-5

Parsons D – *Dynamic Web Application Development Using XML and Java* (Thompson Learning, 2008) ISBN-10: 1844805417

Schwartz R et al – *Learning Perl* (O'Reilly Media, 2008) ISBN-10: 0596520107

Stobart R – *Dynamic Web Application Development Using PHP and MySQL* (Thompson Learning, 2008) ISBN-10: 1844807533

Websites

W3Schools Online Web Tutorials – www.w3schools.com

Employer engagement and vocational contexts

Working with a local web design/development-based organisation or using internet-based open source projects would enhance the learners' experience and offer a relevant vocational context.

Unit 41: Programming in Java

Unit code: F/601/1528

QCF Level 5: BTEC Higher National

Credit value: 15

● Unit aim

To provide learners with an understanding of the principles of programming in Java, exploring the object oriented nature of the language and the multi-platform versatility offered.

● Unit abstract

Object oriented programming is an industry-proven method for developing reliable modular programs and is popular in software engineering and systems development. Consistent use of object oriented techniques can lead to shorter development lifecycles, increased productivity, adaptable code, reuse of different technologies, the interaction of different systems using common platforms and therefore lower the cost of producing and maintaining systems.

Java is synonymous with the object orient paradigm offering all the features of the technology in a format that can be used on many differing systems. The development of systems with Java objects simplifies the task of creating and maintaining complex applications.

Many environments use Java as its 'underpinning' framework, with Java applications found on mobile phones, dedicated systems, web-based multimedia, security and control systems as well as traditional applications and bespoke operating systems.

Learners taking this unit will have the opportunity to develop their understanding of the Java programming language and develop code suited to a range of platforms. The unit is not specific to one instance of the Java programming language and may be used to deploy, among others, mobile applications, bespoke applications or web-based solutions.

● Learning outcomes

On successful completion of this unit a learner will:

- 1 Understand the principles of programming in Java
- 2 Be able to design Java solutions
- 3 Be able to implement Java solutions
- 4 Be able to test and document Java solutions.

Unit content

1 Understand the principles of programming in Java

Characteristics: Java Virtual Machine (JVM); Java platform; classed-based; object-oriented; compilers; class libraries; applications; applets; object models; enforced error handling; concurrency; threads, multi-platform

Reasons for choice of language: organisational policy; suitability of features and tools; availability of trained staff; reliability; development and maintenance costs; expandability

Object models: inheritance; polymorphism; encapsulation; public classes; private classes; public methods; private methods

Data structures: public instance variables; private instance variables; naming conventions; arrays (one-dimensional, two-dimensional); file structures; loops eg conditional (pre-check, post-check, break-points), fixed; conditional statements; case statements; logical operators; assignment statements; input statements; output statements

Data types: constants and literals; integer; floating point; byte; date; boolean; others eg character, string, small int; choice of data types eg additional validation, efficiency of storage

Environment: features eg interpreted, run time environment, system specific libraries

Programming syntax: features eg command rules, variable declaration, class/method declaration

Standards: features eg use of comments, code layout, indentation

2 Be able to design Java solutions

Requirements specification: overview eg inputs, outputs, processing, user interface; constraints eg hardware platforms, timescales for development; delivery environment eg mobile, hand-held, web based, desktop; interaction eg data exchange, compliance, compatibility, standards

Program design: tools eg structure diagrams, data flow diagrams, entity relationship models, flow charts, pseudo code, class diagrams, class responsibilities, collaboration cards; inheritance

Technical documentation: requirements specification; others as appropriate to language eg form design, flowcharts, pseudo code, structured English, action charts, data dictionary, class and instance diagrams

3 Be able to implement Java solutions

Classes: features eg identification attributes, methods, control of scope of attributes and methods, inheritance, aggregation, association, polymorphism

Programming: use of conventional language commands; use of library classes; pre-defined eg class libraries, downloaded, imported

Complexity: multiple classes; inheritance; reuse of objects; application of polymorphism

4 Be able to test and document Java solutions

Mechanisms: methods eg valid declarations, debugging code, checking naming conventions, checking functionality against requirements, error detection, error messages, compiler errors, runtime errors, in code response, dry running

Feedback: record feedback, eg surveys, questionnaire, interviews; analyze feedback; present results

