Edexcel BTEC Levels 4 and 5 Higher Nationals specification in Computing and Systems Development

Contents

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 5: Emerging Technologies

Unit code: Y/601/0451

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To enable learners to explore current and cutting-edge technological developments, disciplines and advancements that have been, and are still being made, within the field of emerging technologies.

Unit abstract

Emerging technologies can be explored in terms of significant research and development that is 'cutting-edge', innovative and dynamic. In other words, technologies that push the boundaries and exceed expectations.

This unit will provide learners with 'food for thought'. It will introduce a range of technologies that fall under this umbrella and explore the impact that such technologies could bring to society. The unit will provide learners with the opportunity to conduct research into this area and also enable them to draw their own conclusions about the benefits and also the concerns of having access to such technologies and their application in critical environments.

Learners will need to demonstrate a range of research and analytical skills. The information available to support certain technology developments might be limited, due to the stage of development. For example the technology might still be in a prototype stage with little to report on. Information available might also be confidential, due to the dynamics of the technology and findings of any experiments or tests.

On completion of this unit the learner will have an awareness and appreciation of emerging technologies, and how they can support the infrastructure of the environment and society in the future.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand emerging technologies

2 Understand the impact of emerging technologies on society

3 Be able to conduct research into emerging technologies

4 Understand the ethical implications of emerging technologies.

Unit content

1 Understand emerging technologies

Definition: cutting edge developments, contemporary advances in technology, converging technologies, technical innovations; gaining competitive advantage; disciplines and domains emerging technologies cover

Environments: prototype and fully-developed technologies eg low carbon technologies and fuels, nanotechnologies, biotechnology, information technology, cognitive science, robotics, genetic engineering, artificial intelligence, optical computing, 4G technologies, swarm technologies, medicine, transportation

2 Understand the impact of emerging technologies on society

Current developments: current research; development stages; future plans; costs; prototype models eg analysis of predicted/outcome results, implementation or roll-out of the technology, testing, costs

Society: implications eg electric car - impact upon manufacturers of cars, fuel companies, fuel distributors, consumers; government initiatives and legislation

3 Be able to conduct research into emerging technologies

Emerging technology selection: initial emerging technology case studies, research or investigation; environment to provide the basis of in-depth research into an emerging technology eg low-carbon fuels

Research approaches: using primary and or secondary sources of information to gather the research material and evidence; using qualitative and quantitative data sources; using paper-based and electronic information sources

Research outcome: presenting research findings and outcome; target audience for delivery and feedback; presentation delivery eg research paper, formal report, oral presentation, discussion forum, blog; tools eg statistical analysis tools, application software and professional packages to support delivery

4 Understand the ethical implications of emerging technologies

Ethical implications: ethical considerations and implications associated with emerging technologies; exploring ethics associated with testing emerging technologies and their environments eg laboratories

Ethical committees: ethical committees or bodies eg 3TU Centre for Ethics and Technology, United Nations Educational, Scientific and Cultural Organisation (UNESCO Ethics of Science and Technology Programme)

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 emerging technologies	1.1 examine the environments that utilise emerging technologies by identifying the emerging technologies and current developments in the field 1.2 examine the environments that utilise emerging technologies by assessing the dependency of these environments on future enhancements
LO2 Understand the impact of emerging technologies on society	2.1 analyse emerging technologies and their impact on society
LO3 Be able to conduct research into emerging technologies	3.1 undertake research on an emerging technology 3.2 present findings from the research 3.3 evaluate the research process
LO4 Understand the ethical implications of emerging technologies	4.1 evaluate the ethical implications of emerging technologies discussing the role of ethical committees.

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 7: Research Skills	

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 Needs Analysis
- Systems Design.

Essential requirements

Learners must have access to a range of resources that can provide both qualitative and quantitative data to support their investigations and research. Learners must also keep up-to-date with current research developments in the field regarding emerging technologies.

Learners will be required to conduct research on emerging technologies. As this subject area is quite vast and covers a number of environments and disciplines, learners will require some direction in terms of where to find the most up-to-date developments or appropriate technologies. Any research that embraces IT or the use of IT would be appropriate, for example Artificial Intelligence (AI) technologies that could be used in medicine, or technologies used to monitor, predict or control certain designs or innovations.

Resources

Websites

http://en.wikipedia.org/wiki/Emerging_technologies

www.cesweb.org/emergingTech/default.asp

www.technologyreview.com/special/emerging/

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 or use any conference footage that is available. The proceedings or coverage of any workshops may be quite engaging and informative.

Unit 6: Management in Information Technology

Unit code: J/601/0462

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To enable learners to embrace the work-based activities expected of a technology manager, by providing the generic skills, knowledge and understanding required in the IT environment.

Unit abstract

The unit will investigate and provide the generic skills, understanding, knowledge and work-based activities required by a manager in the information technology environment, thus enabling them to play an active role within an organisation.

Technology managers have to deal with change and participate effectively with management at all levels, including senior management, in the development and implementation of strategies. Learners will be introduced to the software tools available to support management and produce reports for financial planning and control.

In this unit learners will also use IT for strategic planning activities and evaluate the impact of IT on management as well as learn the importance of embracing new developments.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand principles of staff management

2 Be able to use software management tools

3 Be able to participate in strategic planning

4 Understand current developments in information technology.

Unit content

1 Understand principles of staff management

Recruitment: policies eg legal, job descriptions, selection criteria, preparation for interview, administrative and induction; line management structure

Motivation: current theories eg management of change, leadership, participation, team structure and management

Administration: tasks eg scheduling including links with project management, monitoring performance, appraisal, terms and conditions of employment; employer standards; systems and expectations; company policies and procedures

2 Be able to use software management tools

Management planning processes eg investigation of an organisation's budgetary procedures, bidding procedures, budgetary monitoring systems, production of financial reports, managing projects

Software tools for management: information system tools eg diary systems, spreadsheets, intranet, decision support systems; identification of tools with appropriate applications; project management software; management information systems

3 Be able to participate in strategic planning

Strategic planning: aim of strategic planning; use of IT in strategic planning; participating eg, contributing to disaster recovery plan, IT systems planning on strategic planning

Maintaining currency: research methods eg periodicals, internet, conference; human networking; accreditation; issues eg social, political, ethical, legal (UK, EU, global)

4 Understand current developments in information technology

Developments in IT: impact on management eg learning new skills, training; impact of the internet eg on senior and middle management

Importance: for management eg competitive advantage, efficiency, data analysis, deployment of staff (home working)

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 principles of staff management	1.1 evaluate an organisation's staff recruitment policy 1.2 explain theories concerning staff motivation and the management of change 1.3 evaluate staff administration documentation
LO2 Be able to use software management tools	2.1 use system management tools to assist a company in their management planning process 2.2 effectively use software management tools
LO3 Be able to participate in strategic planning	3.1 critically evaluate the role of IT in strategic planning 3.2 use appropriate research methods to contribute to a company's strategic plan 3.3 discuss the issues associated with strategic planning
LO4 Understand current developments in information technology	4.1 evaluate the importance of embracing new developments in technology 4.2 analyse the impact of new technology on 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 3: Information Systems	Unit 5: Emerging Technologies	Unit 30: Information Systems in Organisations
Unit 4: Impact of the Use of IT on Business 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:

- Information Management.

Essential requirements

Centres are advised to build up a collection of appropriate scenarios and case studies to set the context for the topics covered. Centres must have appropriate tools for budgetary control, and presentation. There must also be materials to help learners keep abreast of current developments in information technology.

The unit has to be delivered within a realistic management context. Centres must provide the management tools, theories and systems to support the learner in satisfying the requirements of the unit.

Resources

Books

Aalders R, Hind P – *The IT Managers Survival Guide* (Wiley, 2002) ISBN 047084454X

Green M – *Change Management Masterclass: A Step-by-step Guide to Successful Change Management* (Kogan Page, 2007) ISBN 0749445076

Holtsnider B, Jaffe B – *IT Manager's Handbook Second Edition: Getting your new job done* (Morgan Kaufmann, 2006) ISBN 012370488X

MacDonald, Lynda – *How to Manage Problem Staff Successfully: Busy Manager's Guide to Managing Staff* (Emerald Guides, 2008) ISBN 1847160581

Robson W – *Strategic Management and Information Systems: An Integrated Approach* (Prentice Hall, 2007) ISBN 0273615912

Websites

www.itmanagement.com/

www.computerweekly.com/it-management/

Employer engagement and vocational contexts

Links with local organisations are paramount to the delivery of the unit. The setting of realistic scenarios supported by employer engagement and guest speakers will enhance learners' experience.

Unit 7: Research Skills

Unit code: D/601/1276

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To equip learners with the knowledge and research skills needed to select a research question, and design a research proposal for a chosen topic of interest.

Unit abstract

Research skills equip learners with a higher level of knowledge and skills that will allow them to be self-directed and focused in a specific field of expertise. Research is undertaken in a range of disciplines and is quite prevalent in domains such as medicine, science and academia.

Research is paramount in terms of establishing what has been experienced and discovered in the past, relating this to current studies in the field, and providing some sort of hypothesis or prediction for the future.

Research involves the exploration of a range of primary and secondary sources of information. From theses sources, conclusions can be drawn regarding a particular question or theory that may need to be investigated and tested. Submitting a research proposal, may be based upon these original findings, and through the adoption of a research methodology, new discoveries could be unearthed and recorded.. There are a number of elements that contribute to research. These can include the application of a research methodology that will determine how the research is conducted and also whether it will be of a qualitative or quantitative nature. The research question should spearhead the studies and provide a focus on a specific area, idea, concept or development.

On completion of this unit learners should be able to conduct a literature review that will engage them in identifying a range of primary and secondary information sources. Learners will be able to critique sources and triangulate the information gathered to determine currency and validity in the area of study undertaken.

Learners will also engage in research seminars both as a participant and as a reviewer. The seminars will be used as a forum to disseminate good practice, and to create an awareness of topical issues within their chosen research field.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand different research methodologies

2 Know how to conduct a literature review

3 Be able to present a research proposal

4 Be able to contribute to a research seminar.

Unit content

1 **Understand different research methodologies**

Research types and methodologies: types eg experimental research, survey research, evaluative research, observational research, developmental research; applied versus fundamental research

Data collection: methods eg primary and secondary data collection, observatory, experimental

Research pitfalls: problems eg dependency and access to information sources, time, money, expertise, introduction of bias, the Hawthorne Effect, the Halo Effect

Types of data: qualitative eg 'information rich and data poor'; quantitative eg statistical analysis techniques, ratios

2 **Know how to conduct a literature review**

Sources of information: types eg visual, audio, paper-based, electronic; benefits and drawbacks of types; categories eg primary and secondary sources, restrictions and limitations

Accuracy of information: validity eg triangulation of resources to ensure validity; currency

Literature review framework: styles eg Harvard referencing; adopting a formal format

3 **Be able to present a research proposal**

Research question: defining the question eg selection and suitability; scope and boundaries; target audience

Survey methods: interview techniques eg unstructured, structured, semi-structured;

administered questionnaire; attitude measurements eg Likert scaling, Thurstone scaling,

Guttman scaling, semantic differential scaling; sampling eg random, quota, stratified

Research ethics: issues eg potential ethical issues arising during research, ways to address ethical issues in research; role of the Ethics Committee

4 **Be able to contribute to a research seminar**

Research seminar: functions eg disseminate ideas and good practice; discuss research proposals; gather feedback to inform proposals

Delivery strategies: structure eg clear framework; level of detail; use of IT

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 research methodologies	1.1 assess different research methodologies 1.2 justify the use of a research methodology to be used for the research proposal 1.3 discuss the importance of both qualitative and quantitative data in research 1.4 explain the problems that can arise when undertaking research
LO2 Know how to conduct a literature review	2.1 justify the use of research sources 2.2 evaluate the importance of using primary information sources 2.3 describe a recognised system for referencing
LO3 Be able to present a research proposal	3.1 present a research proposal to a defined audience utilising appropriate survey techniques 3.2 discuss the role of ethics in research
LO4 Be able to contribute to a research seminar	4.1 prepare an extract from the research proposal appropriate to a seminar environment 4.2 provide constructive feedback on proposals presented within the seminar environment.

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: Emerging Technologies	Unit 4: Project Design, Implementation and Evaluation
	Unit 8: Management of Projects	

Essential requirements

Learners must have access to a range of texts, journals, papers, case studies, conference proceedings, and dissertation submissions. Learners must also keep up to date with current research developments in the field.

Resources

Books

Burton N – *Doing Your Education Research Project* (Sage Ltd, 2008) ISBN 9781412947558

Fink A – *Conducting Research Literature Reviews: From the Internet to Paper, Third Edition* (Sage Inc, June 2009) ISBN 9781412971898

Kassem D, Mufti E and Robinson J – *Education Studies: Issues and Critical Perspectives* (Open University Press, 2006) ISBN 9780335219728

Sharp J – *Success with Your Education Research Project* (Learning Matters first edition, January 2009) ISBN 9781844451333

Wellington J – *Educational Research: Contemporary Issues and Practical Approaches* (Continuum International Publishing Group Ltd, 2000) ISBN 9780826449719

Journals

Education Action Research

International Journal of Educational research

Journal of Dissertation

Research Ethics Review

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 researchers in different fields who can share their experiences of putting together a research proposal.

Unit 8: Management of Projects

Unit code: J/601/0302

QCF level: 4

Credit value: 15

Aim

This unit provides an understanding and experience of project management principles, methodologies, tools and techniques that may be used in industry and the public sector.

Unit abstract

Management of projects is a key element to ensure successful scientific investigations related to academic research, company research and development or consultancy.

Through this unit learners will develop an understanding of what constitutes a project and the role of a project manager. They will examine the criteria for the success or failure of a project, evaluate project management systems and review the elements involved in project termination and appraisal.

Learners will also understand the need for structured organisation within the project team, effective control and coordination and good leadership qualities in the project manager. They will be able to analyse and plan the activities needed to carry out a project. This includes how to set up a project, how to control and execute a project, how to cost a project and how to carry out project reviews using a specialist project management software package. Together with factors associated with effecting project change, learners will also appreciate how the project fits into the strategy or business plan of an organisation.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the principles of project management

2 Be able to plan a project in terms of organisation and people

3 Be able to manage project processes and procedures.

Unit content

1 Understand the principles of project management

Project management: project management and the role of the project manager eg management of change, understanding of project management system elements and their integration, management of multiple projects, project environment and the impact of external influences on projects; identification of the major project phases and why they are required; understanding of the work in each phase; the nature of work in the lifecycles of projects in various industries

Success/failure criteria: the need to meet operational, time and cost criteria; define and measure success eg develop the project scope, product breakdown structure (PBS), work breakdown structure (WBS), project execution strategy and the role of the project team; consideration of investment appraisal eg use of discount cash flow (DCF) and net present value (NPV); benefit analysis and viability of projects; determine success/failure criteria; preparation of project definition report; acceptance tests

Project management systems: procedures and processes; knowledge of project information support (IS) systems; how to integrate human and material resources to achieve successful projects

Terminating the project: audit trails; punch lists; close-out reports

Post-project appraisals: comparison of project outcome with business objectives

2 Be able to plan a project in terms of organisation and people

Organisational structure: functional, project and matrix organisational structures eg consideration of cultural and environmental influences, organisational evolution during the project lifecycle; job descriptions and key roles eg the project sponsor, champion, manager, integrators; other participants eg the project owner, user, supporters, stakeholders

Roles and responsibilities: the need for monitoring and control eg preparation of project plans, planning, scheduling and resourcing techniques

Control and coordination: use of work breakdown structures eg to develop monitoring and control systems, monitoring performance and progress measurement against established targets and plans; project reporting; change control procedures; the importance of cascading; communications briefing; instilling trust and confidence in others

Leadership requirements: stages of team development eg Belbin's team roles, motivation and the need for team building, project leadership styles and attributes; delegation of work and responsibility; techniques for dealing with conflict; negotiation skills; chair meetings

Human resources and requirements: calculation; specification; optimisation of human resource requirements; job descriptions

3 **Be able to manage project processes and procedures**

Project organisation: the product breakdown structure (PBS) and the work breakdown structure (WBS); project execution strategy and the organisation breakdown structure (OBS) eg preparation of organisational charts, task responsibility matrix, statement of work (SOW) for project tasks

Project management plans: the why, what, how, when, where and by whom of project management eg contract terms, document distribution schedules, procurement, establishing the baseline for the project

Scheduling techniques: relationship between schedules, OBS and WBS; bar charts; milestone schedules; network techniques; resourcing techniques; computer-based scheduling and resourcing packages; project progress measurement and reporting techniques; staff-hours, earned value and progress 'S' curves; critical path analysis and reporting; milestone trending

Cost control techniques: cost breakdown structure eg types of project estimate, resource needs, estimating techniques, estimating accuracy, contingency and estimation, bid estimates, whole-life cost estimates, sources of information, cost information sensitivity, computer-based estimating; allocation of budgets to packages of work; committed costs; actual costs; cash flow; contingency management

Performance: cost performance analysis eg budgeted cost for work scheduled (BCWS) budgeted cost for work performed (BCWP); concept of earned value; actual cost of work performed (ACWP); cost performance indicators

Change control procedures: the need for formal control of changes eg project impact of changes, principles of change control and configuration management; changes to scope, specification, cost or schedule; change reviews and authorisation; the formation of project teams; project initiation and start-up procedures

Recommendations: changes in relation to eg scope, specification, cost, improving reliability of outcomes

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 project management	1.1 explain the principles of project management 1.2 discuss viability of projects with particular emphasis on the criteria for success/failure 1.3 explore principles behind project management systems and procedures 1.4 explain key elements involved in terminating projects and conducting post-project appraisals
LO2 Be able to plan a project in terms of organisation and people	2.1 plan the most appropriate organisational structure 2.2 discuss roles and responsibilities of participants within a project 2.3 carry out the control and co-ordination of a project 2.4 document project leadership requirements and qualities 2.5 plan specific human resources and requirements for a project
LO3 Be able to manage project processes and procedures	3.1 design the project organisation with reference to prepared project management plans 3.2 use project scheduling and cost control techniques 3.3 report the methods used to measure project performance 3.4 report project change control procedures 3.5 discuss the outcomes of the project and make recommendations.

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 17: Project Planning With IT	Unit 7: Research Skills	Unit 4: Project Design, Implementation and Evaluation

Essential requirements

Software packages must be used to demonstrate project control and reporting techniques. Packages might include time and cost scheduling packages, documentation and procurement control packages, spreadsheet packages, graphic presentation packages.

Other packages for items such as risk analysis, project accounting and procurement control could be used to illustrate particular techniques in specific industries.

Access to real project data in electronic spreadsheet form would be an advantage.

Employer engagement and vocational contexts

Learners will benefit from visits to organisations that are engaged in project work as a part of academic research, investigations and research for public bodies, company research and development, or consultancy activities. An ideal context would be for learners to manage a project that is of interest to a particular organisation.

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 10: Human Computer Interaction

Unit code: A/601/0457

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

This unit aims to give learners an understanding of recent Human Computer Interaction (HCI) developments and will enable them to develop a human computer interface.

Unit abstract

As technology moves forward, new methods of communicating with computer systems are becoming possible. Developers need to make reasoned choices as to the nature and appropriateness of the interface they are developing or using, in order to ensure that the user interaction is as natural, efficient and effective as possible. This requires a good understanding of the essentials of HCI and of the latest developments. A long-term goal of HCI is to design systems that minimise barriers between the human's cognitive model of what they want to do and the computer's understanding of the user's intent.

Learners will be encouraged to explore the detail of how users interact with software, how the interface works to help fulfil the user needs and how it makes allowances for different users. Learners will develop a critical appreciation of the advantages and disadvantages of various interfaces currently available and develop an HCI using an appropriate programming language or software tool.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand recent human computer interaction related developments and their application

2 Understand the issues related to a chosen human computer interface

3 Be able to develop a human computer interface.

Unit content

1 **Understand recent human computer interaction related developments and their application**

HCI: historical development; motivation; techniques; guidelines; principles; standards.

Developments in technology: changing workstation environments eg screens, keyboards, pointing devices; other non standard input/output devices eg speech recognition; related processing developments and information storage possibilities

Developments in HCI: examples *eg* virtual machines with command line input, graphical interfaces, screen design for intensive data entry; intelligent HCIs; virtual personas; changing concepts of 'look and feel'

User issues: range of users eg expert, regular, occasional, novice, special needs; ergonomics; human information processing; impact on the workplace

Development of systems: new developments eg event-driven systems, use of multimedia; modelling techniques; implication of new developments on user interfaces; implication of developments on hardware eg storage, processing requirements; convergence of systems

Applications: selection of HCIs eg touchscreen, voice activated

2 **Understand the issues related to a chosen human computer interface**

User characteristics: human memory: knowledge representation; perception; attention; reasoning; communication; skills and skills acquisition; user's cognitive model; use of metaphors and the consequences on the design of HCI

Health and safety considerations: ergonomics and the surrounding environment eg lighting, seating; specific concerns eg Repetitive Strain Injury (RSI); legal implications

Wider considerations: costs; training; system requirements eg hardware, software, communications; information storage; health and safety

3 **Be able to develop a human computer interface**

Modelling the interface: mapping the system functionality to the conceptual model; grouping of the tasks into logical sets

Analysis: task analysis; user-centred methodologies eg storyboarding, user needs analysis; HCI options; usability objectives eg performance or response requirements

Design: rules and heuristics for HCI design; review of proprietary examples; supporting information eg context sensitive help, online help/documentation; design tools; design principles eg tolerance, simplicity, consistency, provision of feedback.

Production: selection of tools; production of interface; testing

Evaluating an HCI: functionality characteristics eg keystroke effort per task; ability to navigate within the system; ability to configure the HCI; user satisfaction against requirements; use of quality metrics eg Fitt's Law, Keystroke Level Method; test documentation

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 recent human computer interaction related developments and their application	1.1 evaluate recent HCI related developments and their applications 1.2 discuss the impact of HCI in the workplace
LO2 Understand the issues related to a chosen human computer interface	2.1 discuss the issues related to user characteristics for a chosen HCI
LO3 Be able to develop a human computer interface	3.1 design and create a human computer interface for a specified application 3.2 explain the principles that have been applied to the design 3.3 critically review and test an interface 3.4 analyse actual test results against expected results to identify discrepancies 3.5 evaluate independent feedback and make recommendations for improvements 3.6 create onscreen help to assist the users of an interface 3.7 create documentation for the support and maintenance of an interface.

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 23: Human Computer Interaction	Unit 11: Digital Media in Art and Design	Unit 37: Digital Image Creation and Development
	Unit 12: 2D, 3D, and Time-based Digital Applications	Unit 38: 3D Computer Modelling and Animation
	Unit 13: Multimedia Design and Authoring	
	Unit 14: Website Design	

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/Interface (HCI) Design.

Essential requirements

Learners must have access to a cross-section of applications on differing platforms presenting a range of HCI. Learners should also have access to a development environment that allows rapid prototyping.

This unit must be a balance between theory and practical experience. Learners must be exposed to a range of HCIs as possible, and be encouraged to criticise them. Where possible, tools for developing software prototypes must be used to allow the rapid production of HCIs. The design of the HCI must be seen as an integral part of the software development process.