Supportive documentation: test plan; test results; programmer guidance; user guidance

Review: design against specification requirements, interim reviews

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will	Assessment criteria for pass The learner can
LO1 Understand the principles of programming in Java	1.1 discuss the principles, characteristics and features of programming in Java 1.2 critically evaluate the environmental flexibility of programming in Java
LO2 Be able to design Java solutions	2.1 design a Java programming solution to a given problem 2.2 explain the components and data and file structures required to implement a given design
LO3 Be able to implement Java solutions	3.1 implement a Java programming solution based on a prepared design 3.2 define relationships between objects to implement design requirements 3.3 implement object behaviours using control structures to meet the design algorithms 3.4 identify and implement opportunities for error handling and reporting 3.5 make effective use of an Integrated Development Environment (IDE) including code and screen templates
LO4 Be able to test and document Java solutions	4.1 critically review and test a Java programming solution 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback on a developed Java program solution and make recommendations for improvements 4.4 create user documentation for the developed Java program solution 4.5 create technical documentation for the support and maintenance of a Java program solution.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 6: Software Design and Development	Unit 18: Procedural Programming	Unit 39: Computer Games Design and Development
Unit 14: Event Driven Programming	Unit 19: Object Oriented Programming	Unit 40: Distributed Software Applications
Unit 15: Object Oriented Programming	Unit 20: Event Driven Programming Solutions	Unit 42: Programming in .NET
Unit 16: Procedural Programming	Unit 21: Software Applications Testing	
	Unit 22: Office Solutions Development	
	Unit 23: Mathematics for Software Development	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- Software Development.

Essential requirements

Whilst some procedural languages are commercially available, there are also free languages available incorporating a diverse range of commands, commonly deployed on many platforms. Centres must ensure that in the case of mobile platforms, the applicable free emulators are available.

Learners must have access to facilities, which allow them the opportunity to fully evidence all of the criteria of the unit. If this cannot be guaranteed then centres should not attempt to deliver this unit.

Learners must develop an application that may be event driven, an applet, or command line driven and it may work on a range of platforms. It may be web based, GUI based, a games console or a deliverable for a mobile platform amongst many other solutions.

Centres must use a range of design methodologies, ensuring that the method selected is suited to the environment selected as well as the programming language of choice. Implementation must be based on a suitably structured problem that ensures the use of Java elements. Centres must select a programming activity, or use an external source (employer, commissioner, open source).

Resources

Books

Bloch J – *Effective Java, Second Edition* (Prentice Hall, 2008) ISBN: 0321356683

Goetz B – *Java Concurrency in Practice* (Addison Wesley, 2006) ISBN: 0321349601

Niemeyer P – *Learning Java, Third Edition* (O'Reilly, 2005) ISBN: 0596008732

Websites

<http://java.sun.com/docs/books/tutorial/>

<http://math.hws.edu/javanotes/>

www.idevelopment.info/data/Programming/java/PROGRAMMING_Java_Programming.shtml

Employer engagement and vocational contexts

Working with a local programming-based organisation or using internet-based open source projects would enhance the learners' experience and offer a relevant vocational context.

Unit 44: Local Area Networking Technologies

Unit code: L/601/1547

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with an understanding of Local Area Network (LAN) technologies and the delivery of a wide range of networked services across a LAN infrastructure.

- **Unit abstract**

LANs have become ubiquitous in all but the smallest of enterprises and their implementation has become the realm of skilled designers if the best advantage is to be made of available technology. Whilst it is now the case that simple networks can often be installed by users with little previous knowledge, the design, implementation, testing and management of extended LANs requires considerable technical knowledge.

The impact of LANs across an organisation can require upskilling of staff, changes to the physical environment and changes to commercial procedures. It also requires changes to the access, security and ownership of the data which passes across the LAN. In this unit learners will understand that consideration must be given to not only the physical LAN but the organisational culture as a whole.

Learners will understand the importance of considering both physical and logical environments including network addressing, best use of media, and network segmentation. Learners will also study Quality of Service (QoS) in order to best manage the network traffic. Once a LAN is installed and operational learners will study methods of measuring and maintaining performance in a proactive manner using a range of tools.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the impact of LAN technologies
- 2 Be able to design LAN infrastructures
- 3 Be able to implement LAN infrastructures
- 4 Be able to manage LAN infrastructures.

Unit content

1 Understand the impact of LAN technologies

LAN technologies: standards eg IEEE 802 LAN standards, IEEE 802.11 wireless standards, STP (Spanning Tree Protocol), VLANs (Virtual LAN), VTP (VLAN Trunking Protocol), standby routing, ether channel, ISL (Inter Switch Link), DHCP (Dynamic Host Configuration Protocol); LAN hardware: eg layer 2 switches, layer 3 switches, layer 4 switches, wireless devices, network interfaces, client devices

Traffic intensive services: quality of service management eg DSCP (Differentiated Service Code Point), IP precedence, queues, base rules, 802.1q frame tagging; quality of service need eg Voice over IP, video streaming, audio streaming;

LAN security: security need eg VLANs, switch port control, ACLs (Access Control Lists), MAC-ACL's, MAC (Media Access Control) address filtering, wireless security, port spanning

2 Be able to design LAN infrastructures

Devices: expected average number and types of devices on system; anticipated participation

Bandwidth: expected average load; anticipated peak load; cost constraint

Users: quality expectations, concept of system growth

Applications: security requirements, quality of service needs, redundancy

Communications: suited to devices, suited to users, supportive of quality of service

Scalable: able to support device growth, able to support addition of communication devices, able to cope with bandwidth use and trend change

Security: device access, VLAN membership, traffic management, system monitoring

Traffic intensive services: application of rules, prioritisation

Technology: VLAN design, STP design, DHCP address allocation design, wireless infrastructure design

3 Be able to implement LAN infrastructures

Devices: installation of communication device, allocation of addresses, local client configuration

Services: directory, authentication, DNS (Domain Name Service), email, network file, printing

Specialised configuration: VLAN, VTP, standby, ether channel, STP

Security: ACLs, VLAN membership

Traffic management: system monitoring, traffic intensive services, traffic precedence

Connectivity: suitable bandwidth, cabling, wireless infrastructure

Testing: external access eg WAN access, access to internet; security; bandwidth

4 Be able to manage LAN infrastructures

LAN performance: network monitoring tools, user access, traffic analysis, bandwidth monitoring, checking configuration, checking rules

LAN issues: using troubleshooting methodology; proving resolution

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the impact of LAN technologies	1.1 critically evaluate different LAN technologies 1.2 critically analyse traffic intensive services and their performance 1.3 discuss LAN concerns and make recommendations to sustain network security, reliability and performance
LO2 Be able to design LAN infrastructures	2.1 design a LAN infrastructure to meet a given requirement 2.2 critically evaluate the suitability of LAN components
LO3 Be able to implement LAN infrastructures	3.1 build and configure a LAN (including services) to meet a given requirement 3.2 implement network security on a LAN 3.3 critically review and test a LAN
LO4 Be able to manage LAN infrastructures	4.1 monitor and troubleshoot a LAN 4.2 resolve LAN issues to improve security, reliability and performance 4.3 critically evaluate the performance of a LAN.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 5: Managing Networks	Unit 24: Networking Technologies	Unit 45: Wide Area Networking Technologies
Unit 9: Computer Networks	Unit 25: Routing Concepts	Unit 46: Network Security
Unit 10: Communication Technologies	Unit 26: Design a Small or Home Office Network	
Unit 32: Networked Systems Security	Unit 27: Network Operating Systems	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- IT/Technology Infrastructure Design and Planning
- IT/Technology Service Operations and Event Management
- IT/Technology Management and Support
- Change and Release Management.

Essential requirements

Learners must have access to a live or 'detached' network environment to create the network infrastructure and develop their skills; this may also be successfully accomplished using virtual machines.

Learners must have access to facilities, which allow them the opportunity to fully evidence all of the criteria of the unit. If this cannot be guaranteed then centres should not attempt to deliver this unit.

Evaluation of current systems and solutions, commercial practices, social conditions and the culture surrounding the system in use is of as much importance as delivering work supporting potential understanding of the technological systems the and the services they offer.