Evidence can be obtained from investigating a wide range of HCI applications. Learners must show that they are capable of identifying the main features of a given HCI, that they can diagnose the failings of the interface and propose improvements in the light of user needs.

Resources

Books

Benyon D – *Designing Interactive Systems: A Comprehensive Guide to HCI and Interaction Design* (Addison Welsley, 2010) ISBN 0321435338

Sharp H, Rogers Y and Preece J – *Interaction Design: Beyond Human-computer Interaction* (Wiley, 2007) ISBN 0470018666

Website

http://hcibib.org/

Employer engagement and vocational contexts

Where learners are employed, a project-based assessment would enhance the delivery of this unit. Also, practical demonstrations of HCI, illustrated by speakers from commerce and industry, and of group visits to relevant organisations would contextualize the unit and be of value.

Unit 11: Digital Media in Art and Design

Unit code: H/601/6608

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

The aim of this unit is to develop learners' understanding of the scope and potential of digital media in art and design, coupled with the application of skills in and detailed knowledge of, software applications in a specialist pathway.

Unit abstract

The aim of this unit is to develop learners skills with digital media, combined with the ability to translate ideas from research and drawings into computer-aided design work and visuals. Learners should be given the opportunity to develop their in-depth knowledge of software and be able to communicate ideas using a variety of specialist CAD packages.

Learners should broaden their awareness of the benefits of using digital media inside and beyond the remit of art and design. The range of devices and software mentioned is not exhaustive and learners are encouraged to research beyond design applications to gain a broader view.

The aim is to ensure that learners are familiar with a wide range of essential technology and are able to translate these skills into their own work. As technology develops and moves on, learners must be familiar with current software and emerging trends in digital technology.

A creative experimental approach is required to encourage learners to broaden their design work and to understand how digital media can be used in art and design in a variety of situations, eg creating and developing images, using text and images, creating documents, and creating design work, producing professional standard visuals, concept sheets, design work, environments, renders, fly-throughs, storyboards. Learners should be able to use digital media as a tool to produce supporting documents, eg publicity and promotional materials, presentations, professional materials.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the scope and potential of digital media in art and design

2 Know how to apply and utilise software in specialist pathway

3 Be able to exploit the potential of software applications creatively and effectively

4 Be able to present design work using digital applications.

Unit content

1 Understand the scope and potential of digital media in art and design

Scope: application eg illustration applications, interior design, background, render, CSS, moving image, environments, games levels, database driven, collaborative, reactive, 3D, graphic products, product design, web based design, interactive media, marketing, business administration

Resources: hardware eg, digitising tablet, pressure sensitive stylus, mouse, touch-screen, motion sensor, camera, projector, printer, scanner, hard drive, laser cutter

2 Know how to apply and utilise software in specialist pathway

Software applications: manipulate eg capture, distort, scale, warp, contrast, invert, palette, create swatches, repeat tiles, mask, vector, layer, filter

Digitise: capture eg digital photography, scan

Objects: primary sources eg found objects, natural objects, domestic tools, own work

Image: visuals eg photographs, found images, own visual work, hand-written text, word-processed text

File format: industry standards eg tiff, png, jpeg, gif, pdf, high resolution, low resolution, dpi, pixel size, international paper size, web page, web format, print format

Pathway: specialism eg fine art, fashion, textiles, design, graphics, photography, 3D,craft, art and design management, interior design, product design, manufacturing, printmaking, sculpture, interactive media

3 Be able to exploit the potential of software applications creatively and effectively

Text editing: word processing eg word count, spell checker, grammar checker, formatting styles, font styles, headers and footers, page layout, columns, table, track changes

Image creation: specialist output eg CSS, moving image, environments, games levels, design led, 3D rendering, repeat patterns, freehand files; traditional eg, drawn images, sketches, 3D, photographs

Creative use of software: personal approach eg layering, masking, visual language, personal style, innovation, originality, observation, fluency, confidence

4 Be able to present design work using digital applications

Present visuals: presentation materials eg slide-show, projection, folio, illustration, concept boards, design sheets, orthographic drawings, scale plans, layout, floor-plan, storyboard, render, mock-up; evaluation eg justification, development of ideas, application of software, skills development, communication of intended message, audience feedback, annotation, self-evaluation

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 scope and potential of digital media in art and design	1.1 Research and evaluate the use of digital media in art and design
LO2 Know how to apply and utilise software in specialist pathway	2.1 Create complex and original imagery using specialist software 2.2 Exploit potential of specialist software
LO3 Be able to exploit the potential of software applications creatively and effectively	3.1 Produce creative and effective design work using software application 3.2 Prepare image, graphic and text files for output 3.3 Produce a comprehensive portfolio that shows the creative application of specialist software
LO4 Be able to present design work using digital applications	4.1 Present visual design work 4.2 Evaluate the use of digital media in creating successful art and design outputs.

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 30: Digital Graphics	Unit 12: 2D, 3D, and Time-based Digital Applications	Unit 37: Digital Image Creation and Development
Unit 35: Digital Graphics for Interactive Media	Unit 13: Multimedia Design and Authoring	Unit 38: 3D Computer Modelling and Animation
Unit 37: 2D Animation Production	Unit 14: Website Design	

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/Interface (HCI) Design.

Essential requirements

This unit requires access to computer suites with current software and a range of hardware including scanners, cameras, A3 colour printers and graphic tablets. Access to drawing studios is also necessary to enable learners to translate ideas from drawing to designs. Research tools include the internet, CD ROMs, databases, specialist publications, galleries, exhibitions, questionnaires and interviews with practitioners, software manuals, trend forecasting, graphic design magazines.

Employer engagement and vocational contexts

Off site visits, work experience or visiting speakers related to the concept of digital media in art and design will help to contextualise this unit for learners and see the benefits on their future career aspirations. Competence and fluency with software is a skill that employers will be looking for and which will be useful to learners wishing to work for themselves in the future.

- Marketing – producing publicity materials, keeping databases, producing blogs, advertising
- Business – day to day business administration, finance and budget management
- Design – surface pattern design, fabric design, fine art, 3D design, graphic products, interior design,
- Presentation – creating mood boards, concept boards and presentation images.

Vocational learning support resources:

- Learning and Skills Network.– www.vocationallearning.org.uk

Business and finance advice:

- Local, regional business links – www.businesslink.gov.uk.

Assignments should be vocationally relevant; centres should consider the delivery of 'live projects' for example to support the vocational content of the unit and programme.

Unit 12: 2D, 3D and Time-based Digital Applications

Unit code: F/601/6793

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

This unit aims to develop learners' skills in using a broad set of software applications through the use of 2D, 3D and time-based digital techniques.

Unit abstract

This unit introduces learners to 2D, 3D and time-based digital applications. The scope offered to the designer working with these interactive tools is wide ranging. Creative approaches can be applied to exploring the potential of software applications in extending drawing and painting techniques. There are possibilities for both artists and designers to develop new strategies in working practices through reflection and reaction to the results of digital experimentation. In this unit learners should explore bitmap and vector graphic applications, and address the constraints associated with modelling 3D. They should also reflect on the potential of time-based software to be applied to creative and effective presentations of these elements.

An active experimental approach should encourage learners to broaden their visual thinking and creativity. The potential of combining drawing techniques and digital technology should be promoted widely to cross-fertilise creativity and to explore ways to integrate computer applications with art and design practice involving hand made imagery. Learners should explore 3D computer modelling techniques to create a basic 3D model or environment. This work should be combined with 2D digital artwork and incorporated in a presentation that uses time-based software.

Learning outcomes

On successful completion of this unit a learner will:

1 Be able to carry out a sustained exploration of 2D mark making techniques using software tools

2 Be able to develop the potential of images using digital techniques

3 Be able to carry out a sustained exploration of 3D modelling software

4 Be able to present outcomes creatively and effectively, using time-based Presentation software.

Unit content

1 **Be able to carry out a sustained exploration of 2D mark making techniques using software tools**

2D software: industry standard; vector; compositional; image manipulation

Bitmap and vector graphics: pixels; picture elements; painting; objects; bounding boxes; stretch; distort; paths; pen tool; file formats; digital mark-making techniques

Drawing devices: graphics tablet; light pen; mouse; touch-screen; touch pad; stylus; puck; interactive whiteboard

2 **Be able to develop the potential of images using digital techniques**

Manipulation: adjust colour; contrast; brightness; size; resolution; texture; form; cut; copy; paste; repeat; collage; layer; add text; cyclical process eg print out, rework printed copy, re-scan

Use techniques: distortion; filters; curves; crop; adjust; enhance; styles; palettes; channels; transparency; opacity; invert; posterise; additive; reductive

Document: record; stages; saving protocols; versions; sequential eg development, layering; additive; reductive

3 **Be able to carry out a sustained exploration of 3D modelling software**

Simple objects: articulation; pivotal motion; axis; rotation; objects eg toy, sunglasses, tool, hinge, wheel, door, can opener

Animation: movement; tween; morph; keyframe; timeline

Render: modeling; surfaces eg textures, colour; light sources; reflective light; colour theory

4 **Be able to present outcomes creatively and effectively, using time-based presentation software**

Presentation: preparation; files; consideration eg final output, physical size, resolution; printing requirements; files eg combining, compatibility, economy, physical size, palette, screen resolution

Combine: elements eg drawn vector based imagery, graphics, text

Software: eg presentation, movie, video log, sound; format eg projection, installation

Evaluate: planning; intuition; response; technology; communication; content; format; intentions; reactions

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 carry out a sustained exploration of 2D mark making techniques using software tools	1.1 research examples of 2D digital based markmaking 1.2 use 2D software tools to produce digital artwork
LO2 Be able to effectively exploit the potential of images using digital techniques	2.1 use digital image manipulation techniques to create effective images 2.2 document the image manipulation process
LO3 Be able to carry out a sustained exploration of 3D modelling software	3.1 model simple objects using 3D modelling software 3.2 render models with surface texture and lighting 3.3 animate models using accurate parameters of movement
LO4 Be able to present outcomes creatively and effectively, using time-based presentation software	4.1 research approaches to using time-based presentation software 4.2 combine 2D and 3D elements into time-based presentation software 4.3 present final outcome 4.4 evaluate final outcome.

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 30: Digital Graphics	Unit 11: Digital Media in Art and Design	Unit 37: Digital Image Creation and Development
Unit 35: Digital Graphics for Interactive Media	Unit 13: Multimedia Design and Authoring	Unit 38: 3D Computer Modelling and Animation
Unit 37: 2D Animation Production		

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/Interface (HCI) Design.

Essential requirements

Learners must have access to specialist facilities relevant to this unit.

Employer engagement and vocational contexts

Centres should develop links with practising artists, craftspeople and designers, to deliver assignments to learners or to provide work experience. A lecture or visit by a designer, programmer or practitioner local to the centre may provide useful and pertinent information on working practice.

Links with employers are essential to the delivery of the programme for work experience and future employment. Assignments should be vocationally relevant; centres should consider the delivery of 'live projects' for example to support the vocational content of the unit and program.

Unit 13: Multimedia Design and Authoring

Unit code: H/601/0467

QCF Level 4: BTEC Higher National

Credit value: 15

Unit aim

To help learners understand design processes including planning, iteration and prototyping, in the context of building a multimedia product.

Unit abstract

The interactive multimedia industry is one of the fastest moving sectors in the world. Those hoping to make a career in this sector will need to be able to produce high quality products. Creativity and imagination are key attributes of successful media designers, but learners must also acquire a firm grasp of the principles of interactive media design as well as good planning skills.

In this unit, learners will find out about the disciplines necessary to create a professional multimedia product. They will need to devise a design specification and build a prototype product. They will subsequently refine the product, further developing their initial ideas through an iterative process of development.

In completing this unit, learners will gain an understanding of how multimedia software applications can be used effectively as tools in a disciplined and structured design process aimed at producing a commercially usable prototype.

The unit will also teach learners how to focus on the needs of end users, to study who is likely to use the product they produce, and how to tailor what they are making to the user's needs.

Summary of learning outcomes

On successful completion of this unit a learner will:

1 Understand the use of existing multimedia products

2 Know the importance of design discipline

3 Be able to apply design disciplines to a multimedia production

4 Be able to present a refined multimedia product prototype.

Unit content

1 Understand the use of existing multimedia products

Research: sources eg literature, publications, journals, electronic data, observation, questionnaire, interview, surveys

Products: types eg websites, interactive videos, DVDs, games, advertisements

2 Know the importance of design discipline

Sensitivity: cultural and contextual eg political, sexual, ethnic, minority groups, religious, cognitive and physical special needs, disabilities, discrimination awareness

Human Computer Interaction (HCI): testing eg formative, summative, quantitative, qualitative;

User' needs: requirements eg content, existing systems, environmental issues, location, social context, tasks constraints of a system, delivery platform; input, output devices

3 Be able to apply design disciplines to a multimedia production

Task analysis: observations eg task being performed, difficulties encountered, hesitations, question user expectations, question user requirements and opinions, visual perception, attention span, dexterity, memory constraints

Prototype systems: user-centred design eg storyboards, flow diagrams, scripts, musical scores; structure map; design standards and guidelines; copyright laws

Develop: improvements eg amend, edit, rearrange, replace

Audio-visual: types eg sound samples, animation, video, interactive elements

Design: layout eg quantity of information presented, grouping and prioritising of information, highlighting techniques, standardisation of screen display; features eg text, use of typography, graphics, screen metaphors, navigation systems, video, guides or agents, animation, visual feedback; accessibility eg prioritising, drawing attention, use of colour, language, dynamics of screen design, innovation, creativity; intrinsic and extrinsic rewards, feedback and playback

Checking multimedia outcomes: considerations eg completeness, accuracy, layout, formatting, animation, sound, sequence; review against requirements

Editing multimedia outcomes: customisations eg size, crop and position, proportion, colour schemes, font schemes, border styles, use layout guides; existing styles and schemes for font (typeface), size, orientation, colour, alignment

Resolving problems: sound eg sound-noise ratio, volume, clarity, accessibility, codec support; images eg levels, contrast, file size, proportions, placement, unwanted content; text eg clarity, spelling, grammar, structure

4 **Be able to present a refined multimedia product prototype**

Originate: source materials eg copyright licensing laws, scanned material, digital photography, digital video; cultural sensitivity, political propriety

Presentation: considerations; eg file size, format; constraints eg bandwidth, compression techniques; stand-alone applications eg screen-based, point of sale, educational, entertainment, information kiosk; CD-ROM pressing techniques; world wide web publishing

Audience: evaluate eg target users, computer users, non-computer literate users.

Other considerations: cross-platform file compatibility eg Macintosh file formats, Windows file formats; cross-platform performance eg file size, file economy, file quality, file compression techniques; browser eg browser friendly palettes, frames (Java), browser compatibility; assessing eg evaluating, checking, requirements, usability, accuracy

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 use of existing multimedia products	1.1 critically review examples of high and low quality multimedia products 1.2 discuss what makes a good quality multimedia product
LO2 Know the importance of design discipline	2.1 explain how the design process can be applied to a multimedia product 2.2 plan an iterative design process
LO3 Be able to apply design disciplines to a multimedia production	3.1 use an appropriate combination of resources and techniques to achieve multimedia outcomes 3.2 check multimedia outcomes meet needs 3.3 analyse own use of design discipline
LO4 Be able to present a refined multimedia product prototype	4.1 produce a working multimedia product prototype 4.2 present working multimedia product prototype to a multimedia professional 4.3 evaluate the prototype.

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 43: Multimedia Design	Unit 11: Digital Media in Art and Design	Unit 37: Digital Image Creation and Development
	Unit 12: 2D, 3D, and Time-based Digital Applications	Unit 38: 3D Computer Modelling and Animation
	Unit 15: Website Management	

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/Interface (HCI) Design.

Essential requirements

Learners will need access to computer hardware with appropriate accessories such as scanners and printers, and to appropriate software such as Director, Flash, Dreamweaver, Fireworks, Adobe PhotoShop/Image Ready etc.

Resources

Books

Andrews P – *Adobe PhotoShop Elements* (Adobe, 2009) ISBN 0321660323

Boyle T – *Design for Multimedia Learning* (Prentice Hall, 1996) ISBN 0132422158

Chapman Dr N and Chapman J – *Digital Multimedia* (John Wiley & Sons; 2009) ISBN 0470512164

Coupland K – *Web Works Navigation* (Rockport Publishers, 2000) ISBN 1564966623

Kalbach J – *Designing Web Navigation: Optimizing the User Experience* (O'Reilly Media, 2007) ISBN 0596528108

Gatter M – *Software Essentials for Graphic Designers: Photoshop, Illustrator, InDesign, QuarkXPress, Dreamweaver, Flash and Acrobat* (Laurence King, 2006) ISBN 1856694992

Kerman P – *Sams Teach Yourself Macromedia Flash MX in 24 Hours* (Sams, 2003) ISBN 0672325942

Maciuba-Koppel D – *The Web Writer's Guide* (Focal Press, 2003) ISBN 0240804813

Sengstack J – *Sams Teach Yourself Adobe Premiere in 24 hours* (Sams, 2004) ISBN 0672326078

Websites

www.graphicssoft.about.com/od/findsoftware/a/businessmmedia.htm

www.webstyleguide.com/wsg2/multimedia/design.html

Employer engagement and vocational contexts

Within this unit there are opportunities for tutors to support learners with their understanding of the range of hardware and software currently used as industrial standard. Many of these applications and hardware are now accessible to learners. Providing learners with access to relevant software manufacturers' manuals and other textbooks, the internet, and a range of examples of current multimedia practice should be encouraged.

This unit provides learners with the opportunity to gain knowledge of the styles and conventions of vocational areas such as graphic design, photography, post-production and production management.

Learners will have the opportunity to gain a fundamental knowledge of the creative technical and production practices such as understanding target audiences, copyright law, content production, graphic design, photography, typography, videography and moving image. This unit also presents opportunities for learners to understand wider vocational skills such as communication and planning and organisational skills.

Learners should be encouraged to learn and understand the importance of these principles in context with the work of professional practitioners across the creative arts vocational areas. This unit provides scope for learners to be engaged in 'real life' project briefs.

Unit 14: Website Design

Unit code: J/601/1286

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To enable learners to understand the concepts of website design and apply their own creativity in designing and developing interactive websites.

Unit abstract

The internet is perhaps the most important IT development of the last few decades; it provides new ways to communicate and share information. It has also revolutionised the way people and businesses use IT.

Businesses can now take part in a global marketplace, widening their scope for potential customers, all from a local base and with relatively low start-up costs.

The need for good web designers and developers continues to grow as more and more companies realise they must develop a web presence and keep it maintained and updated.

As web technologies develop, there is an increasing need for websites to be interactive. This allows two-way communication between the user and the website.

The number of websites on the world wide web has increased dramatically and competition is very fierce. This means that designers must employ increasingly sophisticated techniques to capture interest, as well as ensuring that an appropriate company image is presented. Usability issues, such as navigation methods, must be considered carefully. A poorly-designed structure could result in users becoming confused or frustrated and navigating away from the website.

Learners will begin this unit by evaluating existing websites, in the context of cross-platforms, range of browsers, and design features. Designing websites, which are accessible to all types of users is a fundamental aspect of any website design.

This unit also considers the whole process from identification of need, design, implementation, testing, maintenance and review. It is important that learners do not just develop skills in specific techniques but are also able to select when and where they are most appropriate, basing this decision on client and user needs. As with any field of IT, a comprehensive understanding of the relevant legislation and guidelines is always fundamental.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand website design concepts

2 Be able to design interactive websites

3 Be able to implement interactive websites

4 Be able to test interactive websites.

Unit content

1 Understand website design concepts

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; current standards and legislation eg Disability Discrimination Act, Data Protection Act, e-Commerce Regulations Act, Computer Misuse Act, W3C validation, copyright and intellectual property rights

Design: rules and heuristics for good website design; accessibility; functionality eg timings, navigation, ease of use, user-friendliness; evaluation tools eg W3C Mark-up Validation Service

Environment: features eg Uniform Resource Locators (URL), Hypertext Mark-up Language (HTML), Dynamic Hypertext Mark-up Language (DHTML), Extensible Mark-up Language (XML), JavaScript, Java Applets, plug-ins, client and server-side scripting languages; multimedia eg animation, sound/visual effects; hardware and software requirements eg computer platforms, operating systems, application software; browser behaviour eg execute scripting languages, display Cascading Style Sheets (CSS), applets, Common Gateway Interface (CGI)

2 Be able to design interactive websites

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

Design tools: concept designs eg mood boards, story boards; layout techniques eg frames, tables, block level containers, inline containers; templates; colour schemes; screen designs

3 **Be able to implement interactive websites**

Structure: layout of pages; navigation; format of content; 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 product catalogue, shopping cart; images and animation

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

Development: mark-up languages eg (HTML), (XHTML), (DHTML); client side scripting languages eg JavaScript, Visual Basic (VB) script; 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

4 **Be able to test interactive websites**

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

Mechanisms: types eg browser compatibility testing, platform testing, script-language testing; valid (HTML) code; checking functionality against requirements, check internal and external hyperlinks (web files, web documents, images), error detection, error messages, dry running

Supportive documentation: test plan; test results; programmer guidance; user guidance: on-screen help

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 website design concepts	1.1 discuss the design concepts that have to be considered when designing a website
LO2 Be able to design interactive websites	2.1 design an interactive website to meet given requirements 2.2 evaluate website design with other users.
LO3 Be able to implement interactive websites	3.1 implement a fully-functional interactive website using a design specification.
LO4 Be able to test interactive websites	4.1 critically review and test the website 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback and make recommendations for improvements 4.4 create onscreen help to assist the users 4.5 create documentation for the support and maintenance of the website.

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 20: Client-side Customisation of Web Pages	Unit 13: Multimedia Design and Authoring	Unit 35: Web Applications Development
Unit 27: Web Server Scripting	Unit 15: Website Management	
Unit 28: Website Production		

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/Interface (HCI) Design
- IT/Technology Infrastructure Design and Planning
- Software Development.

Essential requirements

Learners must have access to facilities which will give them the opportunity to fully evidence all of the criteria in the unit.

Learners must evaluate a range of different websites, particularly focusing on design. Learners must be encouraged to identify strengths and weaknesses in the design, and discuss what methods they would use to improve the website. This will of course be taking into account accessibility, relevant legislation, usability, functionality, user friendliness, interface design, etc.

Legislation and accessibility are fundamental aspects of website design. Learners must be made aware of the range of legislation and standards, which have an impact on website design. Learners must understand the importance of legislation.

Learners must design and develop their own website. There are many different approaches to website design, all of which demonstrates how a website will be developed, what features and functions it will contain, the appearance, etc. Learners must be able to show that they can apply design skills first before developing a website.

Learners must have access to computing facilities, and web authoring tools to support them with the practical aspects of this unit. Learners must be given a range of activities with plenty of support, which will enable them to create HTML web pages. Further activities must be provided that will allow learners to embed a range of web functions, such as hyperlinks, tables, frames, colour, images, audio, video, etc. Learners must include client-side scripting such as JavaScript.

Evaluation and review continues to be an important theme of this unit, and learners must be encouraged to evaluate their work throughout the entire development process. Thorough testing must be performed on their website, to ensure that it is fit for purpose and meets the requirements/specification. Appropriate testing documentation must be used as a method of capturing test data, and demonstrating relevant testing.