Learners must have access to a range of suitable networking hardware (eg hubs, switches, routers) and software (eg operating systems, management and utility software) as it is important to undertake as many practical activities as possible to reinforce theoretical learning. There are many virtual, emulated and simulated systems that now support delivery. If used they must contain the elements pertinent to the core of this qualification unit to assure delivery.

Resources

Books

Cisco Networking Academy – *CCNA Exploration Course Booklet: LAN Switching and Wireless, Version 4.0* (Cisco Press, 2009) ISBN-10: 1587132540

Dean T – *CompTIA Network+ 2009 In Depth* (Delmar, 2009) ISBN-10: 1598638785

Xiao Y, Pan Y – *Wireless LANs and Bluetooth* (Nova Science, 2005) ISBN-10: 1594544328

Websites

www.cisco.com

www.wb.nic.in/nicnet/lan1.html

Employer engagement and vocational contexts

Working with a live system will present many risks, that the centre, employer and learner must be aware of. Using a current vocational context to deploy an additional or alternate solution will enhance the learners' experience and enable understanding of wider technical application.

Unit 45: Wide Area Networking Technologies

Unit code: F/601/1562

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with an understanding of Wide Area Network (WAN) technologies and the delivery of a wide range of networked services across a WAN infrastructure.

- **Unit abstract**

WANs such as the internet have become a part of everyday life with many commercial, educational and governmental organisations having ownership or access to a WAN infrastructure. Many home and small business users broadband/ADSL (Asymmetric Digital Subscriber Line) connections are part of a WAN infrastructure supplied by their Internet Service Provider, where in many cases, the WAN precedes the direct connection to the internet.

The impact of a WAN across an organisation includes the up-skilling of staff, changes to the physical environment and changes to commercial procedures. It also requires changes to the access, security and ownership of the data which passes across the WAN. In this unit learners will understand that consideration must be given to not only the physical WAN but the organisational culture as a whole.

Learners will understand the importance of considering how WAN devices communicate and 'learn' about other devices and the changing topology. They will also explore communication speed and traffic management issues relating to the Quality of Service (QoS) of data delivery.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the impact of WAN technologies
- 2 Be able to design WAN infrastructures
- 3 Be able to implement WAN infrastructures
- 4 Be able to manage WAN infrastructures.

Unit content

1 Understand the impact of WAN technologies

WAN technologies: eg dial-up, ADSL (Asymmetric Digital Subscriber Line) and all derivatives, broadband, frame relay, ISDN (Integrated Services Digital Network), MPLS (Multiprotocol Layer Switching), interior routing protocols, exterior routing, static routing; WAN hardware: eg routers, layer 2 aggregators, servers, cabling systems, modems, transceivers, satellite uplinks, 3G, 4G, VPN concentrators

Traffic intensive services: quality of service management eg DSCP (Differentiated Service Code Point), IP precedence, queues, base rules, congestion management; quality of service need eg Voice over IP, video streaming, audio streaming;

WAN security: eg MD5 hash (Message Digest algorithm 5), broadcast reduction, filters, traffic rules, firewalls, access control lists, directed updates, tunnelling

Trust: trust of intermediary system; trust of remote systems; trust of networks on WAN

2 Be able to design WAN infrastructures

Devices: expected average number of devices on system; anticipated participation

Bandwidth: expected average load; anticipated peak load; cost constraint

Users: quality expectations, concept of system growth

Applications: security requirements, quality of service needs, redundancy

Communications: suited to devices, suited to users, supportive of quality of service

Scalable: eg able to support network growth, able to support addition of communication devices, able to cope with bandwidth use and trend change

Security: network access, protocol management, peer authentication, tunneling across untrusted domains

Technology: network design, routing table reduction, protocol management

3 Be able to implement WAN infrastructures

Devices: eg installation of communication devices allocation of networks, communication device configuration

Services: DNS (Domain Name Service), email, web, video, application

Specialised configuration: eg routing protocol, interfaces, network address allocation, security features, security ACLs, MD5 authentication, tunnel creation

Traffic management: system monitoring, traffic intensive, traffic precedence

Connectivity: suitable bandwidth, communication infrastructure, throughput

Testing: local systems able to inter-communication; security; bandwidth

4 Be able to manage WAN infrastructures

WAN performance: network monitoring tools, user access, traffic analysis, bandwidth monitoring, checking configuration, checking rules

Resolve WAN issues: using troubleshooting methodology; prove resolution

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the impact of WAN technologies	1.1 critically evaluate different WAN technologies 1.2 critically analyse traffic intensive services and their performance 1.3 discuss WAN concerns and make recommendations to sustain network security, reliability and performance 1.4 critically evaluate different trust systems on a WAN
LO2 Be able to design WAN infrastructures	2.1 design a WAN infrastructure to meet a given requirement 2.2 critically evaluate the suitability of WAN components
LO3 Be able to implement WAN infrastructures	3.1 build and configure a WAN (including services) to meet a given requirement 3.2 implement network security on a WAN 3.3 critically review and test a WAN
LO4 Be able to manage WAN infrastructures	4.1 monitor and troubleshoot a WAN 4.2 resolve WAN issues to improve security, reliability and performance 4.3 critically evaluate the performance of a WAN.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 5: Managing Networks	Unit 24: Networking Technologies	Unit 44: Local Area Networking Technologies
Unit 9: Computer Networks	Unit 25: Routing Concepts	Unit 46: Network Security
Unit 10: Communication Technologies	Unit 26: Design a Small or Home Office Network	
Unit 32: Networked Systems Security	Unit 27: Network Operating Systems	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- IT/Technology Infrastructure Design and Planning
- IT/Technology Service Operations and Event Management
- IT/Technology Management and Support
- Change and Release Management.

Essential requirements

Learners must have access to a live or 'detached' network environment to create the network infrastructure and develop their skills. This may also be successfully accomplished using virtual machines.

Learners must have access to facilities, which allow them the opportunity to fully evidence all of the criteria of the unit. If this cannot be guaranteed then centres should not attempt to deliver this unit.

Evaluation of a current systems and solutions, commercial practices, social conditions and the culture surrounding the system in use is of as much importance as delivering work supporting potential understanding of the technological systems the and the services they offer.

Learners must have access to a range of suitable networking hardware and as it is important to undertake as many practical activities as possible to reinforce theoretical learning. There are many virtual, emulated and simulated systems that now support delivery; they must contain the elements pertinent to the core of this qualification unit to assure delivery.

Resources

Books

Reid A – *WAN Technologies CCNA 4 Companion Guide* (Cisco Press, 2006) ISBN-10: 1587131722

Websites

<http://www.networktutorials.info/>

Employer engagement and vocational contexts

Working with a live system will present many risks, that the centre, employer and learner must be aware of. Using a current vocational context to deploy an additional or alternate solution will enhance the learners' experience and enable understanding of wider technical application.

Unit 46: Network Security

Unit code: D/601/1956

QCF Level 5: BTEC Higher National

Credit value: 15

- **Aim**

To provide learners with opportunities to manage, support and implement a secure network infrastructure for a commercial LAN or WAN environment.

- **Unit abstract**

ICT professionals managing a complex network infrastructure for a large corporate entity, as well as individuals maintaining small systems or personal access, all have to contemplate and implement a variety of network security intrusion prevention and detection methods.

Attacks evolve and threats change as systems increase in speed, capacity and use and as technologies change. The network security expert needs to ensure their skills remain current and maintain an understanding of the technological issues along with the social and commercial impact.

This unit explores the social impact of network security, and by designing a network security solution learners will understand the importance of enabling the IT user to remain safe whilst being able to use the system without unreasonable restrictions.

Learners will research, design and implement secure environments protecting IT systems and therefore individuals from attack. The protection will include intrusion detection and prevention, user and resource access management and the maintenance of malware defence. Learners will implement a proposed networked security solution, and manage the implemented solution.

- **Learning outcomes**

On successful completion of this unit a learner will:

- 1 Understand the impact on the social and commercial environment of network security design
- 2 Be able to design network security solutions
- 3 Be able to implement network security solutions
- 4 Be able to manage network security solutions.