Resources

Books

McFarland D – *CSS: The Missing Manual, second edition* (Pogue Press, 2009) ISBN 9780596802448

McFarland D – *Dreamweaver CS4: The Missing Manual* (Pogue Press, 2009) ISBN 9780596522926

McFarland D – *JavaScript: The Missing Manual,* first edition (Pogue Press, 2008) ISBN 9780596515898

Veer E – *Flash CS3: The Missing Manual* (Pogue Press, 2007) ISBN 9780596510442

Websites

www.thebestdesigns.com/

www.w3.org

www.w3schools.com

www.webdesignfromscratch.com/articles-and-tutorials/

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 15: Website Management

Unit code: R/601/1288

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To enable learners to understand the concepts and knowledge required to effectively manage and maintain websites.

Unit abstract

The work of the IT practitioner does not stop with the official handover of a website to a client. If it is to be successful, an organisation's website needs to be managed and kept up to date. Learners will understand what is involved in managing and monitoring the performance of a website once it has been published on the web and is accessible to a wide audience. They will investigate different types of web hosts and the services they offer by weighing up the benefits and drawbacks.

Learners will upload website files to a web server, as well as manage a range of web server management services. Once the website is published, learners will carry out and document routine maintenance activities and website reviews. They will monitor and assess site performance using statistics and visitor feedback.

There is no point in having a website if no one can find it. Most people use search engines as one method of finding information they need on the web. Learners will explore the different methods and techniques used to promote websites. They will also discover what features will enhance a website so that they retain visitors as well as create opportunities to welcome new visitors.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the functions of website hosting

2 Be able to manage websites

3 Be able to improve website performance

4 Be able to promote websites.

Unit content

1 Understand the functions of website hosting

Hosting: methods eg website hosting, shared hosting, dedicated hosting, server co-location; hosting packages and services; domain names; costs; network uptime

Functions: services eg web management, email management, domain management, ftp management, file management, shopping cart, client support; performance eg reliability, availability, network uptime, access speeds, bandwidth; back-up; log analysis tools; security features

Platforms: operating systems eg Unix, Linux, Microsoft

Scripting technologies: server-side eg Hypertext Pre-Processor (PHP), Active Server Pages (ASP), ASP.NET, My-SQL (Structured Query Language) Common Gateway Interface (CGI)/ (Perl)

Legislation: accessibility, data protection, distance selling, privacy and electronic communications

2 Be able to manage websites

Website: structure eg files, folders, hypertext links; multimedia; web blogs; really simple syndication (RSS) feeds; pod casts; platform compatibility eg operating system, browser software, plug-ins; testing eg website files, links, browser, performance

Upload: methods eg internet, intranet, web server, File Transfer Protocol (FTP); file transfer protocol eg stand-alone FTP software, web-based FTP facilities, browser FTP capabilities; web authoring software; web server management; upload/download files (web pages, images, documents, multimedia content); directory structures; file and folder permissions eg read, write, execute; file security eg password protection; login, eg username, password; account control

Maintenance: content management, site integrity, troubleshooting eg broken hypertext links; monitor performance; implement upgrades; back-up

3 Be able to improve website performance

Performance: site structure; size and type of multimedia components; add-on components; bandwidth speed; network infrastructure; browser; computer hardware; computer software
Popularity: statistical data eg hit counter by day, month, year; traffic monitoring; visitor information eg visitor type, visit length; visitor feedback; website recognition eg awards, sponsorships; website accessibility; website promotion

Tools: hit counters, guest books/forums, statistics, feedback/comments forms

4 **Be able to promote websites**

Marketing: advertising eg search engines, social networking, banner, pay-per-click; exchange website links; cross-marketing techniques eg letterheads, brochures, magazine, company vehicles, television, radio

Visitors: visitor incentives eg promotional/voucher codes, discounts; data security eg website certificates, secure socket layer (SSL), encryption; presentation eg multimedia, flash content, audio and visual components, human computer interaction (HCI); visitor feedback eg check boxes, radio buttons, drop-down menus, text fields, form to email, form to database

Alternative methods: off-the-shelf software, data entry forms, response facility, forums, free user groups

Optimisations: insert components eg title, description, keyword tags; client/server side script components eg dynamic hypertext mark-up language (DHTML), extensible hypertext mark-up language (XHTML), JavaScript, Perl, Hypertext Pre-Processor (PHP), Active Server Pages (ASP), ASP.NET, Cascading Style Sheets (CSS); enhancements eg rollover image maps, audio/visual, drop-down menus, colours, multimedia

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 functions of website hosting	1.1 explain the methods and techniques required to host a website 1.2 evaluate the different services offered by web host providers 1.3 explain the legal requirements of hosting an online website.
LO2 Be able to manage websites	2.1 demonstrate the upload of a website to a web server 2.2 perform website maintenance to sustain maximum efficiency and performance
LO3 Be able to improve website performance	3.1 discuss how to monitor the performance of a website 3.2 analyse statistics relating to visitors accessing a website 3.2 explain the methods and techniques used to gather visitor feedback for a website
LO4 Be able to promote websites	4.1 explain the methods and techniques required to promote a website 4.2 evaluate the different features that are available to enhance and upgrade a website.

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 20: Client-side Customisation of Web Pages	Unit 14: Website Design	Unit 35: Web Applications Development
Unit 27: Web Server Scripting		
Unit 28: Website Production		

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
- Software Development
- IT/Technology Service Operations and Event Management
- IT/Technology Management and Support.

Essential requirements

Learners must have access to appropriate web-hosting software. They must also have access to software that enables them to upload a website.

This unit will provide learners with the opportunity to upload and manage a website, either by developing their own website, or using a website developed in other units.

Learners must be able to publish their website using a web-hosting service or local intranet system controlled by the centre.

Learners must begin this unit by exploring the vast array of website hosting packages, and the range of services they provide. It will be useful to compare these services with other web hosting packages, particularly in terms of cost, performance, reliability, and other critical factors.

Learners must be aware of the legal requirements for hosting a website, where content is accessible to everyone.

A web server can be a complicated system to use. Centres must demonstrate the full functions of using a web host/server, including uploading/downloading files, setting appropriate folder/file permissions (access privileges) as well as other features. Learners must analyse statistics on their website.

Learners must be encouraged to explore a range of methods and techniques, which will help promote websites. There is a vast array of online services, which are designed to help promote and advertise websites.

Resources

Books

Elliot G – *Website Management* (Lexden Publishing Limited, 2007) ISBN 9781904995210

Thompson P – *Website Essentials*: *A Guide to Planning, Designing and Managing Your Website* (Frogeye Publications, 2006) ISBN 0955304008

Websites

http://archive.cabinetoffice.gov.uk/e-government/resources/handbook/html/1-2.asp

www.wdvl.com/WebRef/Tools/

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 16: e-Commerce Technologies

Unit code: K/601/1975

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

The aim of this unit is to give learners an understanding of the functionality and technology that underpin e-Commerce solutions.

Unit abstract

E-Commerce has become one of the biggest growth areas in recent years. Almost everybody has engaged with buying and selling over the internet. This includes individual consumers purchasing or trading online, through to retailers that have extended their business provision to include a website and online presence, reaching out to a global market.

This unit begins by exploring a commercial transactional website, beginning with the front-end services and investigating how this links to back-office processes such as data management systems. The technologies involved in running an e-Commerce solution are explored including web architecture, hardware and software requirements and communication technology features which ensure the smooth running of the site..

Security forms a major part of any e-Commerce solution and this unit explores the various methods of securing the site, data and online payments as customers purchase goods from the site. Finally, learners will design an e-Commerce solution for a small to medium e-Commerce organisation.

On completion of this unit learners will have an understanding and appreciation of e-Commerce technologies, and how they support the infrastructure of e-Commerce activities and trading.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the functionality of commercial transactional websites

2 Understand the technologies involved in setting up commercial websites

3 Know how to address e-Commerce security issues

4 Be able to design e-Commerce technology solutions.

Unit content

1 **Understand the functionality of commercial transactional websites**

Purpose of site: purposes eg how it is structured, the goods and/or services offered, product information provided, types of transactions that can be made and how easy it is to do so, methods used to capture customer information (both overt and covert), customer authentication, techniques used to engage, retain and entice customers, usability and accessibility

Services: benefits eg access to a world wide customer base, low set-up and running costs, extension of product range to include internet-specific goods and services, 24 x 7 presence, faster response times, real-time sales information, customer expectation.

Data: processes eg capture and process data, present and exchange information, conduct transactions, market goods and services, distribute goods, manage customer relations, optimise just-in-time purchasing of stock and components; transactional database eg products and prices, stock levels, customers, orders.

Back office processes: activities eg maintenance of the virtual shopping basket, identification and authentication routines, real-time tracking of customers' actions, payment processing, stock control, despatch and delivery; chain of events leading up to an online purchase; chain of events that an online purchase triggers

2 **Understand the technologies involved in setting up commercial websites**

Web architecture: components eg Server-side scripting, client/server/script interaction, operation of server-side web applications, accessing data on the web server, dynamic web pages, consistent navigational menu on all pages, browser cookies, embedding animation and video content in web pages, adding interactivity with plug-ins

Technology: hardware and software eg web servers, browsers, server software, web authoring tools, database system, shopping cart software, scripting software, browser and platform compatibility

Networking technology eg TCP/IP addresses, ports and protocols; domain names, multiple registration of domains (.com as well as .co.uk); setting up the server directory structure, deploying access configuration/security

Database: uses and processes eg database-driven web pages, opening a connection to a database, storing data captured from forms, performing dynamic queries on the database, generating a web page response displaying the results of a query

Data transmission: features eg download speeds, transfer rates, bandwidth required for given applications including text, graphics, video, speech

Communication technology: uses eg email support, forum; search engine optimisation; additional hardware and software components required to support communications

3 **Know how to address e-Commerce security issues**

Protection from security threats: methods eg risk assessment, physical security, user identification and access rights, firewalls, virus protection, managing software updates, restricting HTTP methods, securing communication with SSL/TLS, enabling HTTPS on the web server, protecting the exchange of credentials, Secure Electronic Transactions (SET), detecting unauthorised modification of content, configuring permissions correctly, scanning for file-system changes

Certification: procedures eg obtaining and installing server certificates, certificate chains/hierarchies, validation; security eg public- and private-key cryptography, verifying message integrity with message digests, digital signatures and digital certificates

Customer information: handling eg how it is protected, how accurate it is, what it is being used for, who has access to it, potential threats such as identity theft and fraud.

Legislation: with respect to organisations and individuals exchanging information and conducting transactions online eg data protection, civil rights, distance selling

4 **Be able to design e-Commerce technology solutions**

Solution: design for a small to medium e-Commerce organisation

Hosting: choice of Internet Service Provider (ISP); in house or sub-contracted

Hardware and software: requirements based on eg projected hits on site, bandwidth requirements

Structure: customer interface eg ease of use, display of products, personal details entry, credit card entry, other types of payment, delivery details; image; style

Promotion: marketing: eg advertising the site, placing in search engines; message board; chat rooms

Finance: costs eg hardware and software, setup, maintenance, security, leasing, advertising; delivery strategy; staff training

Security: fraud protection; threats eg hackers, viruses

Database: processes eg schema design, query processing, file systems, ensuring integrity, availability, successful transactions, recovery and authentication; multimedia databases

Connectivity: linking via a web server/internet with databases eg ODBC (Object Database Connectivity), JDBC (Java Database Connectivity (DBC)), SQL, Microsoft ASP (Active Server Pages)

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 functionality of commercial transactional websites	1.1 evaluate the effectiveness of a commercial transactional website suggesting areas for improvement 1.2 show diagrammatically the chain of events and the flow of information that are triggered by an online purchase
LO2 Understand the technologies involved in setting up commercial websites	2.1 analyse a commercial transactional website detailing the technologies implemented by the site 2.2 explain how to evaluate web server performance
LO3 Know how to address e-Commerce security issues	3.1 discuss how the security of data exchanged through an e-Commerce service can be managed 3.2 describe current legislation related to online purchasing and protection of customer data
LO4 Be able to design e-Commerce technology solutions	4.1 design an e-Commerce technology solution for a small to medium e-Commerce organisation 4.2 discuss the differences between an in-house hosted solution against a sub-contracted hosted 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 1: Business Skills for e-Commerce	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:

- IT/Technology Infrastructure Design and Planning.

Essential requirements

Learners must have access to a range of e-Commerce sites and organisations that engages with e-Commerce at all levels. Learners should also keep up to date with current research developments in the field regarding technologies and security.

Resources

Books

Hassler V – *Security Fundamentals for E-commerce* (Artech House, 2000) ISBN 1580531083

Khosrow-Pour M – *E-commerce Security: Advice from Experts (IT Solutions)* (IGI Publishing, 2004) ISBN-10: 1591402417

Reynolds J – *The Complete E-Commerce Book: Design, Build & Maintain a Successful Web-based Business: Design, Build and Maintain a Successful Web-based Business* (CMP, 2004) ISBN-10: 1578203120

Rich J – *Design and Launch an e-Commerce Business in a Week (Entrepreneur Magazine's Click Starts)* (Entrepreneur Press, 2008) ISBN-10: 1599181835

Websites

http://forums.techarena.in/guides-tutorials/6050.htm

www.ecommerce-digest.com/ecommerce-security-issues.html

www.ecommercetechnology.org/english/index.htm

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 from a range of organisations. Speakers can discuss their e-Commerce system(s) in terms of the infrastructure, technologies and security aspects.

Unit 17: Database Design Concepts

Unit code: R/601/0447

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To give learners opportunities to develop an understanding of the concepts and issues relating to databases and database design as well as the practical skills to translate that understanding into the design and creation of complex databases.

Unit abstract

Databases play an integral part in commercial domains, they provide users with a tool in which to store, model and retrieve data. Database development is fundamental in the area of computing and ICT within organisational contexts. Database Management Systems (DBMS) provide the systems, tools and interfaces by which the organisation can manage their information and use it to assist in the effective running of the organisation. Databases offer many links to other areas such as programming, systems analysis, HCI, as well as embracing issues of compatibility and end-user interfacing.

This unit explores database architecture, DBMS and the use of databases in an organisational context. Database design techniques are investigated and successful learners will be able to apply theoretical understanding to design, create and document a database system.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand databases and data management systems

2 Understand database design techniques

3 Be able to design, create and document databases.

Unit content

1 Understand databases and data management systems

Databases: database architectures; files and record structures; physical and logical views of data; advantages of using databases; reduction of data redundancy; data consistency (validity, accuracy, usability and integrity); independence of data; data sharing possibilities; security; enforcement of standards; database utilities; data dictionaries; query languages; report generators

Databases in an organisational context: database applications; role of the database administrator; key organisational issues eg integrity, security, recovery, concurrency; industry standards eg Microsoft SQL, Oracle, Sybase, dBase

Database Management Systems (DBMS): structures; purposes; features and advantages; applications; methods of data organisation and access

2 Understand database design techniques

Database design methods and methodology: requirements analysis; database designer working with expert in domain development area; requirement specification; logical design eg relational databases, tables; physical design eg data elements, data types, indexes; data analysis and design within systems analysis; database design within a system development methodology

Relational database design: tables, relations, primary/foreign/compound keys; entity-relationship modelling; normalisation theory to third normal form

3 Be able to design, create and document databases

Database development cycle: developing logical data model; implementing a physical data model based on the logical data model; testing the physical data model; comparing model with requirements analysis; user interface eg input masks, drop-down lists, option buttons, command buttons

Database software: using appropriate applications software, eg Microsoft Access, SQL; database tools eg create tables, add new rows, alter data, functions, relational database languages

Tools and techniques: field and table design; validation and verification techniques; forms including such features as dropdown lists or check boxes; reports; queries; macros

Documentation: technical documentation; user documentation

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 databases and data management systems	1.1 analyse the key issues and application of databases within organisational environments 1.2 critically evaluate the features and advantages of database management systems
LO2 Understand database design techniques	2.1 analyse a database developmental methodology 2.2 discuss entity-relationship modelling and normalisation
LO3 Be able to design, create and document databases	3.1 apply the database developmental cycle to a given data set 3.2 design a fully functional database (containing at least four inter-relational tables) including user interface 3.3 evaluate the effectiveness of the database solution and suggest methods of improvement 3.4 provide supporting user and technical documentation.

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: Database Design	Unit 9: Systems Analysis and Design	Unit 33: Data Analysis and Design

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.

Essential requirements

Learners must have access to database software such as Microsoft Access or industry standard software, as learners can then transfer any skills and knowledge and map it directly into a commercial environment.

This unit must be divided into taught theory and practical sessions. In developmental activities, learners must be encouraged to develop designs and then be given feedback prior to any actual implementation – errors and confusions within a database design can cause significant problems at implementation that are difficult to retrieve.

Learners must make connections and identify the role of database design within the systems development lifecycle.

Learners must be introduced to developmental methodologies such as Structured Systems Analysis and Design Methodology (SSADM), Rapid Application Development (RAD) and the SPIRAL software development process.

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

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 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 20: Event Driven Programming Solutions

Unit code: H/601/0453

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the principles of event driven programming as an underpinning technological concept in the fields of programming and systems development.

Unit abstract

Unlike traditional programming, where the flow of control is determined by the program structure and the programmers design, the control in event driven programs is largely driven by external events and is often determined by interaction with the user. Typically, the systems involved employ pre-programmed event loops (or listeners) to continually look for information to process.

Event driven programming is a very flexible way of allowing programs to respond to many inputs or events. It is used for all GUI based applications and can be found in web based multimedia as well as mobile technologies.

This unit allows learners to become familiar with the underpinning concepts of event driven programming and subsequently to develop particular skills in one chosen language. A variety of languages have the capacity to develop event driven solutions and it is not important which language is chosen as long as the skills being developed and evidenced relate to the key event driven focus.

As with all programming, a focus on developing solutions to meet identified needs is made along with one that emphasises the importance of testing and reviewing.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the principles of event driven programming.

2 Be able to design event driven programming solutions

3 Be able to implement event driven programming solutions

4 Be able to test and document event driven programming solutions.

Unit content

1 Understand the principles of event driven programming

Characteristics: key characteristics eg event handlers, listeners, trigger functions, event loops, forms

Features: key features eg flexibility, suitability for Graphical User Interface (GUI) environments, simplicity of programming, ease of development, potential portability

Programming languages: available languages eg Visual Studio .Net environment, Action Script, Java, C++

Development environments: environments eg for a given GUI, Java Runtime, mobile phones, multimedia, web based

2 Be able to design event driven 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 GUI template, graphical interface, design guides, state and interaction diagrams, screen layouts, data storage event procedures and descriptions, data and file structures

Specification: contents eg input, output, processes, user need, purpose

Creation of application: use of development environment eg mobile, handheld, web based, desktop, dedicated device; debugging delivery environment

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

3 Be able to implement event driven programming solutions

Triggers: types eg key press, alarm, system event, touch screen event, mouse click, external trigger, network event, incoming data, incoming call, Global Positioning Systems (GPS) data change

Tools and techniques: tools eg use of tool boxes and controls, debugging tools; techniques eg selection, loops, event handlers, triggers, listeners, objects and object properties, menus

Data: properties eg variables, data types, declaring variables, scope of variables, constants

Programming: coding eg use of methods, use of 'traditional coding'

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

Complexity: multiple events; user interaction

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

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

4 Be able to test and document event driven programming solutions

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

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 event driven programming	1.1 discuss the principles, characteristics and features of event driven programming
LO2 Be able to design event driven programming solutions	2.1 design an event driven programming solution to a given problem 2.2 identify the screen components and data and file structures required to implement a given design
LO3 Be able to implement event driven programming solutions	3.1 implement an event driven solution based on a prepared design 3.2 implement event handling using control structures to meet the design algorithms 3.3 identify and implement opportunities for error handling and reporting 3.4 make effective use of an Integrated Development Environment (IDE) including code and screen templates
LO4 Be able to test and document event driven programming solutions	4.1 critically review and test an event driven programming solution 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback on a developed event driven 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 19: Object Oriented Programming	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

Whilst some event driven languages are commercially available, there are also free languages available incorporating an advanced set of event driven features 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 workstations 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 this unit.

The learner must develop an application that is event driven and may work on a range of platforms, therefore it may be web based, GUI based, games console or a deliverable for a mobile platform amongst many other solutions.

Resources

Books

Balena F – *Programming Microsoft Visual Basic 2005*: *The Language* (Microsoft Press US, 2006) ISBN 0735621837

Bond M, Law D, Longshaw A, Haywood D and Roxburgh P – *Sams Teach Yourself J2EE in 21 Days, Second Edition* (Sams, 2004) ISBN 0672325586

Palmer G – *Java Event Handling* (Prentice Hall, 2001) ISBN 0130418021

Sharp J – *Visual J#.NET Core Reference* (Microsoft Press US, 2002) ISBN 0735615500

Suddeth J – *Programming with Visual Studio .NET 2005* (Lulu.com, 2006) ISBN 1411664477

Troelsen A – *Pro C# 2005 and the .NET 2.0 Platform, Third Edition* (Apress US, 2004) ISBN 1590594193

Websites

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

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

http://tech.miradigm.com/proc_quick.php

http://visualbasic.freetutes.com/

www.developerfusion.com/tag/vb.net/

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 21: Software Applications Testing

Unit code: L/601/1984

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the principles of software applications testing as an essential element in the development of commercial applications for delivery to customers.

Unit abstract

Linking into all programming units, this unit supports the detailed exploration, development and deployment of a functional commercial application. Taking the designed and implemented application and ensuring that it is tested and documented to a commercially viable standard.

Learners taking this unit will be able to work on a range of systems, being able to apply the testing techniques to procedural event driven and object oriented systems. There is no particular programming platform or preferred language inherent in the unit, it will support existing programming solutions as well as new developments.

A learner may work on GUI-based systems, a web-based application, a multimedia resource, a mobile (or handheld) application as well as a 'traditional' procedural programming environment to meet the outcomes of this unit. The assurance is that in any of the applications being tested the learner must be systematic and ensure the quality of the system being developed.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the principles of software application testing

2 Be able to design test strategies

3 Be able to implement test plans

4 Be able to evaluate test plans.

Unit content

1 Understand the principles of software application testing

Specification: user needs eg analysis of requirements, expected outcomes, expected timeline

Dry run of design: testing eg given data, expected outcomes

Implementation: testing techniques eg black box, functional, white (or glass) box; sub-system testing eg integration, whole system, interface

Methodology: testing method eg top down, bottom up, component based, Graphical User Interface (GUI), code, event only, pre-alpha, alpha, beta

Maintenance: procedures eg following changes, reviews, time based, stress/overload

User evaluation: user testing eg against requirements, actual outcomes, acceptance, alpha participation, beta participation

Requirements: resources eg software, hardware, tester time, user time, system access

Documentation: technical documentation eg system and program specifications, user requirements, plans and logs

2 Be able to design test strategies

Test strategy: contents eg timing, justification, functionality, maintainability

Test plan: example data eg normal, erroneous, extreme; expected outcomes eg valid, invalid, information gained; prioritisation

Techniques: types of testing eg black box, functional, white (or glass) box, validation, verification, creation of test cases, reuse of test cases

Versioning: alpha testing in closed test; beta test in open environment; version cycles; bug fixing

3 Be able to implement test plans

Reporting: procedures eg manage reporting process, bug collection protocol, bug response and fix protocol

Tools: testing tools eg Bugzilla

Fault identification: procedures eg prioritisation, categorisation, response

Monitoring: procedures eg adjusting timelines, time management, allocation of resources, feedback to customer, managing adherence

4 Be able to evaluate test plans

Evaluation: of features eg functionality, accuracy, effectiveness, alterations to tests carried out, timeliness; of possible improvements eg program specification and design, self-reflection on product, aspects of test management; of maintainability eg usefulness to self, usefulness to others, usefulness for customers

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 software application testing	1.1 evaluate testing techniques applicable to the testing opportunity 1.2 compare the relative benefits of different testing methodologies 1.3 justify a proposed testing methodology
LO2 Be able to design test strategies	2.1 design a test strategy for a given testing opportunity 2.2 design a test plan for a given testing opportunity 2.3 justify the test plan proposition and testing strategy
LO3 Be able to implement test plans	3.1 implement a test plan based on a given testing opportunity
LO4 Be able to evaluate test plans	4.1 critically review the test outcomes 4.2 justify the validity of the test and identify any potential issues.

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 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
- IT/Technology Solution Testing.

Essential requirements

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.

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 22: Office Solutions Development

Unit code: R/601/1971

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To equip learners with the knowledge and skills needed to develop application solutions that can be used to automate business processes.

Unit abstract

Within an organisation, a range of business processes are functional at operational, tactical and strategic levels within the business structure. Some business processes are quite simplistic, especially at the operational level where routine, non-complex decisions and tasks are undertaken. However as you advance through the levels of an organisation, the strategic levels, more complex business processes and decision making is required that may need support from more automated, on-demand information systems and solutions.

Providing office solutions to support a range of business functions and decision making can range from the implementation of a simple rule or macro, through to the design of a more complex piece of code or program to support different end users.

This unit is designed to build upon existing skills and knowledge previously gained from using different types of application and design software. Learners will be expected to demonstrate more advanced skills in terms of data manipulation, configuration, application and implementation of software packages to enhance a given business processes or processes.

On completion of this unit the learner should be able to use design application software at an advanced level of proficiency. Learners will engage with a range of software, and select the most appropriate application(s) to offer feasible and working business solutions.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand how application software can support business processes

2 Be able to design and implement office solutions

3 Be able to demonstrate that business processes have been enhanced/improved.

Unit content

1 **Understand how application software can support business processes**

Applications software: types eg spreadsheets, database, presentation, graphics, desk-top publishing, word processing

Business processes: management eg supporting decision making, problem solving; operational eg sales, purchasing, marketing; support eg accounting, technical

Supporting processes: improving the efficiency of a business process eg forecasting, decision making, predictive reasoning; automating processes eg print runs, salary slips

Supporting the user: user requirements eg accessibility, usability, clarity, help

2 **Be able to design and implement office solutions**

Solutions: supporting a business process eg end user requirements, systems requirement, application to automate procedures, designing a tool, program or package that can perform a specific task to support problem-solving or decision-making at an advanced level, creating an e-Commerce function for a website to support a specific business process, designing a program for a specific end user that will support another application or process

Design: considerations eg addressing the user or system requirement; user-friendly and functional interface; consideration of user engagement and interaction with the designed solution; customization of the solution to satisfy the user and system requirements

Advanced tools and techniques: tools eg analysing data with interactive PivotTables and PivotCharts, linking Excel spreadsheets with Sharepoint, team collaboration and document management with Windows SharePoint; techniques eg creating decision-making macros, programming Access objects, building intuitive user interfaces with VBA, building ASP.net web applications

Testing: functionality: eg checking against requirements, error handling, documentation

3 **Be able to demonstrate that business processes have been enhanced/improved**

User engagement: engagement through eg meetings, questionnaires, interviews

Enhanced/improved: comparisons eg more efficient, faster results, more user friendly, improved compatibility with other systems and processes, improved management information

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 how application software can support business processes	1.1 discuss ways in which applications software can support business processes 1.2 justify the use of different application software to support a given user requirement or business process 1.3 discuss the importance of addressing both user and business requirements
LO2 Be able to design and implement office solutions	2.1 design a solution to address a business or user need 2.2 use advanced tools and techniques to implement a solution 2.3 test a solution against expected results
LO3 Be able to demonstrate that business processes have been enhanced/improved	3.1 discuss ways in which end user engagement has taken place 3.2 provide evidence that business processes have been enhanced/improved 3.3 evaluate possible further improvements that could be made to enhance the 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 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 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:

- IT Application Management/Support.

Essential requirements

Learners must have access to a range of applications and design software. In addition, examples of real-life business process scenarios would also provide further guidance and support in terms of their own solutions.

Resources

Books

Heathcote P – *Successful ICT Projects in Excel* (Payne Gallway, 2002) ISBN-10: 1903112710

Jellen B – *Brilliant Microsoft Excel 2007 VBA and Macros (Brilliant Excel Solutions)* (Prentice Hall, 2007) ISBN-10: 0273714058

Jellen B – *Excel VBA and Macros with MrExcel* (Video Training) (Livelessons) (QUE, 2009) ISBN-10: 0789739380

Rendell I, Mott J – *Advanced Spreadsheet Projects in Excel* (Hodder, 2008) ISBN 0340929243

Websites

http://spreadsheets.about.com/od/advancedexcel/Advanced_Topics_in_Excel_Spreadsheets.htm

www.ehow.com/topic_2573_advanced-excel-tutorial.html

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 speakers from a range of organisations to discuss business processes and the applications that support these.

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 24: Networking Technologies

Unit code: M/601/0472

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To enable learners to understand computer networking concepts, how they work, how they operate and the protocols, standards and the models associated with networking technology.

Unit abstract

Understanding of the underlying principles of networking is of vital importance to all IT professionals in an environment that is increasingly complex and under continuous development.

The aim of this unit is to provide a background to the basic components of networked systems from which all networking operations derive. It also includes the evaluation of networks and network applications.

Learners taking this unit will explore a range of hardware and technologies, culminating in the design and deployment of a networked system. Working with many technologies, this unit can be used for mobile systems, local area networks as well as larger scale wider area networked systems. Supporting a range of units in the Higher National suite this unit underpins the principles of networks for all and enables learners to work towards their studies in vendor units if applicable.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand networking principles

2 Understand networking components

3 Be able to design networked systems

4 Be able to implement and support networked systems.

Unit content

1 Understand networking principles

Role of networks: purpose, benefits, resource implications, communications, working practice, commercial opportunity, information sharing, collaboration

System: types, eg peer based, client-server, cloud, cluster, centralised, virtualised

Networking standards: conceptual models eg OSI model, TCP/IP model; standards: eg IEEE 802.x

Topology: logical eg Ethernet, Token Ring; physical eg star, ring, bus, mesh, tree, ring

Communication: bandwidth, throughput

Protocols: relationship to networking standards; purpose of protocols; routed protocols eg IPv4, IPv6, FTP, HTTP, SMTP, POP3, SSL; management of protocols for addressing; routing protocols eg RIP, RIPv2, OSPF, OSPFv3, BGP

2 Understand networking components

Hardware components: workstation eg mobile, fixed, handheld, console; servers; switches; routers; cabling; hubs; repeaters; bridges; wireless devices; mobile eg 3G, 4G, GPRS

Software components: software eg client software, server software, client operating system, server operating system

Server: type eg firewall, email, web, file, database, combination, virtualisation, terminal services server

Server selection: cost, purpose, operating system requirement

Workstation: hardware eg network card, cabling; permissions; system bus; local-system architecture eg memory, processor, I/O devices

3 Be able to design networked systems

Bandwidth: expected average load; anticipated peak load; local internet availability; cost constraints

Users: quality expectations, concept of system growth

Applications: security requirements, quality of service needs

Communications: suited to devices, suited to users, supportive of lifestyle desires, supportive of commercial requirements

Scalable: able to support device growth, able to support addition of communication devices, able to cope with bandwidth use and trend changes, protocol utilisation, addressing

Selection of components: supporting infrastructure needs; supporting connectivity requirements

4 **Be able to implement and support networked systems**

Devices: installation of communication devices, allocation of addresses, local client configuration, server configuration, server installation

Connectivity: installation of internet work communication medium

Testing: communication; bandwidth

User access: bandwidth, applications, devices

Policy review: bandwidth, resource availability

System monitoring: utilisation, bandwidth needs, monitoring user productivity

Maintenance schedule: backups, upgrades, security, auditing

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 networking principles	1.1 discuss the benefits and constraints of different networking systems types and topologies 1.2 evaluate the impact of current network technology, communication and standards 1.3 discuss how protocols enable the effective utilisation of different networking systems
LO2 Understand networking components	2.1 discuss the role of software and hardware components 2.2 discuss server types and selection requirement 2.3 discuss the inter-dependence of workstation hardware with network components
LO3 Be able to design networked systems	3.1 design a networked system to meet a given specification 3.2 evaluate the design and analyse user feedback
LO4 Be able to implement and support networked systems	4.1 implement a networked system based on a prepared design 4.2 test the network system to meet user requirements 4.3 document and analyse test results against expected results 4.4 recommend potential enhancements for the networked systems 4.5 design a maintenance schedule to support the networked 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 5: Managing Networks	Unit 2: Computer Systems	Unit 36: Internet Server Management
Unit 9: Computer Networks	Unit 25: Routing Concepts	Unit 43: Networking Infrastructure
Unit 10: Communication Technologies	Unit 26: Design a Small or Home Office Network	Unit 44: Local Area Networking Technologies
Unit 32: Networked Systems Security	Unit 27: Network Operating Systems	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/Technology Service Operations and Event Management
- 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 be successfully accomplished using virtual machines.

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 and the services they offer.

Implementation of the networked system must be tested systematically and based on the technology used in the design solution. The final system implemented may be on a live system, but ideally should be tested in a simulated or sand box environment.

Resources

Books

Burgess M – *Principles of Network and System Administration, 2nd Edition* (John Wiley and Sons Ltd, 2003) ISBN 0470868074

Hallberg B – *Networking*: *A Beginner's Guide*, *4th Edition* (Osborne/McGraw-Hill US, 2005) ISBN 0072262125

Limoncelli T and Hogan C – *The Practice of System and Network Administration* (Addison Wesley, 2001) ISBN 0201702711

Lowe D – *Networking All-in-One Desk Reference for Dummies, 2nd Edition* (Hungry Minds Inc US, 2005) ISBN 0764599399

More M, Southwick P, Pritsky T and Riggs C – *Telecommunications*: *A Beginner's Guide* (McGraw-Hill Education, 2001) ISBN 0072193565

Olifer N and Olifer V – *Computer Networks: Principles, Technologies and Protocols for Network Design* (John Wiley and Sons Ltd, 2005) ISBN 0470869828

Schiller J – *Mobile Communications*, *2nd Edition* (Addison Wesley, 2003) ISBN 0321123816

Subramanian M – *Network Management: An Introduction to Principles and Practice* (Addison Wesley, 2000) ISBN 0201357429

Websites

www.cisco.com

www.howstuffworks.com

www.webopedia.com

www.wikipedia.org

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 25: Routing Concepts

Unit code: Y/601/1423

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the complexities of routing and routed networks, which includes the management of reliable communication across a distributed LAN or WAN infrastructure.

Unit abstract

Networks such as the internet have become a part of everyday life with many commercial, educational and governmental organisations having ownership or access to a routed network infrastructure. Where any system has to endure segmentation, for security, traffic management or distance communication, a routed infrastructure ensures the persistence of communication and the management of data transfer.

The impact of a routed network across an organisation requires the up-skilling of staff, changes to the physical environment and changes to commercial procedures. For example connectivity between departments may take a new routed pathway, and access, security and ownership of data may change as a result of the addition of routed subnets to the network. Learners will understand that consideration must be given to not only the physical network but the organisational culture as well.

Learners will also understand how routing affects network communication and how routers utilise protocols to 'learn' about the changing topology in a network infrastructure in order to offer reliable data transfer.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the impact of routing technologies

2 Be able to design complex routed environments

3 Be able to implement complex routed environments

4 Be able to troubleshoot and monitor routed environments.

Unit content

1 Understand the impact of routing technologies

Routing hardware: hardware eg access routers, distribution routers, core switches, layer 3 switches

Routing protocols: protocol eg interior routing protocols, exterior routing, static routing

Protocol management: management eg redistribution between protocols, route maps, route filters

Device management: management eg password control, access levels, configuration storage, remote access

Network management: types eg address allocation, interface configuration, load balancing, mirroring, costing routes, changing metrics, hop-count

Security: requirements eg MD5 hash (Message Digest), update control, access control lists, directed updates, tunnelling

2 Be able to design complex routed environments

Devices: types eg expected average number of routing devices on system

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

Users: types eg quality expectations, concept of system growth

Applications: types eg allowing, denying ingress/egress

Communications: types eg suited to devices, suited to users, suited to environment

Scalable: types 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

Technology: network design, routing table reduction, protocol management, convergence time, protocol specific, number of hops, routing table size

3 Be able to implement complex routed environments

Devices: types eg access routers, distribution routers, core switches, layer 3 switches; installation of routing devices; allocation of networks; routing device configuration

Specialised configuration: eg routing protocol, redistribution, interfaces, network address allocation, security features

Security: types eg ACL's (Access Control Lists), MD5 authentication, routing device

Connectivity: types eg suitable bandwidth, communication infrastructure, throughput

Testing: systems eg local communication, end-to-end communication; security; bandwidth; routing table validity

4 **Be able to troubleshoot and monitor routed environments**

Infrastructure performance: network monitoring tools, user access, traffic analysis, bandwidth monitoring, checking configuration, checking rules, show commands, traceroute

Resolve issues: use troubleshooting methodology; make change to resolve issue; 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 routing technologies	1.1 evaluate current routing hardware and routing protocols 1.2 evaluate device and network management 1.3 evaluate current security requirements
LO2 Be able to design complex routed environments	2.1 design a routed environment to meet a given specification. 2.2 evaluate design and analyse user feedback
LO3 Be able to implement complex routed environments	3.1 implement a routed environment from a design specification 3.2 test the routed environment 3.3 document and analyse test results
LO4 Be able to troubleshoot and monitor routed environments	4.1 monitor and evaluate infrastructure performance against a given specification 4.2 resolve issues to improve performance.

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 26: Design a Small or Home Office Network	Unit 44: Local Area Networking Technologies
Unit 32: Networked Systems Security	Unit 27: Network Operating Systems	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/ 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 be successfully accomplished using virtual machines.

Learners must have access to facilities, which allow them the opportunity to fully evidence all 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 and the services they offer.

Learners must have access to a range of suitable routing hardware 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.

Resources

Books

Macfarlane J – *Network Routing Basics: Understanding IP Routing in Cisco Systems* (Wiley, 2006) ISBN-10: 0471772739

Medhi D, Ramasamy K – *Network Routing: Algorithms, Protocols, and Architectures* (Morgan Kaufmann, 2007) ISBN-10: 0120885883

Xiao Y, Li J, Pan Y – *Security and Routing in Wireless Networks: Wireless Networks and Mobile Computing v. 3* (Nova Science, 2005) ISBN-10: 159454316X

Websites

www.aplawrence.com/Girish/gentle-routing.html

www.cisco.com

www.sangoma.com/support/tutorials/tcp_ip.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 26: Design a Small or Home Office Network

Unit code: Y/601/0448

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To provide learners with opportunities to design, implement, manage and support a small or home office network as a standalone system or as part of a larger remote infrastructure.

Unit abstract

IT utilisation has evolved rapidly since the initial personal internet boom of the late 1990s with the majority of private homes and small organisations now having megabit capable bandwidth and an extensive range of devices able to connect to the Internet.

For many home and commercial users of the internet, the design of a system could be an ad hoc affair, with many high-street retailers offering 'out-of-the-box' solutions. Whilst this solution will suit the lower capacity user, many discover the limitations of security, scale and device interaction offered.

Learners taking this unit will explore how private homes and small organisations, as well as branches of larger enterprises can create a system that will scale according to demand. Learners will also have the opportunity to consider how they may design and deploy a system with the potential to adapt to technological change as well as user preference.

There is no restriction on the type of system or devices that may be incorporated into the learning behind this unit. The technological aspect ranges from games consoles through to mobile devices as well as systems with only two or three users up to a system that may have to support at least 50 users or devices.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the impact of small or home office networks

2 Be able to design small or home office networks

3 Be able to implement small or home office networks

4 Be able to support small or home office networks.

Unit content

1 Understand the impact of small or home office networks

Mobility: device participation, range of devices on system

Capacity: constraints eg bandwidth to internet; local internet contention ratio; internal network bandwidth; internal network contention ratio; bandwidth requirements (applications; users; devices)

Devices: types eg phones, handheld consoles, Personal Digital Assistants (PDA), laptops, games consoles, workstations, printers, network drives, media centres

Usage: activities eg entertainment, gaming, social networking, video streaming; users eg commercial, personal, home working

Security: methods eg address allocation, local Demilitarized Zone (DMZ), Network Address Translation (NAT) address mapping, wireless encryption, Virtual Private Network (VPN) to central employer/commercial location, device security, firewall

Communications: connections eg wireless, wired, Ethernet over power, 3G, Bluetooth, broadband, Asymmetric Digital Subscriber Line (ADSL)

Impacts: social practice eg working patterns, social engagement, user expectations, entertainment, sharing of resource, use of technology

2 Be able to design small or home office networks

Devices: number of connected devices; anticipated participation

Bandwidth: average load; peak load; local Internet availability; cost constraint

Users: quality expectations; concept of system growth

Applications: requirements eg security, quality of service

Communications: considerations eg suited to devices, suited to users, lifestyle preferences, commercial requirements

Scalable: considerations eg supporting device growth, supporting additional devices, bandwidth use trend change

Security: considerations eg addressing policy, device participation, firewall rules, encryption preference

3 Be able to implement small or home office networks

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

Connectivity: setup eg communication medium, external network, internet connection

Testing: internet access; security; bandwidth; documentation eg comparison charts, performance graphs

4 **Be able to support small or home office networks**

User access: requirements eg applications, devices, bandwidth

Maintenance: monitoring eg security, utilisation, bandwidth needs, user productivity

Future improvements: upgrades eg adding devices, removing devices, upgrade bandwidth, additional communications devices; maintenance schedule eg backups, upgrades, security, auditing

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 small or home office networks	1.1 evaluate the usage and impact of current small or home office networks
LO2 Be able to design small or home office networks	2.1 design a small or home office network solution to meet a given specification 2.2 evaluate the design and analyse user feedback
LO3 Be able to implement small or home office networks	3.1 implement a small or home office network solution based on a prepared design 3.2 test the small or home office network solution to meet user requirements 3.3 document and analyse test results against expected results
LO4 Be able to support small or home office networks	4.1 discuss future improvements for the small or home office network 4.2 design a maintenance schedule to support a small or home office network.

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 27: Network Operating Systems	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

Essential requirements

Learners must have access to a live or 'detached' network environment to create the network infrastructure and develop their skills, this may 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.

If your centre is using a real network to base the design upon, you must consider the legal implications of how this may affect the owners of the real network, as well as for the learner and the academic centre.

Implementation of the SOHO solution must be tested systematically and procedurally based on the technology used in the design solution.

Resources

Books

Moulton P – *Soho Networking: A Guide to Installing a Small Office/Home Network* (Prentice Hall, 2002) ISBN-10: 0130473316

Reed A, Lorenz J – *Networking for Home and Small Businesses, CCNA Discovery Learning Guide* (Cisco Press, 2007) ISBN-10: 1587132095

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 learner's experience and enable understanding of wider technical application.

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 28: IT Support for End Users

Unit code: F/601/0458

QCF Level 4: BTEC Higher National

Credit value: 15

Aim

To enable learners to perform user support tasks and to provide training materials for users and user support staff.

Unit abstract

As the number and variety of systems used by management, administration and other non-IT professionals grows, and as organisations become increasingly dependent upon these, the need to provide efficient, effective and consistent support to the users of these systems becomes paramount.

Computer users need appropriate training and support in order to be able to make best use of the systems available to them. As problems will inevitably occur, they also need access to knowledgeable and sympathetic staff within a formal framework of support. This is often via a help desk which, depending on the complexity of the problem, may provide direct assistance, remote support or refer to further expert support.

Learners will begin this unit by looking at how to analyse a reported problem and provide user support. This can be in the context of the problem and also in preventive training. Learners will evaluate how problems affect user productivity.

Learners will then deliver appropriate user support, both by remote means and in person. They will design and apply methods of monitoring and documenting user support activities.

Finally, learners explore user support planning including production of user manuals, training courses, and plans for system maintenance and disaster recovery.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand user problems

2 Be able to provide user support

3 Be able to create user support programmes.

Unit content

1 Understand user problems

Analysis of problem: incoming incidents; problems; change requests; identifying user requirements eg accessing user computer systems (remotely or at the desktop), user description; using software tools; human factors eg appreciation of user frustration, appropriate communication techniques

Types of problem: technical problems eg hardware (compatibility, failure, degradation, configuration), software (compatibility, failure, corruption, configuration), system capacity problems, transmission problems (cables, switches, routers), connectivity problems (internet, other systems, printers, shared resources); continuous; user created; system changes (automatic updates, installed patches)

Response: support levels, methods of supporting a user eg immediate response, advice on access to manuals, help systems, obtaining additional support

Evaluation: estimations of system downtime and reduction in user productivity

2 Be able to provide user support

Incident recording: details eg customer name, problem, date and time of call, response, action taken, time taken to resolve problem; media to store details eg paper, software; support materials consulted eg manuals, guides, multimedia, courses

Fault diagnosis: tools eg remote fault diagnosis, third-party utilities; record tests carried out, advise on corrective action, confirm problem has been solved

User support: remote; in person; incidents eg software update, device driver installation, re-configuring network card, adding memory chips; change of motherboard; installing new hard drive

3 Be able to create user support programmes

User support manual: troubleshooting eg logging on, accessing the network, email, browser issues, printer problems, viruses, mobile access; accessing software eg office, company bespoke.

User training: identifying training needs; IT policy (email, web, software installation);.security; applications; routine maintenance.

Support planning: upgrading/replacement of existing system hardware/software, infrastructure (backbone, routers, switches, cabling, WAPs).

System maintenance: preventative, predictive, remedial; routine maintenance eg backing up, cleaning, virus scan, defragmentation, removal of temporary files, password policies.

Recovery plans: hardware failure (workstation, server), natural disaster, power failure, major loss of data, security breaches, restoring data.

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 user problems	1.1 discuss an analytical approach to solving different types of user problems 1.2 evaluate the impact of problems on user productivity
LO2 Be able to provide user support	2.1 design suitable methods to monitor and document technical support activities 2.2 deliver user support, both at the desktop and remotely, to meet user needs
LO3 Be able to create user support programmes	3.1 design a user support manual for an organisation that could be used by users before contacting the help desk 3.2 devise a training course that could be presented to new employees of a company to enable them to be familiar with company IT policies and systems 3.3 produce a system support services plan for an organisation that includes support planning, system maintenance and disaster recovery.

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 12: IT Technical Support	Unit 2: Computer Systems	
Unit 13: IT Systems Troubleshooting and Repair	Unit 24: Networking Technologies	
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:

- IT/Technology Service Helpdesk and Incident Management
- IT Application Management/Support
- IT/Technology Management and Support.