Unit content

1 Understand the impact on the social and commercial environment of network security design

Threats: management of threats eg awareness, current threats, patches, updates, access policies, maintenance of systems, expertise management

Social impact: organisation trust eg data credibility, good will, corporate trust, financial trust; individual impact; corporate impact; social engineering; public relations management; law enforcement involvement

Security policy: review and management eg access to systems, establishment and review of personal, corporate and technical trust; vetting of staff; forensic analysis of systems

Impact on productivity: loss eg systems recovery, data recovery, loss of good will, loss of custom, loss of services; systemic review; legal proceedings

Estimating risk: penetration testing; audits eg internal and external; procedures eg establishment of baseline operating model, contingency planning, scrutiny and due diligence, vetting of contractors and commercial partners

2 Be able to design network security solutions

LAN design: technical response eg STP (Spanning Tree Protocol) prioritisation, MAC control, VLAN (Virtual Local Area Network) security, ARP (Address Resolution Protocol) poisoning, client access, wireless, device trust; VLAN design; trunk design; segregation of LAN segments

WAN design: technical response eg routing protocol authentication, access control lists, route maps, passive interfaces, traffic filters, network segregation, DMZ (Demilitarised Zone) management

Server deployment: security needs according to server specification eg printer access, file management, data management, email

Border systems: Intrusion Detection Systems (IDS) eg firewalls filters and rules, email monitoring, application and packet monitoring, signature management, trust, network behavioural norms; access control eg traffic filters, route redirection

User access: user group eg group membership, user group allocation, attribution of rights; user eg personal attribution of rights, continual review of rights allocation; rights eg file, server, service, data, hardware, printer, email

Physical security: power resilience and supply; physical access control eg lock and key, electronic access control, personnel based security, biometrics; hardware and systems redundancy; backup eg data, configuration, imaging; recovery policies

3 Be able to implement network security solutions

Core systems: components eg servers, switch systems, router systems, firewalls

Communication: methods eg routing protocols, STP, hash exchanges, VLANs, dot1q

Cryptography: tunnelling eg GRE, VPN; key exchange methodology; crypto method eg RSA, IPSec, ISAKMP, IKE, DES, 3DES

Intrusion detection: precautions eg establishment of signatures, establish network behavioural norms

Intrusion prevention: tools eg firewalls, access control, traffic filters

Malware: policy levels eg desktop, server, router; virus definition deployments

Rights: access eg user, group, network, device, VLAN, address range, file, database, time based

Testing: systematic; type eg port, address, protocol, load, access, known exploits

4 Be able to manage network security solutions

User access: physical access; systems access

Environment testing: security audits; penetration testing

Policy review: access policy review; periodic review of user access (physical and system level)

System monitoring: monitoring eg load, traffic types, peak flow, trend analysis, user access patterns, device behaviour, logging servers

Change management: infrastructure eg network device removal/addition, server addition/removal, network addition/removal; procedural eg user group addition/removal, service addition/removal; impact on productivity

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Understand the impact on the social and commercial environment of network security design	1.1 evaluate a current system's network security 1.2 discuss the potential impact of a proposed network design 1.3 discuss current and common threats and their impact
LO2 Be able to design network security solutions	2.1 design a network security solution to meet a given specification 2.2 evaluate design and analyse feedback
LO3 Be able to implement network security solutions	3.1 using a design, implement a complex network security solution 3.2 systematically test the complex network security solution 3.3 document and analyse test results
LO4 Be able to manage network security solutions	4.1 manage a network security solution 4.2 analyse ongoing network security policies and practices 4.3 recommend potential change management.

Guidance

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes associated with this unit are closely linked with:

Level 3	Level 4	Level 5
Unit 32: Networked Systems Security	Unit 24: Networking Technologies	Unit 44: Local Area Networking Technologies
	Unit 25: Routing Concepts	Unit 45: Wide Area Networking Technologies
	Unit 26: Design a Small or Home Office Network	Unit 48: IT Security Management
	Unit 27: Network Operating Systems	

This unit has links to the Level 4 and Level 5 National Occupational Standards for IT and Telecoms Professionals, particularly the areas of competence of:

- IT Security Management.

Essential requirements

A centre delivering this unit must have access to suitable network routing or switch technology as a live or emulated resource. The primary focus is practice based and therefore this unit cannot be delivered in a theoretical context.