Essential requirements

Learners must be given access to appropriate hardware and software to allow them to practise and demonstrate practical skills as evidence of learning. This will necessitate the provision of well-managed break-fix resources.

Resources

Books

Beisse F – *A Guide to Computer User Support for Help Desk and Support Specialists, International Edition* (Course Technology, 2009) ISBN-10: 1439042055

Bruton N – *How to Manage the IT Help Desk: A Guide for User Support and Call Center (Computer Weekly Professional)* (Butterworth Heinemann, 2002) ISBN-10: 0750649011

Gookin D – *Troubleshooting and Maintaining Your PC All-in-one Desk Reference for Dummies* (Wiley, 2009) ISBN-10: 0470396652

McRae K, Marshall G – *Computer Troubleshooting: The Complete Step-by-step Guide to Diagnosing and Fixing Common PC Problems* (Haynes & Co, 2008) ISBN-10: 1844255174

Sanchez A – *Technical Support Essentials: Advice to Succeed in Technical Support (Beginner to Intermediate)* (CA Press, 2010) ISBN-10: 1430225475

Wooton R – *Building and Running a World Class IT Help Desk* (McGraw Hill, 2001) ISBN-10: 007213237X

Websites

www.answersthatwork.com/

www.internet4classrooms.com/support.htm

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 29: e-Commerce Strategy

Unit code: T/601/1994

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To enable learners to understand how businesses and organisations develop e-Commerce strategies to remain competitive in the global market.

Unit abstract

This unit starts by considering customers' expectations of e-Commerce, because these will dictate implementation priorities.

When planning an e-Commerce strategy, it is necessary to assess the current status of the business information and logistics systems because these will provide the foundation for e-Commerce. Preparations will also be necessary to meet the standards of support that e-customers expect. Marketing, promotion and supply chain management must all be considered, alongside the website, when developing an implementation strategy.

In managing an e-Commerce strategy, considerations include protecting the intellectual property of the business and maintaining the integrity of its website. This will require considerations of risk and the implementation of appropriate security precautions.

Finally in this unit learners will critically evaluate current developments in e-Commerce.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the impact of e-Commerce on business

2 Be able to plan an e-Commerce strategy

3 Be able to manage an e-Commerce strategy.

Unit content

1 Understand the impact of e-Commerce on business

Customer expectations: raised expectations for a quick and efficient service eg timely responses to customer communications, quick delivery of the product or service, accurate information

Common applications: types eg payment systems, online shopping, shopping cart software, newsgroups, email

2 Be able to plan an e-Commerce strategy

Strategy: general eg marketing, supply chain, electronic payment

Internet strategy: hosting eg internal, sub-contracted; designing the website; maintaining 24/7 access

Marketing strategy: methods eg targeting market segments and interest groups, developing electronic 'web-communities', promotion strategies to target specific market segments, search engine optimisation, e-marketing software

Supply chain strategy: methods eg satisfying customer demand, responsive supply chain, managed in house or sub-contracted, developing 'partnership' relationships with suppliers

Electronic payment: methods eg online transaction processing, Commercial Off the Shelf Software (COTS), security; other payment systems eg PayPal, WorldPay

3 Be able to manage an e-Commerce strategy

Intellectual property: ownership eg domain name, company name, trade marks

Assessment of security risks: risks eg risk of linking business systems to the Internet

Security measures: propose security measures to minimise risks eg firewalls and use of intranets or extranets

Current developments: areas eg marketing, supply chain management, electronic payment

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 e-Commerce on business	1.1 critically discuss the expectations of internet customers 1.2 critically assess the potential impact of common applications on an e-Commerce business
LO2 Be able to plan an e-Commerce strategy	2.1 plan an e-Commerce implementation strategy for an e-Commerce business
LO3 Be able to manage an e-Commerce strategy	3.1 critically assess the risks of linking business systems to the internet 3.2 explain the importance of protecting the intellectual property of an organisation 3.3 critically discuss security measures to protect an e-Commerce solution. 3.4 critically evaluate current e-Commerce developments and assess their incorporation into an e-Commerce 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 3: Information Systems	Unit 1: Business Skills for e-Commerce	Unit 30: Information Systems in Organisations
Unit 8: e-Commerce	Unit 16: e-Commerce Technologies	
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.

Resources

Books

Chaffey, D – *E-Business and E-Commerce Management* (Prentice Hall, 2006) ISBN 9780273707523

Cumming, T – *Little e*, *Big Commerce* (Virgin Publishing, 2010) ISBN 9780753522899

Lauden, K C, Traver, C G – *E-Commerce: Business*, *Technology*, *Society* (Addison Wesley, 2002) ISBN: 032112202X

Schneider, G P – *Electronic Commerce* (Course Technology, 2006) ISBN 9781418837037

Turban, E et al – *Electronic Commerce* (Pearson Education, 2009) ISBN: 9780137034659

Websites

http://academic.cengage.com/coursetechnology

www.booksites.net

www.pearsonhighered.com/laudon

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 from a range of organisations. Speakers can discuss their e-Commerce system(s) in terms of the infrastructure, technologies and security aspects.

Unit 30: Information Systems in Organisations

Unit code: M/601/1444

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of how organisations use information systems to help them manage their specific needs.

Unit abstract

Information is the most valuable resource that an organisation possesses. The effective gathering, protection, analysis, processing and dissemination of information is vital to the success of any organisation. As globalisation and the 24-hour economy develop and increase, organisations must ensure that their information systems are reliable, efficient and able to cope with rapid change.

Organisations whose information systems previously dealt purely with data processing have now introduced those supporting strategic management and decision support. Managers at all levels need appropriate and timely information to plan successfully in the short, medium and long term, and that information can have many sources and destinations. As organisations diversify and de-centralise, information also needs to be available to many non-managerial staff in a variety of locations. The logical conclusion is that an organisation is now completely dependent on the effectiveness of its information systems in order to survive and thrive in the 21st century business environment.

Learners will begin this unit by analysing the information needs of an organisation at different levels and within different functional areas. It is important that computing professionals are able to understand how an organisation works and how it uses information, in order to be able to design, implement, maintain and manage systems to support its operation.

On completion of this unit, learners will understand the importance of effective information systems to an organisation. They will be aware of the variety of options available for information processing and know that these will inevitably change over time. They will also use an information system to produce management information.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand information needs within different functional areas of organisations

2 Be able to compare information systems

3 Be able to use information systems to produce management information.

Unit content

1 Understand information needs within different functional areas of organisations

Functional areas of an organisation: typical areas eg finance, accounts, human resources, stock control, sales, marketing, research and development, production, distribution, customer service, administration

Information needs: requirements analysis eg strategic, tactical, operational; data requirements eg inputs, outputs, processing activities; information distribution requirements eg location, department, individual

2 Be able to compare information systems

Information systems: types eg business information systems, decision support systems, management information systems, executive information systems, office information systems, transaction processing systems, expert systems, global information systems, data warehouse systems, enterprise systems, enterprise resource planning systems, integrated information systems

Information and data: definition of information and data, sources of information, information requirements and the needs for information at different levels within an organisation, storing information and its importance with regard to security, accuracy and relevance; outputs eg payroll, invoicing, ordering, bookings, stock control, personnel records, goods tracking, decision making, marketing, customer service

3 Be able to use information systems to produce management information

Management information: reports eg sales report, college enrolment statistics, marketing analysis (brick v click)

Gathering information: defining requirements; establishing sources of information; defining other factors to be considered eg constraints

Selecting information: analysis of eg validity, accuracy, currency, relevance; identifying alternatives

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 information needs within different functional areas of organisations	1.1 evaluate the information needs of the different functional areas of an organisation
LO2 Be able to compare information systems	2.1 describe different types of information systems 2.2 investigate the current trends in using information systems applications to solve business problems 2.3 evaluate the suitability of information systems for different functional areas of an organisation
LO3 Be able to use information systems to produce management information	3.1 use an information system to generate valid, accurate and useful information for a given problem 3.2 evaluate alternative methods of solving the problem.

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 5: Emerging Technologies	

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:

- Information Management.

Essential requirements

Learners must have access to an information system.

Resources

Books

Avison D, Fitzgerald G – *Information Systems Development: Methodologies, Techniques and Tools* (McGraw Hill, 2006) ISBN-10: 0077114175

Benyon-Davies P – *Business Information Systems* (Palgrave Macmillan, 2009) ISBN-10: 023020368X

Giarratano J, Riley G – *Expert Systems: Principles and Programming* (Course Technology, 2004) ISBN-10: 0534384471

Laudon J, Laudon K – *Essentials of Management Information Systems* (Pearson, 2008) ISBN-10: 0135013534

Pijpers G – *Information Overload: A System for Better Managing Every Day Data* (Microsoft Executive Leadership Series) (Wiley, 2010) ISBN-10: 0470625740

Turban E et al – *Decision Support and Business Intelligence Systems* (Pearson, 2008) ISBN-10: 0131580175

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 or use any conference footage that is available. The proceedings or coverage of any workshops may be quite engaging and informative.

Unit 31: Knowledge-based Systems

Unit code: J/601/0459

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

The aim of this unit is to develop the learner's understanding of knowledge systems, their relationship with artificial intelligence and their utilisation by expert systems. Learners will use this understanding to develop a knowledge-based application.

Unit abstract

Knowledge-based systems encompass expert systems tools and techniques and incorporate artificial intelligence. This area is rapidly expanding into new and advanced environments such as science, education and medicine where there is a need for more complex and sophisticated systems.

The types of system available are constantly evolving and it is the expectation that learners will engage in extensive research into existing and emerging technologies that fall under the umbrella of knowledge systems.

On completion of this unit, learners should be able to appreciate the value and contribution of knowledge-based systems and their importance in many critical environments. Learners will also engage with artificial intelligence languages, knowledge-based systems and shells to develop and design their own applications.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand knowledge-based systems

2 Be able to design knowledge-based applications

3 Be able to develop knowledge-based applications.

Unit content

1 Understand knowledge-based systems

Knowledge base: components eg data, rules and structure; human readable eg Microsoft troubleshooter software, FAQs; machine readable, structured data with entity relationships eg medical diagnostics, mortgage selection

Knowledge management: techniques eg data mining; gathering, organising, refining and disseminating information

Artificial Intelligence (AI): simulation of human intelligence by computer systems; use of knowledge bases within AI; traits eg reasoning, learning; applications of AI eg expert systems, speech recognition, share trading, video games, web search engines

Expert systems: inference rules; architecture; people eg end-user, subject matter expert, expert system engineer or programmer; applications eg medicine, financial services, accounting, chess

2 Be able to design knowledge-based applications

Investigative techniques: use a range of investigative techniques to review current applications

System elements: using a 'shell' as a framework for development eg eGanges

Design and planning: use of an appropriate design method eg rules, frames, nets

Language elements: skills as required for the language used

3 Be able to develop knowledge-based applications

All development languages: based on eg Lisp, Prolog, IPL, C++

Development: use of appropriate language to create an application; develop an application using the system/shell

Testing: test strategy; recording results

Documentation: documenting of the application to set standards

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 knowledge-based systems	1.1 analyse a real-world knowledge-based system, detailing: i data, rules and structure ii how the knowledge is managed iii how artificial intelligence traits are incorporated into the system iv how an expert system is created from utilising the knowledge base and including AI traits
LO2 Be able to design knowledge-based applications	2.1 plan the design of an application using an AI development language 2.2 identify the screen components and data and file structures required to implement a given design 2.3 design knowledge base, rules and structure of the application
LO3 Be able to develop knowledge-based applications	3.1 implement the application 3.2 implement data validation for inputs 3.3 identify and implement opportunities for error handling and reporting 3.4 design and implement a test strategy 3.5 create documentation to support users.

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 24: Controlling Systems using IT	Unit 9: Systems Analysis and Design	Unit 39: Computer Games Design and Development
	Unit 10: Human Computer Interaction	Unit 40: Distributed Software Applications
		Unit 41: Programming in Java
		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:

- Human Needs Analysis
- Systems Analysis
- HCI Design
- Software Development
- IT Application Management/Support.

Essential requirements

Learners must have access to a range of organisational environments that are using or planning on implementing a knowledge-based system. Specific commercial, medical or academic domains would also be of benefit as expert systems have already been established in these fields.

In addition to more traditional texts, journals and case studies would complement this unit. Learners must also keep up to date with current systems developments in the field.

Resources

Books

Akerkar R – *Knowledge Based Systems* (Jones and Bartlett, 2009) ISBN-10: 0763776475

Barski C – *Land of LISP* (No Starch Press, 2010) ISBN-10: 1593272006

Bratko I – *Prolog Programming for Artificial Intelligence, 3rd Edition* (Addison Wesley, 2000) ISBN-10: 0201403757

Negnevitsky M – *Artificial Intelligence: A Guide to Intelligent Systems* (Addison Wesley, 2004) ISBN-10: 0321204662

Seibel P – *Practical Common Lisp* (Apress, 2005) ISBN-10: 1590592395

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 32: Quality Systems in IT

Unit code: D/601/1987

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the importance of the quality process as applied to IT-related systems development.

Unit abstract

Quality control and assurance relies on the establishment of standards by which projects can be measured. This is carried out through reviews, tests and inspections to ensure that the end product meets requirements.

IT projects need to be carried out within a structured framework of procedures that will ensure that quality is an integral part of the development process. Adherence to this framework ensures that the final outcome meets its intended purpose and has been produced using the most efficient method.

Learners will begin this unit by exploring the meaning of quality in the context of IT development and the implications of adopting this approach. They will continue by learning about the quality control issues and then project management tools that can be used to support the process.

On completion of this unit, learners will understand the importance of a quality-focused approach to development and maintenance and be able to select appropriate tools to enable this.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the need for quality assurance in IT systems

2 Be able to employ standard quality control documentation

3 Be able to use project management tools.

Unit content

1 **Understand the need for quality assurance in IT systems**

Standards: compliance against national and international standards eg ISO 31000 risk; risk management standards eg Project Management Institute, National Institute of Science and Technology; quality standards, ISO 9000, best practice

Risks: types of risk eg financial, project failure, legal, accidents, natural causes, attacks

Systems Development Life Cycle: stages eg planning, requirements analysis, design, build, test, maintenance

2 **Be able to employ standard quality control documentation**

Documentation: to include eg detailed product specification, environmental, safety, reliabilty, maintainability requirements, monitoring checks, reviews, inspections, test results, control charts

3 **Be able to use project management tools**

Tools: techniques eg Gantt charts, CPM, PERT, PRINCE, project management software

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 need for quality assurance in IT systems	1.1 discuss appropriate standards for the development of an IT system 1.2 assess the risks associated with the development of an IT system 1.3 discuss quality assurance practices at all stages of the systems development lifecycle
LO2 Be able to employ standard quality control documentation	2.1 produce quality control documentation for each stage of the systems development lifecycle
LO3 Be able to use project management tools	3.1 apply project planning and management tools to plan specific resources and requirements for an IT system development 3.2 evaluate the suitability of tools used to manage the development of an IT 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 11: Systems Analysis and Design	Unit 8: Management of Projects	Unit 4: Project Design, Implementation and Evaluation
Unit 17: Project Planning with IT	Unit 9: Systems Analysis and Design	

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:

- Change and Release Management
- IT/Technology Service Catalogue and/or Service Level Management
- Measurement and Reporting.

Essential requirements

Learners must have access to suitable project planning and management tools.

Resources

Books

Chatfield C, Johnson T – *Microsoft Office Project 2007 Step by Step Book/CD Package* (Microsoft Press, 2007) ISBN-10: 0735623058

Clark W – *The Gantt Chart, a Working Tool of Management* (2010) ISBN-10: 1152255762

Galin D – *Software Quality Assurance: From Theory to Implementation* (Addison Wesley, 2003) ISBN-10: 0201709457

Honey G – *A Short Guide to Reputation Risk (Short Guide to Business Risk)* (Gower, 2009) ISBN-10: 0566089955

Portney S – *Project Management for Dummies* (Wiley, 2006) ISBN-10: 0470049235

Reuvid J – *Managing Business Risk: A Practical Guide to Protecting Your Business* (Kogan Page, 2009) ISBN-10: 0749454490

Websites

www.businessballs.com/project.htm

www.softwareqatest.com/qatlnks1.html

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 programmers or employers from organisations that have had exposure to expert systems or have been involved in their development.

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 36: Internet Server Management

Unit code: A/601/1513

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To enable learners to implement and manage secure internet technologies for networking systems.

Unit abstract

As more organisations adopt internet-aware software there is an increasing need to understand the implications of internet technologies. In addition many organisations are now creating their own internet and intranet sites and therefore the successful management of sites and servers is becoming fundamental to network managers. The aim of this unit is to provide an introduction to internet server management within the context of a network operating system.

Internet technologies play an important role in all modern businesses operations. They are used extensively to strengthen the competitive edge of organisations and businesses and their position in the current marketplace climate. They allow businesses not just to market their products and services, but also to undertake business transactions with their partners and customers.

Internet servers are the backbone on which these internet technologies are implemented; these servers are at the heart of modern business operations. In this unit learners will discuss and analyse modern internet technologies used to establish internet services such as web, FTP, mail, proxy, certificate servers, directory servers, and many others. Learners will install, maintain and secure internet servers using tools and techniques available.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand internet technologies

2 Understand internet server architectures

3 Be able to implement internet server and services

4 Be able to manage internet server and services.

Unit content

1 Understand internet technologies

Internet technologies and communication protocols: protocols eg TCP/IP (Transmission Control Protocol/Internet Protocol), OSI (Open Systems Interconnection), DNS (Domain Name System), DHCP (Dynamic Host Configuration Protocol), SNMP (Simple Network Management Protocol); routing and remote access; telnet; ports and addresses; internet organisations eg ICANN (Internet Corporation for Assigned Names and Numbers), InterNIC (Internet Network Information Center), IEEE (Institute of Electric and Electronic Engineers); subnetting and supernetting

Internet services: services, eg intranet, email, e-Commerce, instant messaging, wikis, blogs, certificate services, directory services; internetworking servers eg ISP (Internet Service Provider), World Wide Web, FTP (File Transmission Protocol), database servers, e-Commerce servers, news servers, email servers, proxy servers, media servers, directory servers

Networking technologies and concepts: devices, eg hub, switch routers; network management concerns, eg client/server environment, user and group management, resources management, security, network attacks, firewall, ethical and legal issues, servers and server performances, user access issues

2 Understand internet server architectures

Internet server technologies: architecture eg modular; server structure eg core units, basic functionality, request handling mechanisms, performance and access issues; examples eg IIS (Internet Information Services), Apache

Hardware and software: required components eg CPU (Central Processing Unit), memory, storage devices, network connectivity, operating system; cost of running an internet server

3 Be able to implement internet server and services

Planning installation: procedures, eg examine and evaluate network infrastructure, select a suitable internet server, undertake pre installation activities, eg downloading and extracting the required files, preparing the required installation scripts, configuring the network server and the operating system for internet server inclusion; plan server required information, eg domain names, URLs (Uniform Resource Locators); consider customisation issues

Installation: tools eg GUI (Graphical User Interface) and command line; activities eg create web site, create virtual directory, install FTP services, create FTP sites

Configure internet services: services eg web services, FTP, SMTP (Simple Mail Transfer Protocol), proxy; certificate authority; configure site properties eg site bindings, IP (Internet Protocol), address hosting, port numbers hosting, host header hosting, default document filenames, directory browsing; publish websites

Testing: documentation, eg test plan (test data, expected results, actual results); test results

4 Be able to manage internet server and services

Websites and services: web applications eg CGI (Common Gateway Interface), ISAPI (Internet Server Application Programming Interface); server-side eg Active Server Pages (ASP), ASP.NET; activities eg installing UDDI (Universal Description, Discovery and Integration), configuring FTP, SMTP and other services, implement and secure network access

Internet services security: activities eg configuring web site security; configuring IP address and domain name restrictions, enabling and configuring authentication methods, configuring anonymous access, using operating system authentication, enabling forms authentication, creating URL authorisation rules, using access control and file permissions, enabling and implementing certificate authentication and creating certificates Using VPN (Virtual Private Network) and secure sockets layer to protect integrity and authenticity and data exchange

Monitoring and troubleshooting: procedures eg configuring sites and applications logging, configuring centralised and remote logging, identifying log file and format, analysing log file; trace and diagnose problems; troubleshoot and solve common problems; monitor internet server performance; use server tools to measure and enhance internet server resources performance; document internet servers and services configurations and usage

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 internet technologies	1.1 critically evaluate different internet technologies and communication protocols 1.2 critically compare different internet services and internetworking servers 1.3 discuss network management concerns and make recommendations to sustain network security, reliability and performance
LO2 Understand internet server architectures	2.1 critically analyse different internet server technologies and their performance 2.2 explain the hardware and software components of an internet server
LO3 Be able to implement internet server and services	3.1 produce a system specification to meet a given requirement 3.2 evaluate the suitability of internet server components 3.3 build and configure an internet server including services to meet a given requirement 3.4 critically review and test an internet server
LO4 Be able to manage internet server and services	4.1 install and manage websites and services to meet a given requirement 4.2 implement secure network access to meet a given requirement 4.3 monitor and troubleshoot an internet server and services 4.4 critically evaluate the performance of an internet server.

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 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 46: Networking 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
- Systems Development
- Security Management
- IT/Technology Service Operations and Event Management
- IT/Technology Problem Management
- IT Application Management/ Support
- IT/Technology Management and Support.

Essential requirements

Hardware: up-to-date hardware, computer and network systems that allow learners the opportunity to experiment with client/server based network, redundancy and the use of performance monitoring tools.

Software: latest network operating system with built in or add on internet servers and services based on either proprietary or open source software or both, to allow learners the ability to compare and contrast.

Resources

Books

Bennett M et al – *Professional Microsoft FAST Search* (Wiley, 2010) ISBN-10: 0470584661

Comer D – *Hands-on Networking with Internet Technologies* (Addison Wesley, 2004) ISBN-10: 0131486969

Donahue G – *Network Warrior* (O'Reilly Media, 2007) ISBN-10: 0596101511

Ford A – *Apache 2 Pocket Reference* (O'Reilly Media, 2008) ISBN-10: 0596518889

Miller M – *Internet Technologies Handbook: Optimizing the IP Network* (Wiley Blackwell, 2004) ISBN-10: 0471480509

Olifer N, Olifer V – *Computer Networks: Principles, Technologies and Protocols for Network Design* (Wiley, 2005) ISBN-10: 0470869828

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 37: Digital Image Creation and Development

Unit code: Y/601/6721

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

This unit aims to develop skills and understanding in sourcing, creating, developing and managing digital images for specific purposes.

Unit abstract

In this unit learners will work with digital image systems and equipment to produce digital images to a specified brief. They will learn key aspects of digital practice such as file naming conventions, storage, compression and output. They will also work with a range of input devices and software tools.

Learners will be encouraged to explore approaches to developing digital imagery that incorporate creativity and sound technical skills. Learners will evaluate their response to the set brief, and consider areas such as copyright and legislation in commercial and non-commercial contexts in contemporary practice.

Delivery will be primarily practical with the provision of demonstrations of software and hardware. In addition, theory sessions will facilitate learning in some topic areas, for example file size, formats, resolution and compression.

Learners will be encouraged to adopt an experimental approach to generating imagery. This will enable learners to broaden their creative experiences and their understanding of the creative and potentiality of digital imaging systems.

Tutors will provide a set brief, or facilitate learners in developing their own set brief that meets the requirements of the unit. Learners will prepare designs for images, capture images, save appropriately, and present evidence that demonstrates their understanding. There will be opportunities for learners to focus on the critical evaluation of their own work. This may involve peer group and/or tutor presentation and discussion.

It is anticipated that a major proportion of this unit will be practice-based, and thus learners should demonstrate competent use of digital imaging systems in the production of practical work. Thus documentary evidence for each outcome will include images, their evaluation, and supporting material that demonstrates knowledge and understanding.

Learning outcomes

On successful completion of this unit a learner will:

1 Be able to create digital images for specific purposes

2 Be able to process digital images

3 Be able to manipulate digital images to meet requirements

4 Understand the use of digital images.

Unit content

1 Be able to create digital images for specific purposes

Sources: primary; secondary; recording; sampling

Input devices: eg cameras, scanners, external hard-drives, USB devices, mobile phones, video cameras

Acquisition: analogue eg continuous tone, transparent, opaque, monochrome, colour, line, halftone; digital eg photograph, .jpg, clip art, royalty-free stock photography, internet, creative commons, mobile phone, hand-held device

Input fundamentals: resolution eg screen, print, dpi, lpi, bits per pixels (bpp), CMOS systems, file size, file formats; cross-platform, eg PSD, TIFF, JPEG, GIF, PDF

2 Be able to process digital images

Devices: eg portable, online, archive, screen, proofing, printing

File formats: file naming conventions; file management; applications; image size; compression eg lossy and lossless, ISDN

Processing fundamentals: capture; file format; back-up; import; export; image size; resolution; canvas size; resolution; output; image modes eg RGB, CMYK, indexed colour, grayscale, duotone

Transmission: download; stream eg File Transfer Protocol (FTP)

3 Be able to manipulate digital images to meet requirements

Tools, techniques and palettes: software tools eg text, exposure, cropping, adjusting, painting, duplicating, levels, curves, colour balance, hue, saturation, layers, history, paths, masks, channels, filters

4 Understand the use of digital images

Own work: evaluate; constraints of brief; originality; aesthetics; context; meaning; emphasis

Others' work: commercial contexts; design; sources; aesthetics; context; meaning; emphasis

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 create digital images for specific purposes	1.1 identify sources for digital images 1.2 create digital images from sources for specific purposes
LO2 Be able to process digital images	2.1 identify file formats and fundamentals required to process image data 2.2 apply digital data management techniques to store imagery
LO3 Be able to manipulate digital images to meet requirements	3.1 use software tools to manipulate images 3.2 prepare image files for output
LO4 Understand the use of digital images	4.1 evaluate own use of digital images in meeting requirements 4.2 evaluate others' use of digital images in meeting specified purposes.

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 30: Digital Graphics	Unit 11: Digital Media in Art and Design	Unit 38: 3D Computer Modelling and Animation
Unit 35: Digital Graphics for Interactive Media	Unit 12: 2D, 3D, and Time-based Digital Applications	
Unit 37: 2D Animation Production	Unit 13: Multimedia Design and Authoring	
	Unit 14: Website Design	

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/Interface (HCI) Design.

Essential requirements

Centres will need to provide access to hardware, software and peripheral devices, to enable learners to gain practical knowledge and skills.

Employer engagement and vocational contexts

There is the potential for centres to offer a live project or employer-led brief, where the requirements of the unit are addressed through a set brief that identifies real and tangible needs. Learners should be encouraged to work through the different stages of the set brief through presenting images and evaluating fitness for purpose of their ideas generation and digital developmental work, as well as their final outcomes.

Unit 38: 3D Computer Modelling and Animation

Unit code: J/601/6780

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

This unit aims to develop learners' skills and understanding of the principles and practical applications of 3D modelling and animation.

Unit abstract

The unit supports learners to visualise and design three-dimensional space and object forms that exist within it. An appreciation of the requirements and applications of computer modeling and animation in commercial contexts may be used to inform learners' development of personal animation work. Learners may also consider the technical requirements for producing and distributing digital animation effectively. Learners should gain a working knowledge of 3D computer modeling and animation software, through applying techniques in their own animation work. Research elements of the unit allow learners to review the work of 3D computer artists.

Learners should develop creative responses to a set or self-generated brief, through exploring the potential offered by digital animation. Whilst the technical requirements of this field are demanding, learners should also be encouraged to reflect on creative approaches. Learners should work though stages such as visualisation and identifying technical requirements for scenes and models. Animation is a dynamic process, and learners may need to explore alternative approaches to be able to realise their creative intentions.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand how 3D computer modelling and animation are applied in commercial contexts

2 Be able to create a complex 3D scene

3 Be able to create a 3D model within a scene

4 Be able to produce 3D animations to meet a creative brief.

Unit content

1 **Understand how 3D computer modelling and animation are applied in commercial contexts**

Productions: interactive media; video; web; television; film; CGI; gaming; special effects; animation

Production resources: machine specification; memory requirements; rendering time; software

Output: download time; web-based; machine specification; end-user; interface

Formats: models; animations; environments; factors eg compression, workflow, assets, deliverables,

Output requirements: frames eg per second, size, rate; resolution; colour depth; initialising; bandwidth, real-time; streaming; downloading

Evaluate: purpose eg commercial, artistic, target audience, interactivity; context eg communication, entertainment, promotion, marketing, advertising; references eg work of others, animation studios, mainstream studios, independent animators

2 **Be able to create a complex 3D scene**

Tools: V plane; H plane; scale; stretch; link; unlink; render; zoom; navigate

Objects: geometric eg cube, sphere, cylinder; light objects; camera objects; adding; deleting; naming; aiming

Lights: colours; intensity; types; invisible; positioning; rotating

Render modes: ray trace; shade best; phong; gouraud; wireframe

Techniques: select; link; unlink; render

Scene: visualize; location eg interior, exterior; type eg natural, scientific, imaginative, realistic, architectural, environment; references eg historical, contemporary; textures

Technical issues: files; formats; compression; output; memory

3 **Be able to create a 3D model within a scene**

Objects: extrude; freeform; spline; lathe

Editing objects: spline form; path view; cross-section

Linking: hierarchy eg parent, child; grouping; ungrouping

Surfaces: applying; editing; composing; properties; maps; images; layers

Techniques: Boolean facility; environment maps; rigging; motion capture

Create: visualize; select sources eg subject, photography, drawings, models, own work, work of others; apply visual language eg shape, form, scale, colour, contrast

4 **Be able to produce 3D animations to meet a creative brief**

Animation tools: sequencer eg preview, spool, time bar, timelines, eventmarks; adding; deleting; overlapping; motion paths eg spline-based, linear; velocity eg graphs, control; keyframes; gravity control; simulators

Types: animation eg character, product; capture eg motion, performance

Animation techniques: morphing; kinematics; animating lights; texture mapping; rigging, tweening

Produce: sources eg images, characters, subject; themes eg narrative, action; factors eg clarity, detail, sound, humour, irony

Evaluate: planning; intuition; response; choices eg technology; format, visual language

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 how 3D computer modelling and animation are applied in commercial contexts	1.1 Evaluate the application of 3D computer modelling and animation in a commercial context 1.2 Analyse technical requirements for 3D computer modelling and animation in a commercial context
LO2 Be able to create a complex 3D scene	2.1 Develop a complex scene using available geometric objects 2.2 Select tools and techniques appropriate to creative intentions
LO3 Be able to create a 3D model within a scene	3.1 Use editing tools to create custom objects. 3.2 Apply knowledge of hierarchy and linking 3.3 Modify an existing preset object to meet creative intentions
LO4 Be able to produce 3D animations to meet a creative brief	4.1 Use camera views creatively and effectively 4.2 Apply morphing techniques 4.3 Produce effective animation work that combines scenic and character elements.

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 30: Digital Graphics	Unit 11: Digital Media in Art and Design	Unit 37: Digital Image Creation and Development
Unit 35: Digital Graphics for Interactive Media	Unit 12: 2D, 3D, and Time-based Digital Applications	
Unit 37: 2D Animation Production	Unit 13: Multimedia Design and Authoring	

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/Interface (HCI) Design

Essential requirements

Learners must have access to specialist facilities relevant to this unit.

Employer engagement and vocational contexts

Centres should develop links with practising artists, craftspeople and designers, to deliver assignments to learners or to provide work experience. A lecture or visit by a web designer or design practitioner local to the centre may provide useful and pertinent information on working practice.

Links with employers are essential to the delivery of the programme for work experience and future employment. Assignments should be vocationally relevant; centres should consider the delivery of 'live projects' for example to support the vocational content of the unit and programme.

Unit 39: Computer Games Design and Development

Unit code: Y/601/1518

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of computer games development as an underpinning technological concept in the fields of computer gaming and systems development.

Unit abstract

It is often easy to forget that behind the polished high-definition graphics and increasingly cinematic content of modern computer games is a highly skilled team of designers and programmers. With more sophisticated environments and new ways of interacting with computers, computer game developers now have the choice to extend into many software development realms.

Linking to any of the programming units, this unit enables learners to use any suitable platform to explore design requirements and methods of user interaction as well as the coding demands required for the differing types of gaming environments. Whilst it is essential to offer learners an overview of the differing gaming environments, unit delivery for the development of a game should focus on one specific environment and the required user and technological interactions.

This unit is not suited to learners who do not have experience in programming and should ideally be delivered when the learner has completed procedural programming, object-oriented programming or event-driven programming.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand computer games development

2 Be able to design computer games

3 Be able to develop computer games

4 Be able to test and document computer games.

Unit content

1 Understand computer games development

Types of computer game: genre eg action, role-play, adventure, strategy, simulation, sports, combat, educational, puzzle, personal development, skills based; development areas eg graphics, Artificial Intelligence (AI), audio, role, scripting; interaction design eg Graphical User Interface (GUI), online, social, integration with media

Platforms: devices eg personal computer, hand held console, stand-alone platform, mobile phone, internet, network, web page

Programming: requirements eg mathematical, simulated physics, GUI components, interface

User control: interaction eg voice, movement, mouse, keyboard, touch screen, floor based, headset, simulated artifact

Impact of gaming: concerns eg time spent, social isolation, cost, separation of reality from actuality, addiction; benefits eg development of thinking, skills development, social interaction, impact on device development, impact on device accessibility

Psychological factors: effects eg use of sound, high score listings, competitive element, peer pressure, fun, educational value, expectations, personal development, skills acquisition

2 Be able to design computer games

Design: tools eg storyboards, pseudo code, narratives, action lists, graphical tools, actor interaction dialogues

Development environment: language eg event driven, object oriented, procedural; considerations eg development facilities, gaming resource offered, library availability, interaction resources, platform compatibility, platform portability

Programming: use of eg data types, conditional statements, control structures, objects, listeners, syntax rules, parameter passing

Program design: considerations eg purpose, modularity, systematic approach, data dictionary, structure charts, flow charts, pseudo code, state diagrams

Units: elements eg functions, procedures, methods, widgets, GUI components, symbols, avatars, characters

Delivery: environments eg desktop, application, mobile app, web based, utility, web based, applet, handheld, console based

3 **Be able to develop computer games**

Implementation: language eg event driven, object oriented, procedural; working application

Programming: use of programming standards; relationship to program design

Coding: use of conventional language commands; material produced is unique; use of library classes

Pre-defined: types eg class library, downloaded, imported, reversion code

Complexity: implementation of user interaction: assurance of user benefit; assurance of use

Components: features eg multimedia, sound, audio, visual, data management, file management

Environment: tools eg games programming software

4 **Be able to test and document computer games**

Mechanisms: procedures eg checking 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; technical documentation eg data dictionary, action charts, action tables, input-process-output tables, class and instance diagrams, data flow diagrams; user guidance; game playing instructions

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

Testing methods: test strategy eg black box, white box, interface; iterative approach (testing at various stages of development); test plans and test cases; test logs; test evidence; test reports; retests done

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 computer games development	1.1 critically compare different types of computer games and platforms 1.2 evaluate the characteristics of user interaction 1.3 evaluate the impact of computer-based gaming
LO2 Be able to design computer games	2.1 design a computer game for a given requirement 2.2 identify the components and data and file structures required to develop a computer game 2.3 evaluate alternative designs and solutions to meet a given requirement
LO3 Be able to develop computer games	3.1 implement a computer game to a given design using a suitable programming environment 3.2 implement components to meet design requirements 3.3 implement a game user interface to meet design requirements 3.4 identify and implement opportunities for error handling and reporting
LO4 Be able to test and document computer games	4.1 critically review and test a computer game 4.2 analyse actual test results against expected results to identify discrepancies 4.3 critically evaluate independent feedback on a developed computer game and make recommendations for improvements 4.4 create documentation for the installation, set-up and support for a developed computer game.

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 22: Developing Computer Games	Unit 18: Procedural Programming	Unit 40: Distributed Software Applications
Unit 40: Computer Game Design	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 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 games development systems and programming languages are commercially available, there are also free resources available incorporating an advanced set of gaming oriented features deployed on many platforms. You 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 this unit.

The learner must develop a game that has a level of interaction or challenge and may be applied on a range of platforms. Therefore it may be web based, GUI based, games console, mobile deliverable or a range of other platforms.

Implementation must be based on a suitably complex problem that ensures use of multiple actions and user interaction.

Resources

Books

Harbour J, Smith J and LaMothe A (editor) – *Beginner's Guide to Darkbasic Game Programming* (Muska & Lipman Publishing US, 2003) ISBN 1592000096

McShaffrey M – *Game Coding Complete*, *2nd Edition* (Paraglyph Inc US, 2005) ISBN 1932111913

Websites

Allegro	www.talula.demon.co.uk/allegro
Game Developer	www.gamedev.net
Game Programmer	www.gameprogrammer.com
Game Programming Wiki	www.gpwiki.org
Game Programming	en.wikipedia.org/wiki/Game_programming
Game Tutorials	www.gametutorials.com
The Game Creators	www.thegamecreators.com
Ultimate Game Programming	www.ultimategameprogramming.com

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 40: Distributed Software Applications

Unit code: M/601/1525

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the principles of distributed computing, and apply the skills to design and build software applications delivered on distributed platforms.

Unit abstract

Irrespective of framework or delivery platform, the development of distributed software applications is now at the core of many commercial applications development projects. Where no single resource contains the entire system and the client-server environment has moved to a more web-based and cloud-based solution.

This unit allows learners to become familiar with the underpinning concepts of distributed software applications design, without needing to develop particular skills in one chosen language. Each of the languages have the capacity to develop distributed and it is not important which language is chosen and can be based on the range of languages available in the qualification.

Content in this unit ties into skills developed in other programming units. All units may be delivered in partnership to offer the learner the best possible experience and scope for a larger project. As with all programming, the unit's focus of developing a distributed software application solution to meet identified needs is made along with one that emphasises the importance of testing and reviewing. Learners taking this unit may work on distributed video, networked applications or remote database calls amongst other systems.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the principles of distributed computing

2 Be able to design distributed software applications

3 Be able to implement distributed software applications

4 Be able to test distributed software applications.

Unit content

1 Understand the principles of distributed computing

Frameworks: considerations eg selection of networking class libraries, selection of classes, identification of resources, suitability for system requirement; remote calls; data exchange; distribution system eg database, networked application, data exchange, web server, game, audio communication, video communication, data stream

Communications: specification eg protocols used, design of new protocols, data stream, use of networking class library, use of remote calls, use of database requests, framework interactions, DNS, addressing requirements, ports

Interaction: requirements eg selection of framework, language requirements, system requirements

Security: procedures eg remote access considerations, local defence, firewall rules, network traffic rules, Quality of Service (QoS) limitations

2 Be able to design distributed software applications

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

Design methodology: tactic eg reuse of existing resources, adaptation of code, use of open source

Design method: technique eg class responsibilities, collaboration cards, class diagrams, identification of dependencies and inheritances

Specification: contents eg input, output, processes, user needs, purpose, communications method

Creation of application: use of development environment; debugging

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

Interaction: considerations eg remote exchange of data, local exchange of data, environment, compliance, compatibility, recognition of standards employed

Communications: specification eg bandwidth, protocol, compatibility, port, security considerations

3 **Be able to implement distributed software applications**

Implement: tools and techniques eg tool boxes and controls, selection, loops, event handlers, event driven triggers, listeners, objects and object properties, menus, debugging tools

Data: data types eg variables, declaring variables, scope of variables, constants

Remote communication: method eg use of existing methods, use of existing classes,

Programming: options eg use of methods, use of 'traditional coding', use of libraries
Complexity: complex techniques eg multiple classes, multiple code elements, remote communication

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

4 **Be able to test distributed software applications**

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

Communications testing: testing eg bandwidth, traffic analysis

Errors: handling eg management of extremes, use of system imposed statements, interaction between .Net classes

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

Documentation: technical documentation 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 distributed computing	1.1 discuss the principles, characteristics and features of distributed computing 1.2 critically evaluate the impact of distributed software applications delivered on distributed computing platforms
LO2 Be able to design distributed software applications	2.1 design a distributed software application for a given problem 2.2 explain the components and data and file structures required to implement a given design
LO3 Be able to implement distributed software applications	3.1 implement a distributed software application solution based on a prepared design 3.2 define relationships between components to implement design requirements 3.3 identify and implement opportunities for error handling and reporting 3.4 make effective use of an Integrated Development Environment (IDE) including code and screen templates
LO4 Be able to test distributed software applications	4.1 critically review and test a distributed software application 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback on a developed distributed software application and make recommendations for improvements 4.4 create user documentation for the developed distributed software application 4.5 create technical documentation for the support and maintenance of a distributed software 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 18: Procedural Programming	Unit 39: Computer Games Design Development
	Unit 19: Object Oriented Programming	Unit 40: Distributed Software Applications
	Unit 20: Event Driven Programming Solutions	Unit 41: Programming in Java
	Unit 21: Software Applications Testing	Unit 42: Programming in .NET
	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 programming languages are commercially available, there are also free languages available incorporating an advanced set distributed components deployed on many platforms. You 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.

Resources

Books

Kshemkalyan A and Singhal M http://www.amazon.co.uk/Distributed-Computing-Principles-Algorithms-Systems/dp/0521876346/–- *Distributed Computing: Principles, Algorithms, and Systems* (Cambridge University Press, 2008) ISBN-10: 0521876346

Tanenbaum A and van Steen M – *Distributed Systems: Principles and Paradigms* (Pearson Education, 2008) ISBN-10: 0136135536

Websites

www.springer.com/computer/communication+networks/journal/446

www.wisegeek.com/what-is-distributed-computing.htm

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 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 42: Programming in .NET

Unit code: H/601/1537

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the principles of programming using a .NET framework as an underpinning technological concept in the fields of programming and systems development.

Unit abstract

The .NET framework defines a range of reusable class libraries that define the interactions used for Windows operating systems based development of utilities, applications, web based resources, games as well as data integration.

Whilst specific to Microsoft products, the .NET framework defines interactions with servers, workstations and mobile devices. The .NET framework also describes interactions and data exchange with other programming and development systems and is designed to enable cross-platform interaction.

This unit allows learners to become familiar with the underpinning concepts of .NET framework programming, without needing to develop particular skills in one chosen language. Each of the languages has the capacity to develop event driven solutions and it is not important which language is chosen as long as the skills being developed and evidenced relate to the key .NET focus.

The focus of the unit is on developing solutions to meet identified user needs while emphasising the importance of testing and reviewing.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the principles of programming using a .NET framework.

2 Be able to design .NET solutions

3 Be able to implement .NET solutions

4 Be able to test and document .NET solutions.

Unit content

1 Understand the principles of programming using a .NET framework

Version: current version; backwards compatibility; design considerations; alternative implementations

Design features: interoperability, common runtime engine, language independence, base class library, deployment, security, portability

.NET languages: eg C#, C++, F#, J#, PowerShell, JScript .NET, IronPython, IronRuby, Visual Basic, IronLISP, L#, P#

Architecture: Common Language Infrastructure (CLI), assemblies, metadata, security, class library, memory management; framework versions (architecture) eg 3.5, 3.0, 2.0; common language runtime and the .NET framework class libraries

2 Be able to design .NET solutions

Selection: identification of .NET compatible programming language, identification of .NET programming libraries, selection of development environment

Design methodology: reuse of existing system, adaptation of code, GUI template, graphical interface, design guides, state and interaction diagrams, screen layouts, data storage, event procedures and descriptions

Specification: input, output, processes, user need, purpose

Creation of application: use of development environment; debugging

Delivery environment: mobile, handheld, web based, desktop, dedicated device, server

Interaction: exchange of data, compliance, compatibility, recognition of standards employed, environment

3 Be able to implement .NET solutions

Tools and techniques: use of tool boxes and controls, selection, loops, event handlers, event driven triggers, listeners, objects and object properties, menus, debugging tools

Data: variables, data types, declaring variables, scope of variables, constants

Programming: use of methods, use of 'traditional coding'

Complexity: multiple .NET classes; multiple code elements

4 **Be able to test and document .NET solutions**

Mechanisms: valid declarations; debugging code; comment code; naming conventions; checking functionality against requirements; documentation

Error handling: management of extremes, use of system imposed statements, interaction between .NET classes

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

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

Documentation: user eg onscreen help to assist users of the programme, pop-ups, help menu, hot-spots; technical eg designs, delivery system, platform, environment, file structures, coding, constraints, documentation for maintenance of programme

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 using a .NET framework	1.1 discuss the principles, characteristics and features of programming using a .NET framework 1.2 critically compare different types of .NET framework architectures 1.3 critically evaluate the components that support the .NET framework
LO2 Be able to design .NET solutions	2.1 design a .NET programming solution to a given problem 2.2 explain the components and data and file structures required to implement a given design 2.3 evaluate potential delivery environments and interaction
LO3 Be able to implement .NET solutions	3.1 implement a .NET programming solution based on a prepared design 3.2 implement event handling using control structures to meet the design algorithms 3.3 identify and implement opportunities for error handling and reporting 3.4 make effective use of an Integrated Development Environment (IDE) including code and screen templates
LO4 Be able to test and document .NET solutions	4.1 critically review and test a .NET programming solution 4.2 analyse actual test results against expected results to identify discrepancies 4.3 evaluate independent feedback on a developed .NET program solution and make recommendations for improvements 4.4 create user documentation for the developed .NET program solution 4.5 create technical documentation for the support and maintenance of a .NET 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 41: Programming in Java
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 event driven languages are commercially available, there are also free languages available incorporating an advanced set of .NET features deployed on many platforms. Centres must ensure that in the case of mobile platforms the applicable 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 and work on a range of .NET platforms. It may be web based, GUI based, a games console or a deliverable for a mobile platform, amongst many other solutions.

Resources

Books

Esposito D – *Programming Microsoft ASP.NET MVC* (Microsoft, 2010) ISBN-10: 0735627142

Libert J, Horovitz A – *Programming .NET 3.5* (O'Reilly, 2008) ISBN-10: 059652756X

Lowy J – *Programming .NET Components: Design and Build .NET Applications Using Component-Oriented Programming* (O'Reilly, 2005) ISBN-10: 0596102070

Websites

http://msdn.microsoft.com/en-gb/library/zw4w595w.aspx

www.dotnet-guide.com/

www.programmingtutorials.com/vbnet.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 43: Networking Infrastructure

Unit code: A/601/1964

QCF Level 5: BTEC Higher National

Credit Value 15

Aim

To provide learners with an understanding of networking infrastructures, the directory based system that supports the addressing and resource management of any large scale networked system.