Resources

Books

Bhaiji Y – *Network Security Technologies and Solutions: CCIE Professional Development* (Cisco Press, 2008) ISBN-10: 1587052466

Clem A – *Network Management Fundamentals* (Cisco Press, 2006) ISBN-10: 1587201372

Stallings W – *Network Security Essentials: Applications and Standards* (Pearson, 2008) ISBN-10: 0132303787

White G et al – *CompTIA Security+ All-in-One Exam Guide, Second Edition* (McGraw Hill, 2009) ISBN-10: 0071601279

Websites

www.developers.net/ciscoshowcase/view/1162

www.eogogics.com/talkgogics/tutorials/SNMP/

www.networktutorials.info/wireless_sec.html

Employer engagement and vocational contexts

Liaison with network (or internet) security experts from local or national organisations would enhance the delivery of this unit. If the learner is employed, a contextual assessment based on their working environment with the support of their supervisory management would be of considerable value. Care must be taken to ensure any real work projects are not detrimental to their employer or employment.

Calculation of the qualification grade

Pass qualification grade

Learners who achieve the minimum eligible credit value specified by the rule of combination will achieve the qualification at a pass grade (see section *Rules of combination for the BTEC Level 4 and 5 Higher National qualifications*). The Rules of combination have been summarised below:

BTEC HND Diplomas

To achieve the qualification a learner must:

- achieve at least 240 credits at or above the level of the qualification
- achieve a minimum of 125 credits at Level 5 or above.

The best valid combination of units is used to calculate the overall grade, e.g. if a learner has completed more than the minimum number of optional units at the appropriate level the best performance from these will be used.

All learners will receive a Notification of Performance showing all unit grades whether or not they were included in the calculation for the overall grade.

Qualification grades above pass grade

BTEC HND Diplomas

The grade achieved in units from an appropriate HNC may contribute to an HND grade.

If a learner moves from HNC to HND, credits at Level 5 or above from both the HNC and HND can contribute to the best 75 credits of the overall HND grade. Note that for HND learners, level 4 units do not count towards the qualification grade.

Calculation of the BTEC HND qualification grade is based on the learner's best performance in units at or above the level of the qualification – i.e. **only units at level 5** can be counted towards the value of 75 credits:

- The best 75 credits must come from a maximum of 240 credits as a valid rule of combination
- The units from which the 75 best credits are selected come from the whole qualification including the mandatory core credit, but must be level 5 units or above.

This means that credit from some mandatory core units is likely to form part of the best 75 credits in most programmes (the mandatory core credit units will automatically be included in the calculation once the maximum amount of credit for optional specialist units for the rule of combination is used up.)

It is the responsibility of a centre to ensure that a correct unit combination is adhered to.

Qualification grades

Learners will be awarded a pass, merit or distinction qualification grade using the points gained through the 75 best credits based on unit achievement.

Unit credit points for specified unit grades at Level 5 only

Unit points per credit		
Pass	Merit	Distinction
0	1	2

BTEC Level 5 HND overall qualification grades

Points range	Grade	
0–74	Pass	P
75–149	Merit	M
150	Distinction	D

Annexe gives examples of how qualification grades are calculated.

Annexe

Calculation of the qualification grade

Pass qualification grade

Learners who achieve the minimum eligible credit value specified by the rule of combination will achieve the qualification at pass grade (see section *Rules of combination for BTEC Levels 4 and 5 Higher National qualifications*).

Qualification grades above pass grade

Learners will be awarded a merit or distinction qualification grade by the aggregation of points gained through the successful achievement of individual units. **The graded section of both qualifications is based on the learner's best performance in units at the level or above of the qualification to the value of 75 credits.**

The number of points available is dependent on the unit grade achieved and the credit size of the unit (as shown in the table below).

Points available per credit at specified unit grades

Points per credit		
Pass	Merit	Distinction
0	1	2

So a 15 credit unit awarded a merit grade will gain 15 points.

Qualification grades

BTEC Level 5 HND

Points range	Grade	
0-74	Pass	P
75-149	Merit	M
150	Distinction	D

Examples for the HND Diploma:

The tables below give examples of how the overall grade is determined.

Only points from units at or above the level of the qualification can be counted towards the grade.

Examples used are for illustrative purposes only. Other unit combinations are possible.