Unit abstract

Network infrastructure systems such as Active Directory (from Microsoft) or eDirectory (from Novell) amongst many others, are systems used to manage resources, naming of devices, allocation of rights, privileges and security polices.

Each can be used to deploy software as well as control the behaviour of the network infrastructure. Learners taking this unit will explore the principles supporting any network infrastructure system, design a solution for a given networked environment as well as implement and test the solution.

This unit has links to many vendor qualifications and can be used to encourage the study and certification of these by learners. Additionally this unit links to all networking and systems support units and offers learners the opportunity to build a complex network system.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the principles of network infrastructure management

2 Be able to design complex network infrastructure systems

3 Be able to implement complex network infrastructure systems

4 Be able to test complex network infrastructure systems.

Unit content

1 **Understand the principles of network infrastructure management**

Name resolution: services eg Domain Name System (DNS), eDirectory, Active Directory; requirements eg addressing, resource management, user management, services management, security of resources, access control

Technology: resources eg servers supporting networking infrastructure management, routers, printers, switches, firewalls, clients, wireless access, cabled access, remote workstations, 3G based remote access

Security: resources eg rights management, resource availability, user management, access times, group allocation, timed access, encryption, authentication, Virtual Private Network (VPN), tunneling, remote access, RADIUS (Remote Access Dial In Support), TACACS (Terminal Access Controller Access-Control System), IPSec, certificate authorities, PKI (Public Key Infrastructure)

2 **Be able to design complex network infrastructure systems**

Addressing: naming methodology, delivery of addresses, identification of devices and resources

Rights: designing user and group rights, access rights to resources, access to files, access to printers, access to services

Security: creation of remote access services, deployment of VPN access, time based rules, trust management, access control and login, logging, system activity audit trail

Deployment: scalable, use of technology, adaptable, change management, commercial requirements, supportive of environment

3 **Be able to implement complex network infrastructure systems**

Addressing: application of naming methodology, delivery of addresses

Rights: issue of rights to users, apply rights to groups, apply access rights to resources, access to files, access to printers, access to external services

Security management: remote access services, deployment of VPN access rules, trust management, access control and login, logging, system activity audit trail

Interaction: with external DNS, with other directory services, with existing directory services infrastructure

4 **Be able to test complex network infrastructure systems**

System assurance: security of system, access, availability, visibility of all resources

User assurance: valid access issued, group access, inheritance of rights

Documentation: test plan; test results; analyse results

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 network infrastructure management	1.1 evaluate current name resolution services 1.2 discuss the technologies that support network infrastructure management 1.3 discuss security resources available in network infrastructure management
LO2 Be able to design complex network infrastructure systems	2.1 design a network infrastructure for a given networked environment 2.2 evaluate addressing and deployment solutions for a given networked environment 2.3 evaluate rights and security requirements for a given networked environment
LO3 Be able to implement complex network infrastructure systems	3.1 implement a network infrastructure based on a prepared design
LO4 Be able to test complex network infrastructure systems	4.1 critically review and test an implemented system 4.2 evaluate system and user assurance of the implemented 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 5: Managing Networks	Unit 24: Networking Technologies	Unit 44: Local Area Networking Technologies
Unit 9: Computer Networks	Unit 25: Routing Concepts	Unit 45: Wide Area Networking Technologies
Unit 10: Communication Technologies	Unit 26: Design a Small or Home Office Network	Unit 46: Network Security
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.

Implementation of the infrastructure solution must be tested systematically and procedurally based on the technology used in the design solution. The solution implemented may be on a live system, but ideally should be tested in a simulated or sand box environment.

Resources

Books

Mackin J and McLean I – *MCSE Implementing, Managing & Maintaining a Windows Server 2003 Network Infrastructure* (Microsoft, 2006) ISBN-10: 0735622884

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

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 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. Whist it is now the case that simple networks can often been 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.

Unit 47: IT Virtualisation

Unit code: A/601/1933

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the principles of virtualisation and the deployment of virtual server and desktop environments as a commercial or personal technology option.

Unit abstract

As technology has evolved, the need to create virtual systems to simulate the behaviour of a real environment has become a primary objective. In having a virtual environment, an information technology professional may use virtualisation to plan a server deployment, test an application or operating system update, as well as test software created in a development environment.

The power of virtualisation has reached a stage where many commercial environments use virtualisation to run seemingly live arrays of servers to ensure redundancy, reliably, security and a lower cost of hardware ownership. It has become possible with the development of server virtualisation environments to have one hardware platform deliver many servers or remote workstations.

There are many hardware and software virtualisation solutions offered by different vendors. This unit allows the learner to access either desktop based virtualisation or server-based virtualisation, or possibly both. In delivery, there are many free to education as well as commercially available offerings.

Creating a virtualisation environment will require an understanding of the host system and its limitations as well as the requirements of the guest operating system. This unit will encourage the learner to explore how this may be accomplished and implement a viable system for commercial or personal use.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the commercial impact and potential of virtualisation

2 Be able to design virtualisation deployments

3 Be able to implement virtualisation deployments

4 Be able to manage virtualisation environments.

Unit content

1 Understand the commercial impact and potential of virtualisation

Scalability: methods eg simplicity of server addition, rapid deployment, rapid development

Redundancy: methods eg mirroring, server image backup, load balancing, reduction of points of failure

Support: centralisation of services, testing of resources

Environmental: server deployment; remote desktop; desktop; web based

Solutions: server based eg VMWare ESXi, ESX, Citrix; desktop based eg parallels, QEMU, virtual PC, VM-Ware Player, VMWare fusion

Technology: hypervisor; abstraction; virtual drivers; network connection eg NAT, bridged;

environments for developers; arrays of servers; cloud computing; server solutions; web servers

Cost: reduction of hardware cost of ownership; reduction of upgrade costs; larger platforms for many servers

2 Be able to design virtualisation deployments

Needs analysis: user requirement; corporate requirement; processor load assessment; storage; guest operating system requirement; host operating system requirement; solution needs eg application, development, testing, sandbox, interactivity

Hardware requirements: compatibility; storage availability; memory allocation eg host system, guest system, number of instances in use; processor capability; network bandwidth

Selection of virtualisation solution: eg server based, desktop based, free, commercial

Deployment image requirement: memory required for efficient operation; software eg applications to be installed, updates to be installed, antivirus; addressing eg conformance with host environment; operating system selection eg local need, application requirement

Environmental: interaction eg network addressing, access to local storage, access to remote storage, user allocation, membership of directory services

3 **Be able to implement virtualisation deployments**

Implementation: tasks eg testing of updates, desktop users, alternate operating systems, sandbox

Virtualisation environment: installation eg hardware, environment software, registration of environment with host operating system, addressing of environment with network

Image environment creation: establishment of virtual storage requirements eg size, dynamic, fixed; establishment of base memory requirements; network communication; location of image

Image: installation eg from ISO, from remote image, pre-existing image, web install

Image adaptation: installation of updates; task specific software eg antivirus, applications, development environments

Testing: tasks eg producing documentation, system compatibility, hardware and software systems

4 **Be able to manage virtualisation environments**

User access: setting of virtual image privilege levels eg user, administrator, read rights, write rights, execution rights

Environment: testing eg access, usability, performance, compatibility

System: monitoring eg performance; memory use; speed; network access times; load and degradation on host environment

Update: maintain image; installation/removal of features; virtual disk management

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 commercial impact and potential of virtualisation	1.1 evaluate current virtualisation solutions 1.2 discuss the potential benefits of virtualisation 1.3 discuss the current technology requirements for implementing virtualisation
LO2 Be able to design virtualisation deployments	2.1 complete a needs analysis for a virtualisation deployment 2.2 design a virtualisation solution for a given virtualisation deployment
LO3 Be able to implement virtualisation deployments	3.1 maintain a virtualisation solution 3.2 systematically test the virtualisation environment 3.3 document and analyse test results
LO4 Be able to manage virtualisation environments	4.1 monitor the virtualisation environment 4.2 maintain a virtualisation environment 4.3 critically review and analyse findings.

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 48: IT Security Management
		Unit 49: Digital Forensics

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:

- Disaster Recovery
- Availability Management.

Essential requirements

As recommended in the delivery guidance, a centre delivering this unit must have access to suitable virtualisation resources to deliver this unit. There are many free and open source desktop and server solutions and there is no perceived limitation on any centre. The primary focus is practice based and therefore this unit cannot be delivered in a theoretical context.

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.

The learner will need to create a virtualisation environment. For server based solutions, this must be on a hardware system capable of supporting a system such as VM Ware ESXi or any other equivalent. For desktop based solutions, the underlying host operating system must have sufficient memory and storage resources to support one or more images in residence.

There are many potential virtualisation solution and implementation approaches, all having different complexities and technological needs as well as outcomes.

If the centre is using a real environment in which to host the virtualisation solution, the legal implications of how this may affect the owners of the real network, as well as the implications for the learner and the academic centre, must be considered.

Implementation of the virtualisation environment must be tested systematically and procedurally based on the technology used in the design solution. The final solution implemented may be on a live system, but ideally should be tested in a segregated 'sandbox' environment.

Resources

Books

Ruest N and Ruest D – *Virtualization, A Beginner's Guide* (McGraw Hill, 2009) ISBN-10: 007161401X

Hess K and Newman A – *Practical Virtualization Solutions: Virtualization from the Trenches* (Prentice Hall, 2009) ISBN-10: 0137142978

Lowe S – *Mastering VMware VSphere 4* (Wiley, 2009) ISBN-10: 0470481382

Hoopes J – *Virtualization for Security: Including Sandboxing, Disaster Recovery, High Availability, Forensic Analysis, and Honeypotting* (Syngress, 2009) ISBN-10: 1597493058

Websites

www.networkworld.com/links/Research/Storage/Virtualization/index.html

www.serverwatch.com/tutorials/article.php/3634911/The-Hows-and-Whys-of-Server-Virtualization.htm

Employer engagement and vocational contexts

Liaison with virtualisation and server deployment/management from local or national organisations would enhance the delivery of this until. 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.

Unit 48: IT Security Management

Unit code: A/601/1995

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

The aim of this unit is to provide an understanding of IT security management to enable learners to manage organisational security.

Unit abstract

This unit deals with the management of an organisation's security. This involves controlling access, regulating use, implementing contingency plans and devising security policies and procedures. Breaches in security may be caused by human actions, accidental, malicious or negligent, or through incorrect installation, configuration or operation.

Physical security management involves regulating the access to the computers, network devices, databases etc by physical means such as securing buildings from unauthorised access, prevention of loss or damage due to weather, fire and water ingress. Consideration must also be given to alternative sources of supply of hardware, software, power, telecommunications and suitable buildings to allow the organisation to continue after a disaster has occurred (disaster recovery planning).

Human resource management is also an important topic as regards the management of security. It allows for the selection of roles and responsibilities and the associated documentation of organisational procedures based on current legislation and standards.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand risks to IT security

2 Understand mechanisms to control organisational IT security

3 Be able to manage organisational security.

Unit content

1 **Understand risks to IT security**

Risks: types eg unauthorised use of a system without damage to data, unauthorised removal or copying of data or code from a system, damage to or destruction of physical system assets and environment, damage to or destruction of data or code inside or outside the system, naturally occurring risks

Organisational security: procedures eg data, network, systems, operational impact of security breaches, web systems, wireless systems

2 **Understand mechanisms to control organisational IT security**

Risk assessment: potential loss eg data, intellectual property, hardware and software; probability of occurrence eg disaster, theft; staff responsibilities

Data protection: government regulations eg Data Protection Act 1998, Computer Misuse Act ; company regulations: eg site or system access criteria for personnel; anti-virus software; firewalls, basic encryption techniques; operational continuity planning; back-up procedures

Physical security: types eg biometrics, swipe cards, theft prevention

3 **Be able to manage organisational security**

Organisational security: policies eg system access, access to internet email, access to internet browser, development/use of software, physical access and protection, 3rd party access, business continuity, responsibility; controlling security risk assessments and compliance with security procedures and standards eg ISO/IEC 17799:2005 Information Technology (Security Techniques – code of practice for information security management); informing colleagues of their security responsibilities and confirming their understanding at suitable intervals

Security: tools eg user logon profiles to limit user access to resources, online software to train and update staff, auditing tools to monitor resource access

Security audits: gathering and recording information on security; initiating suitable actions to deal with identified breaches of security (see also *Human resource issues* below); scheduling of security audits; defining requirements for security audits

Human resource issues: staff rights and responsibilities; coping with disaffected staff eg disciplinary procedures in the event of identified security breaches

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 risks to IT security	1.1 identify and evaluate types of security risks to organisations 1.2 valuate organisational security procedures
LO2 Understand mechanisms to control organisational IT security	2.1 discuss risk assessment procedures 2.2 evaluate data protection processes and regulations as applicable to an organisation 2.3 analyse physical security issues for an organisation
LO3 Be able to manage organisational security	3.1 design and implement a security policy for an organisation 3.2 evaluate the suitability of the tools used in an organisational policy 3.3 discuss the human resource issues that have to be considered when carrying out security audits.

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 7: Organisational Systems Security		Unit 36: Internet Server Management
		Unit 46: Network Security
		Unit 47: IT Virtualisation

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:

- Information Management
- IT Security Management
- Disaster Recovery.

Essential requirements

IT security has become a subject in its own right and deserves serious consideration in any organisation that uses modern information systems. In order to effectively complete this unit the leaner must have access to many sources of information that will allow a natural progression of study from an initial understanding of the risks to organisational security, to an understanding of the mechanisms of control through to designing of policies and procedures.

Whilst this is mainly a managerial/administrative unit, not overly concerned with technical detail of particular computer systems, an understanding of them will be important, especially those that concern access to computer networks, web and wireless access and databases.

Resources

Books

Alexander D et al – *Information Security Management Principles* (BCS, 2008) ISBN-13: 978-1902505909

Beekman G – *Computer Confluence Complete: and Student CD* (Prentice Hall, 2005) ISBN 1405835796

Tipton H – *Information Security Management Handbook: v. 4* (Auerbach Pubs, 2010) ISBN-10: 1439819025

Websites

www.acm.org – Association of Computing Machinery

www.bcs.org – British Computer Society

www.bsa.org.uk – Business Software Alliance

www.fast.org.uk – Federation Against Software Theft

www.ico.gov.uk – Information Commissioners Office

Employer engagement and vocational contexts

Liaison with network (or internet) security experts from local or national organisations would enhance the delivery of this until. 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.

Unit 49: Digital Forensics

Unit code: D/601/1939

QCF Level 5: BTEC Higher National

Credit value: 15

Aim

To provide learners with an understanding of the principles of digital forensics and the impact on commerce, society and the individual.

Unit abstract

With the evolution of information technology and the increasing adoption of telecommunication-based systems, opportunities for criminal and illegal practice have expanded exponentially. For an ICT professional, managing the security of any complex corporate system comes with many challenges. When a breach of the system occurs a criminal act takes place against an organisation or an individual.

As with a real-world crime scene, a computer system can be used as a tool to implicate criminal activity. The need to preserve the crime scene and ensure the analysis is completed in a manner conducive to the fair and unbiased pursuit of justice is of the greatest importance.

In legal proceedings, the evidence presented is often called into doubt by the presence of unsafe practice in the acquisition of forensic evidence from a computer system. In taking this unit, the learner is introduced to IT forensics and the critical need for accurate, detailed and recorded investigation of the fact.

The practice of IT forensics has to be supported by individuals trained in national or international law enforcement practice. In preserving the scene learners must ensure system logs, operating system data and other relevant information is acquired and stored as an image of the time of forensic acquisition. Learners must be in a position to assist any potential legal process and ensure the evidence acquired supports a successful and fair legal outcome.

Learners will need to understand and review cases where the process of forensic analysis determines the absence of direct criminal intent and serves as a process to improve security and administrative processes as well as technological implementation.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the impact of digital forensics on the social and commercial environments

2 Understand the principles of evidence gathering

3 Be able to plan and implement digital forensics investigations

4 Be able to analyse the outcomes of digital forensics investigations.

Unit content

1 **Understand the impact of digital forensics on the social and commercial environments**

Approach: types eg legal forensic analysis, illegal forensic analysis, defensive forensics, offensive forensics

Data manipulation: digital data/information hiding techniques eg steganography, encryption, obfuscation; tools available

Malware: types eg virus, trojan, worm, zombie, botnet, keylogger, screen recorder; social engineering; exploitation of personal confidence

Motivation: deliberate eg commercial, criminal, personal, political, ideological, investigative; casual eg explorative, leading to deliberate motivation

Commercial: impacts eg loss of faith, financial loss, competitive advantage, unfavourable corporate image

Social: impacts eg financial loss, loss of resource, loss of access, loss of trust

2 **Understand the principles of evidence gathering**

Evidence: chain of custody; evidence preservation; local legislation on evidence; international evidence requirements; jurisdiction

Evidential challenges: technological change; technological behaviours; adaptability of the opponent; change in legislative practice; legal challenge

Involvement of legal authorities: international law enforcement; local law enforcement; criminal proceedings; civil action

Record keeping: methods eg reporting, recording, statements, system logs, operating system images

Interview of witnesses: methods eg keeping a record, with a co-interviewer, interviewees right to counsel; involvement of corporate personnel management eg disciplinary management, criminal proceedings, civil action; background checks

3 Be able to plan and implement digital forensics investigations

Network forensics: sources eg traffic monitoring, traffic signatures, Simple Mail Transfer Protocol (SMTP) logging, span ports, traffic redirection, traffic reassembly, intrusion detection systems, email trails, firewall logs, anomaly identification and management, scanning tools, Address Resolution Protocol (ARP) poisoning

Workstation or server forensics: sources eg analysis of file systems, different operating system profiles, malware detection and removal, working on images of systems, application MD5 fingerprint, registry (system database) change analysis

Data Forensics: sources eg storage device data recovery, analysis of data change, database rollback and audit

Device specific behaviour: devices eg server, desktop computer, mobile device, file system, communication medium, protocol, application used, power status

Tools: commercial eg encase, fdk, helix, cloning software, virtualisation environments, virus scanning, network scanning, network analysis; open source; system logs; access logs

Planning: evidence gathering techniques; involvement of legal authority; involvement of corporate personnel management; record keeping; time constraint; diligence

Safe practice: procedures eg handling evidence on first receipt, creation of images, disk cloning, safe shutdown of an active system for forensic analysis.

4 Be able to analyse the outcomes of digital forensics investigations

Presentation of the fact: impartial information; absence of supposition; detailed delivery; independent analysis eg second opinion

Reporting: legal proceedings (civil, criminal, disciplinary, technical review, security audit, procedural audit)

Procedural change: update policy eg security, technology, forensic analysis technique, staff vetting

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 digital forensics on the social and commercial environments	1.1 evaluate current forensic practice 1.2 discuss the potential impact of a forensic investigation 1.3 discuss the impact of 'motivation', data manipulation and malware
LO2 Understand the principles of evidence gathering	2.1 discuss the principles of evidence gathering 2.2 evaluate current evidence gathering practices and assess their impact
LO3 Be able to plan and implement digital forensics investigations	3.1 based on a given scenario, plan a digital forensics investigation 3.2 implement a digital forensics investigation 3.3 systematically record each process during investigation
LO4 Be able to analyse the outcomes of digital forensics investigations	4.1 present findings of forensics investigation 4.2 critically review and analyse findings.

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 46: Network Security
		Unit 48: IT Security Management

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

As recommended in the delivery guidance, a centre delivering this unit must have access to suitable forensic applications and 'investigative' artefacts to deliver this unit. The primary focus is practice based and therefore this unit cannot be delivered in a theoretical context.

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.

The learner will need to evaluate a system, using an existing system or live computer.

The investigation must be systematic and procedural based on the planning and current 'local' forensic practice. Please refer to local law, international law and the accepted practice of managing criminal evidence.

Resources

Books

Casey E – *Handbook of Digital Forensics and Investigation* (Academic Press, 2009) ISBN-10: 0123742676

Carvey H – *Windows Forensic Analysis DVD Toolkit* (Syngress, 2009) ISBN-10: 1597494224

Malin C et al – *Malware Forensics*: *Investigating and Analyzing Malicious Code* (Syngress, 2009) ISBN-10: 159749268X

Websites

www.digitalforensicsmagazine.com/

www.e-evidence.info/thiefs_page.html

Employer engagement and vocational contexts

Liaison with local or national law enforcement 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. Extreme care must be taken to ensure any real work projects are not detrimental to their employer or employment, or prejudicial to any potential legal outcome.

Unit 50: Work-based Experience

Unit code: D/601/0998

QCF level 5: BTEC Higher Nationals

Credit value: 15

Aim

This unit aims to enable learners to experience the scope and depth of learning which may take place in a work-based context by planning, monitoring and evaluating the work experience.

Unit abstract

A significant amount of learning can be achieved by carrying out practical activities in a workplace. Learning may be enhanced by taking a more formal approach to work-based activities – by planning, carrying out the activities and reflecting on the benefits of the activities to the business and to the learner.

This unit is designed to allow flexibility of study for part-time and full-time learners. It is expected that learners will be supervised in the workplace in addition to the supervision provided by their academic supervisor.

Learners will have the opportunity, supported by their supervisors, to negotiate and perform activities which will allow them to fulfil the assessment criteria for this unit. They will recognise the scope of what they have achieved by recording evidence from carrying out the activities. They will also gain maximum benefit by reflection on and evaluation of the work they undertake.