Example 1: Achievement of an HND Diploma with a pass grade

		Level	Credit	Grade	Grade points	Points per unit (weighting × credit points)
Unit 1	Mandatory core unit	4	15	P	X	(15)
Unit 2	Mandatory core unit	4	15	M	X	
Unit 3	Mandatory core unit	4	15	M	X	30
Unit 4	Mandatory core unit	4	15	M	X	
Unit 5	Mandatory core unit	4	15	M	X	
Unit 6	Mandatory core unit	5	15	P	0	
Unit 7	Mandatory core unit	5	15	M	1	15
Unit 8	Mandatory core unit	5	20	P	0	
Unit 20	Specialist unit	5	15	M	1	15
Unit 21	Specialist unit	5	15	P	0	
Unit 23	Specialist unit	5	15	P	0	
Unit 25	Specialist unit	4	15	P	X	
Unit 26	Specialist unit	5	15	M	1	15
Unit 29	Specialist unit	4	15	M	X	
Unit 33	Specialist unit	4	15	M	X	
Unit 35	Specialist unit	5	15	M	1	15
	Qualification grade totals	Min 125 at level 5	245			60

Count the points from level 5 units for the best 75 credits
 X these units are **below** the level of the HND Diploma so not counted for grading

The learner has sufficient points for a pass grade.

Example 2

Achievement of an HND Diploma with a Merit grade

		Level	Credit	Grade	Grade points	Points per unit (weighting × credit points)
Unit 1	Mandatory core unit	4	15	P	X	
Unit 2	Mandatory core unit	4	15	M	X	
Unit 3	Mandatory core unit	4	15	M	X	
Unit 4	Mandatory core unit	4	15	M	X	
Unit 5	Mandatory core unit	4	15	M	X	
Unit 6	Mandatory core unit	5	15	M	1	15
Unit 7	Mandatory core unit	5	15	D	2	30
Unit 8	Mandatory core unit	5	20	D	2	40
Unit 20	Specialist unit	5	15	M	1	15
Unit 21	Specialist unit	5	15	M	1	(15)
Unit 23	Specialist unit	5	15	P	0	
Unit 25	Specialist unit	4	15	P	X	
Unit 26	Specialist unit	5	15	M	1	(15)
Unit 29	Specialist unit	4	15	M	X	
Unit 33	Specialist unit	4	15	M	X	
Unit 35	Specialist unit	5	15	M	1	(15)
Unit 36	Specialist unit	5	10	D	2	20
	Qualification grade totals	Min 125 at level 5	260			105

The learner can be considered for a merit:

only count the points from **the best 75** credits from a valid combination of 240 credits

X these units are **below** the level of the qualification so **cannot** be counted for grading

The best 75 credits include both mandatory core and optional units

() these units are not counted in the overall score

The learner has sufficient points for a merit grade.

Example 3

Achievement of an HND Diploma with a distinction grade

		Level	Credit	Grade	Grade points	Points per unit (weighting × credit points)
Unit 1	Mandatory core unit	4	15	P	X	
Unit 2	Mandatory core unit	4	15	M	X	
Unit 3	Mandatory core unit	4	15	D	X	
Unit 4	Mandatory core unit	4	15	D	X	
Unit 5	Mandatory core unit	4	15	M	X	
Unit 6	Mandatory core unit	5	15	D	2	30
Unit 7	Mandatory core unit	5	15	D	2	30
Unit 8	Mandatory core unit	5	20	D	2	30
Unit 20	Specialist unit	5	15	D	2	30
Unit 21	Specialist unit	5	15	D	2	30
Unit 23	Specialist unit	5	15	P	0	
Unit 25	Specialist unit	4	15	P	X	
Unit 26	Specialist unit	5	15	M	1	(15)
Unit 29	Specialist unit	4	15	M	X	
Unit 33	Specialist unit	4	15	M	X	
Unit 35	Specialist unit	5	15	M	1	(15)
Unit 36	Specialist unit	4	15	P	X	
Qualification grade totals		Min 125 at level 5	245			150

The learner can be considered for a distinction: only count the points from level 5 units for the best 75 credits from a valid combination of **240** credits
 () these units are not counted in the overall score
 X not counted as **below the** level of the qualification.

The learner has sufficient points for a distinction grade.