Learning outcomes

On successful completion of this unit a learner will:

1 Be able to negotiate industry experience

2 Understand the specific requirements of the placement

3 Be able to undertake work experience as identified

4 Be able to monitor and evaluate own performance and learning.

Unit content

1 **Be able to negotiate industry experience**

Suitable organisation and location: types of establishments for placement eg industry-related work for a client brief at college, existing work environment, different departments within current employer's business

Negotiation: methods of contacting organisations; methods of undertaking negotiations

Nature of duties: type of undertaking eg routine duties and tasks, project work, development of new procedures/protocol

Supervisors: roles and responsibilities of academic and industrial mentors

Expectations of learning: aims eg proficiency in new tasks and procedures, time-management and problem-solving skills, reflection, discuss progress with others, teamwork

Business constraints: consideration of possible limitations eg need to be fully trained, adherence to quality systems, health and safety considerations, supervision time, workload, customer satisfaction, limited staffing, cost of materials

2 **Understand the specific requirements of the placement**

Tasks: details of activities eg specific hourly, daily, weekly routine and non-routine tasks; breakdown of a project into stages; new procedures/protocol

Prioritise: reasons for rationalisation of the order of tasks; methods of prioritising work

Plan for the work experience: methods used to develop detailed plan with schedule of tasks, proposed dates for reviews, expected input from supervisors

Benefits to organisation and learner: advantages to business eg allowing more routine tasks to be carried out, allowing procedures/techniques to be developed, increasing responsiveness, identifying cost saving measures; advantages to learner eg understanding how a business operates, understanding importance of teamwork, learning new techniques, development of problem-solving and time-management skills

3 **Be able to undertake work experience as identified**

Carry out the planned activities: realisation eg carrying out tasks and project work according to relevant legislation, training and codes of practice; developing new procedures or protocol

Record activities in the appropriate manner: systematic and appropriate recording of relevant activities eg logbook, diary, portfolio, spreadsheets, data bases; list of resources

Revise the initial plan as required: methods used to review activities at the appropriate time to see if they meet requirements, make alterations as needed

4 **Be able to monitor and evaluate own performance and learning**

Evaluation of the quality of the work undertaken: meeting industry standards and evaluating own performance against original proposal; comments/testimony from supervisors

Account of learning during the work experience: details of experience gained eg new procedures, interpersonal skills, time management, problem solving, teamwork; details of evidence eg portfolio of evidence, scientific report, management report

Recommendations on how the learning experience could have been enhanced: alternative ideas eg different location, different brief, different time period, more/less support, better time management, better preparation

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 negotiate industry experience	1.1 research and evaluate suitable organisations that could provide industry experience 1.2 negotiate with work and academic supervisors a proposal for the work experience 1.3 recognise the business constraints on the work experience offered
LO2 Understand the specific requirements of the placement	2.1 agree and prioritise the tasks and responsibilities involved in the work experience 2.2 produce a plan for the work experience 2.3 analyse the benefits of the proposed activities to the business and the learner
LO3 Be able to undertake work experience as identified	3.1 fulfil specified requirements of placement conforming to all related codes of practice 3.2 produce systematic records of work undertaken 3.3 revise the initial plan as required 3.4 make suggestions for improvement and review these with appropriate supervisor
LO4 Be able to monitor and evaluate own performance and learning	4.1 monitor progress against original proposal 4.2 evaluate the quality of own performance 4.3 analyse the learning which has taken place during the work experience using suitable reflections 4.4 make recommendations on how the experience could have been enhanced.

Guidance

Links

This unit has possible links with all units in the programme, especially the *Personal and Professional Development* and *Employability Skills* units.

This unit has links to the Management and Leadership NOS.

Essential requirements

Given the work-based nature of this unit, the majority of resources will be those available to the learner in the workplace. The work will normally be planned to be achievable within the resource constraints of the employer. Therefore, knowledge of company structures and daily routines and expectations are essential. Learners should also have access to a wide range of research facilities including careers library and/or careers services.

Tutor support and guidance are essential. Learners should remain in touch with tutors during the work experience – email is often the best way but some colleges may have access to a virtual learning environment where learners can share information and experiences with each other and the tutor.

Unit 51: Computer Systems Architecture

Unit code: J/601/2003

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

To enable learners to understand the underlying architecture and components behind the functioning of computer systems.

Unit introduction

All computer systems share the same underlying computer architecture principles. This unit examines these principles and explores the fundamentals of how computer systems work. Learners will focus on the technical detail including how the components function at an electronic level.

Learners will explore how various types of data can be represented and then stored within computer systems. This is followed by a study of the low-level system components. It includes the processor, buses and memory incorporating an analysis of how these components interact to manipulate data using the fetch-execute cycle. Low-level program instructions make up the fetch-execute cycle and simple assembly code instructions are investigated along with their interaction with the various registers that make up the Central Processing Unit (CPU). Learners will have the opportunity to develop simple programs in a low-level language.

Learning outcomes

On completion of this unit a learner should:

1 Understand how data can be represented within computer systems

2 Understand the functions of computer system components

3 Understand the principles of processor operations.

Unit content

1 Understand how data can be represented within computer systems

Numeric data: conversions between different representations of data; representing integer numbers in different number bases; converting between number bases using integer numbers eg denary to binary, denary to hexadecimal, binary to hexadecimal; performing arithmetic operations in different number bases; representing fixed-point numbers in different number bases; representing floating-point numbers in binary

Boolean logic: logic gates; truth tables; use of logic gates in integrated circuits; logical operations eg AND, OR, NOT, NAND, NOR, XOR

Coding of data: sign and magnitude; two's compliment; floating point; binary coded decimal; coding of character data eg ASCII (American Standard Code for Information Interchange)

Types of data: representing bit patterns for different types of data eg graphics, video, audio and other data; graphics eg bitmap (resolution, colour depth, file calculations), vector (objects, properties); sound (compression, sampling resolution, sampling rate, streaming audio, quality); video (compression, encoding, streaming, quality); analogue data; digital data; analogue signals; digital signals; data conversion eg analogue to digital; file formats eg mp3, mp4, wav, avi

2 Understand the functions of computer system components

Key components: Central Processing Unit (CPU); memory; interfaces; clock; buses, diagrammatic representation; Von Neuman architectures

Central Processing Unit: control unit; ALU (Arithmetic Logic Unit); general purpose registers; special purpose registers eg instruction pointer, accumulator; core eg single, multiple; features eg pipelining, multiprocessing, parallel processing; polling; interrupts

Memory: I/O maps; Direct Memory Access (DMA); ROM (Read Only Memory); cache; RAM (Random Access Memory) eg static, dynamic, flash

Buses: system bus; address bus; control bus; physical connections to components eg Central Processing Unit, memory, input/output (I/O) devices, system buses

Peripherals: types eg hard disc, printer, scanner, network card

3 Understand the principles of processor operations

CPU instruction sets: Reduced Instruction Set Computer (RISC); Complex Instruction Set Computer (CISC); clock rate; performance levels

Addressing: modes eg immediate; relative; address bus; addressing in the fetch-execute cycle

Machine operations: how they are organised and represented; role of the instruction decoder; low-level programs; assembly code instructions eg fetch, load, add; decision making and branching; using registers, transferring data between registers, fetch-execute cycle; program storage; data storage; addressing

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain using examples how numeric and alphanumeric data can be coded within a computer system		
P2 explain using examples how different types of data can be converted and stored in computer systems		
P3 convert numeric data between different number systems including floating point	M1 explain using examples how floating point numbers can be represented in binary	
P4 carry out Boolean logic operations		
P5 illustrate the key computer system components and how they interact		
P6 explain the different types of memory that can be attached to a processor	M2 compare the roles played by different types of memory	D1 explain how the processor is physically connected to memory and input/output (I/O) devices using the system buses
P7 explain how polling and interrupts are used to allow communication between processor and peripherals		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P8 compare Reduced Instruction Set Computer (RISC) chips and Complex Instruction Set Computer (CISC) chips		
P9 illustrate the use of the different processor registers in the fetch-execute cycle.	M3 create a low-level program which includes decision making and branching.	D2 explain how the width of the data bus and address bus affect processor performance and complexity.

Essential guidance for tutors

Delivery

It is recommended that this unit is delivered either after or in conjunction with *Unit 2*: *Computer Systems*.

Simulation software could be used extensively in this unit for example to develop learners' understanding of logic gates and low-level programming. Other software that simulates the internal operation of the processor would also be valuable to confirm learners understanding.

Alternatively, a software application that simulates a simple CPU and an associated assembly language could be used. This type of software usually covers the basic elements of assembly language programming. Learners are able to put the theory into practice using the simulator to run programs in a controlled way, seeing all CPU activity step by step.

LO1 should be delivered using a series of worksheets to deliver the maths theory and Boolean logic operations. It's important to link the number theory to computer activity, noting that at the lowest level binary represents the off/on nature of electricity. For example, hexadecimal is a user-friendly way of representing binary and is used in electronics and computing. Use of binary and hexadecimal in IP addressing (versions 4 and 6) could be demonstrated.

For LO2 and LO3, the CPU can be introduced as the part of the computer architecture that runs computer programs. This is facilitated by the fetch-execute cycle and this could be explained in conjunction with a simple assembly language program that, for example, adds two numbers together. This could then be used to introduce learners to the different registers that make up the CPU. The functions of the various buses and the different types of memory could then be covered.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
How data is represented within a computer system: • whole-class exercise – tutor presentation on numeric data, followed by practical exercise • whole-class exercise – tutor presentation on coding of data, followed by practical exercise • whole-class exercise – tutor presentation on representing analogue data, followed by practical exercise • a mixture of practical exploration of the technologies, learner exercises, case studies and detailed investigation.
Assignment 1 – The Devil is in the Data
Low-level components of computer systems: • whole-class exercise – tutor presentation on architecture components, followed by practical exercise • whole-class exercise – tutor presentation on processors, followed by practical exercise • whole-class exercise – tutor presentation on busses, followed by practical exercise • whole-class exercise – tutor presentation on memory, followed by practical exercise • a mixture of practical exploration of the technologies, learner exercises, case studies and detailed investigation.
Processor operations: • whole-class exercise – tutor presentation on the operation and use of logic gates, followed by practical exercise • whole-class exercise – tutor presentation on representation of gates and logical circuits, followed by individual exercise • whole-class exercise – tutor presentation on gate and logic circuits, followed by practical exercise • mixture of practical exploration of the technologies, learner exercises, case studies and detailed investigation.

Topic and suggested assignments/activities and/assessment
Assignment 2 – The Data Driver
Low level programming: • whole-class exercise – tutor presentation on low-level programs, followed by practical exercise • whole-class exercise – tutor presentation on addressing modes, followed by practical exercise • individual exercise – research into uses of low-level programs • learners will need access to practical resources and suitable technology, they can also use simulators or multimedia tools to gain prior experience before handling 'live resources' if available.
Assignment 3 – Low-level Programmer

Assessment

To achieve a pass grade, learners must achieve the nine pass criteria listed in the grading grid.

To achieve a merit grade, learners must achieve all of the pass grade criteria and the three merit grade criteria.

To achieve a distinction grade, learners must achieve all of the pass and merit grade criteria and the two distinction grade criteria.

Suggested Assignment 1 – The Devil is in the Data

For P1, appropriately designed short test questions could show understanding; alternatively some worked examples in a controlled open book environment would be appropriate. Whatever method is used, learners must explain in their own words how data can be coded, and must use examples within their explanation.

For P2, learners could use combinations of diagrams, and descriptions that show coverage of the different types of data in the unit content. Alternatively, a presentation and demonstration could be appropriate.

P3 could be assessed through conventional testing, however learners do not need to be 100 per cent correct in all conversions in order to achieve this criterion but they must eventually show competence. Evidence of learners' workings should be provided.

For P4, learners must carry out Boolean logic operations as specified in the content. This could be assessed through conventional testing as long as the criterion is covered. Evidence of learners' workings must be provided.

For M1, learners could investigate for example, single and double precision floating point and show how numbers are stored in 16, 32, 64 bit etc registers.

Suggested Assignment 2 – The Data Driver

For P5, a complex and annotated diagram or series of related diagrams could be appropriate, perhaps stored in a web page with appropriate detail stored in hot spots. Confirmation of learners' understanding could be gained using a discussion, which if suitably documented could also be part of the evidence.

For P6, a written report, presentation or web document could be used to explain the different types of memory attached to a processor.

For M2, learners could look at the role of processor cache memory, main memory and DMA.

For D1, learners could produce a diagram showing schematically the connectivity between processor and I/O devices with an explanation of, for example, how a document is printed or how a file is retrieved from disk.

Suggested Assignment 3 – Low-level Programmer

For P7, written responses to a series of scenarios could be used to generate evidence.

For P8, learners could research the different types of chips and look at the performance advantages and disadvantages of each.

For P9, learners could show diagrammatically the different registers involved in running a simple programme that, for example, adds two numbers together incorporating the fetch-execute cycle.

For M3, learners should produce listings of the programs, together with a statement from the tutor confirming that the program is valid.

For D2, learners could research bit sizes of current address and data buses and explain the effect these have on performance.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1-P4, M1	The Devil is in the Data	A series of mathematical exercises based on number conversions using different representations of data. A series of Boolean algebra exercises demonstrating use of logic diagrams.	Website/portfolio Presentation
P5, P6, M2, D1	The Data Driver	A company requests a report illustrating how the key computer system components and how they interact. A further extension to explain different types of memory, and the role they play in computer systems.	Poster Presentation
P7-P9, M2, M3, D2	Low-level Programmer	A company requests further information about the relationship with the processor and peripherals. The company wants a comparison of RISC and CISC to help their understanding of computer systems architecture. A company asks you to demonstrate assembly programming by creating a simple low-level program for a specific need.	Documentation Working program

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

This unit forms part of the BTEC in IT sector suite. This unit has particular links with the following unit titles in the IT suite:

Level 2	Level 3	Level 4
Unit 3: Computer Systems	Unit 2: Computer Systems	Unit 2: Computer Systems

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 2 National Occupational Standards for IT (ProCom):

- 4.1 Systems Architecture.

Essential resources

Learners must have access to practical resources and suitable technology, they can also use simulators or multimedia tools to gain prior experience before handling 'live resources' if available.

Indicative reading for learners

Textbooks

Blum R – *Professional Assembly Language Programming* (John Wiley & Sons, 2005) ISBN-10 0764579010, ISBN-13 978-0764579011

Gaura E, Hibbs D and Newman R – *Computer Systems Architecture* (Lexden, 2008) ISBN-10 1904995098, ISBN-13 978-1904995098

Goodstein R – *Boolean Algebra* (Dover, 2007) ISBN-10 0486458946, ISBN-13 978-0486458946

Website

freecomputerbooks.com/compscArchitectureBooks.html

Unit 52: Spreadsheet Modelling

Unit code: Y/601/6637

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

To enable learners to use complex spreadsheet modelling in order to support organisational activities such as credit control, sales forecasting and stock analysis.

Unit introduction

Spreadsheets are key software for many businesses and organisations, helping them to keep track of numerical information and analyse it quickly and more easily than with paper records.

Accounting and finance use spreadsheets to record the transactions made by organisations. They have replaced manual pages in ledgers, where income and expenditure are organised into rows and columns. Users can make use of inbuilt functionality to help them to understand the data without needing specialist mathematical skills.

Utilities such as ordering, sorting and filtering will show the same data in different ways. Charts and graphs help to display information more visually. Complex calculations can be carried out using library functions or users can choose to create their own formulae.

One of the main advantages of spreadsheet software is that it can be customised with buttons and macros. IT practitioners can use many features, for example to restrict user access to whole workbooks, spreadsheets or parts of spreadsheets.

Spreadsheets can be saved in a number of different formats. The most useful format is comma separated value (csv), as this particular format can be read by many applications which means that data created in one type of spreadsheet software can be exported easily to other programs. This technology enables organisations to be more knowledgeable about their own activities. This, in turn, allows managers to make decisions more quickly which can lead to organisations gaining competitive advantage.

As IT practitioners, learners will need to be able to use spreadsheet software competently as well as being able to support users as part of a technical or helpdesk role.

Learning outcomes

On completion of this unit a learner should:

1 Understand how spreadsheets can be used to solve complex problems

2 Be able to develop complex spreadsheet models

3 Be able to automate and customise spreadsheet models

4 Be able to test and document spreadsheet models.

Unit content

1 Understand how spreadsheets can be used to solve complex problems

Use of spreadsheets: manipulating complex data; presentation to requirements; supporting decision making eg analysis of data, goal seeking, scenarios, regression, data mining

Complex problems: types eg cash flow forecasting, budget control, what-if scenarios, sales forecasting, payroll projections, statistical analysis, trend analysis

Interpretation: methods eg comparisons of totals, trend analysis

2 Be able to develop complex spreadsheet models

Complexity: multiple worksheets (with links); complex formulae eg at least two-step process; large data sets; cells linkage; data entry forms eg menu systems, list boxes, drop-down boxes, event controls; data validation; error trapping; lookup tables; nested IF functions; templates; cell protection

Formulae: relative references; absolute references; logical functions eg IF, AND, OR, NOT, SUMIF; correct operators

Structure and fitness for purpose: formatting eg integer, real, date, currency, text; styling eg bold, italics, borders, shading, column alignment, consistency; context

Features and functions: named ranges; file sharing; tracking changes; security issues; user interface; add-ins; built-in functions eg cell functions, lookup functions, text functions, statistical function; finding data

Refine: improving efficiency eg shortcuts, aiding navigation; formatting eg fonts, page orientation, header and footer, print area, use of colour, conditional formatting

3 Be able to automate and customise spreadsheet models

Sorting and summarising data: use of sub-totals and facilities eg pivot tables; sorting data on multiple fields; filtering data sets

Tools: charts and graphs eg titles; labels eg axis scales, colours, annotation; select appropriate type eg line, bar, column, pie, xy (scatter)

Presenting: combining information eg table of data and chart; maintaining data eg between worksheets, workbooks, packages

Analysing and interpreting data: convert data eg charts, graphs; lists eg filtering, sorting; trends; patterns; data analysis; results; conclusions

Customisation: restricting data entry eg hiding; protecting; modifying toolbars; modifying menus; checking data eg data validation, range checking, not NULL; error messages

Automation: methods eg macros, ActiveX control, Control Toolbox, Visual Basic

4 **Be able to test and document spreadsheet models**

Test: manual calculations eg formula, functions; data entry forms; validation; calculations; correct outcomes eg layout, values; suitability for client; user testing; test plans using normal, extreme and erroneous data

Feedback: methods eg surveys, questionnaire, interview; analyse results; make recommendations

Alternative formats: converting to eg xls, csv, txt, xms, xml, html

Documentation: user documentation eg instructions, guide, troubleshooting; technical documentation eg hardware resources, software resources; instructions; calculations eg formula, functions used; validation procedures

Assessment and grading criteria

In order to pass this unit, the evidence that learners presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain how spreadsheets can be used to solve complex problems		D1 discuss how organisations can use interpretation methods to analyse data
P2 develop a complex spreadsheet model to meet particular needs	M1 refine a complex spreadsheet model by changing rules and values	
P3 use formulae, features and functions to process information		
P4 use appropriate tools to present data	M2 analyse and interpret data from a spreadsheet model	
P5 customise the spreadsheet model to meet a given requirement		
P6 use automated features in the spreadsheet model to meet a given requirement	M3 compare different automation methods	
P7 test a spreadsheet model to ensure that it is fit for purpose		D2 evaluate a spreadsheet model incorporating feedback from others and make recommendations for improvements.
P8 export the contents of the spreadsheet model to an alternative format		
P9 produce user documentation for a spreadsheet model.	M4 produce technical documentation for a spreadsheet model.	

Essential guidance for tutors

Delivery

This unit assumes learners have a basic understanding of spreadsheets and spreadsheet terminology. The unit should be delivered in a room containing computers so that learners can work through sample exercises or other source materials. Using practical examples, the activities undertaken in this unit should, if possible, be contextualised so learners gain the maximum benefit from learning about concepts.

Tutors should expect that the majority of time will be allotted to practical tasks, which will require, for most of the tasks and exercises, each learner to have access to a computer with some form of spreadsheet software installed.

For most of the practical work, it is strongly recommended that the tutor provide learners with a prepared spreadsheet. Ideally, these spreadsheets could be created for a specific business scenario. For instance, a spreadsheet could be created with a business's financial management in mind. Spreadsheets are normally designed to use advanced formulae and make use of many of the spreadsheet's advanced functions.

Another example of practical spreadsheet use is as a research tool for recording and analysing statistical information.

For the directed research exercises, the tutor could also give learners material to help them in directed research tasks. This material could come from a variety of sources, including websites specialising in advanced use of spreadsheet software, and from textbooks within the centre.

However, the tutor could also recommend a list of suitable textbooks that learners could obtain from local libraries, which could also help in research exercises. Most spreadsheet programs come with 'Help' functions that contain extensive 'How To' guides, and the tutor could also recommend that learners use these as research aids.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
Using spreadsheets to solve problems: • whole-class exercise – tutor presentation on how to use spreadsheets for complex tasks • whole-class exercise – begin using the spreadsheet to solve complex problems • individual exercise – from tutor-prepared materials learn advanced formulae and use on a spreadsheet • directed research – find out the different ways in which a spreadsheet can be used to interpret complex data sets.
Assignment 1 – Embracing Complexity
Complex models: • whole-class exercise – tutor presentation on creating and using complex spreadsheets with advanced formulae, features and functions • individual exercise – from tutor-prepared material look at higher-level formulae, features and functions • whole-class exercise – tutor presentation on formatting and styling • whole-class exercise – tutor presentation on how to automate and customise spreadsheet models using macros, Active X control, Visual Basic • whole-class exercise – tutor presentation on what sorting and summarising data means, why it's needed and how it can be done • whole-class exercise – tutor leads lesson on charts/graphs and how to manipulate them • individual exercise – learner works from tutor-prepared materials to understand how to automate and customise spreadsheets.

Topic and suggested assignments/activities and/assessment
Assignment 2 – Making it Presentable
Test and document: • individual exercise – learner works from tutor-prepared materials to test spreadsheet models and document test plans • whole-class exercise – tutor leads lesson on methods for capturing feedback and how to interpret the results from feedback • individual exercise – learner works from tutor-prepared materials to produce user and technical documentation • whole-class exercise – learn about conversion to other file formats.
Assignment 3 – Going to the Next Level

Assessment

At this level, assessment is probably suited to assignments in the form of a mini project, where learners can apply all the principles of the unit to one business problem.

To achieve a pass grade, learners must achieve the nine pass criteria listed in the assessment and grading criteria grid.

For P1, learners will need to explain how spreadsheets can be used to solve complex problems, and they should provide examples to support their explanation.

For P2, learners will need to develop a complex spreadsheet model, where 'complex' requires that the spreadsheet contains some aspects of the following range: multiple worksheets (with links), complex formulae, for example at least two-step process, large data sets, cells linkage, data entry forms, for example menu systems, list boxes, drop-down boxes, event controls, data validation, error trapping, lookup tables, nested IF functions, templates, and cell protection.

For P3, learners should solve a complex problem using formulae and functions in the spreadsheet. This might best be through a supplied scenario such as a cash flow forecast, a budgeting problem, 'what if' analysis, payroll projections or another similar scenario. This should include some aspects of the following range: relative references, absolute references, logical functions, for example IF, AND, OR, NOT, SUMIF, correct operators, named ranges, file sharing, track changes, security issues, user interface, add-ins, built-in functions, for example cell functions, lookup functions, text functions, statistical function and finding data.

P4 requires learners to create charts and graphs from numeric data sets. This can be either the same data used in different graphical images, or a number of different charts or graphs created from different data. Tutors should ensure that learners have created charts and graphs that are fit for purpose, they should contain appropriate titles, labels, axis scales and suitable colours, and that the chart or graph should be of the appropriate type. This would be achieved most successfully by giving learners a user need that requires them to select an appropriate graphical image from a possible range.

For P5, learners must customise the spreadsheet model. Examples of customisation include restricting data entry, for example hiding information, protecting worksheets and cells, modifying toolbars and menus, checking data, for example data validation, range checking, not NULL and display error messages.

For P6, learners should be able develop the spreadsheet model further by implementing automated features, such as macros, Active X control, Control Toolbox or Visual Basic.

For P7, learners should check the accuracy of the spreadsheet model. For example, evidencing that they have checked the spreadsheet model both in terms of the required functionality, accuracy of calculations, data validation, and to appropriate levels of detail (columns for example to two decimal places). Evidence should be in the form of test plans.

P8 could be evidenced through an observation and witness statement where learners demonstrate converting a spreadsheet file to an alternative format, and importing the converted file into the relevant software, for example an html file opened and printed successfully from a browser.

For P9, learners must produce user documentation with instructions on how to use the spreadsheet model, especially when navigating with user interfaces.

To achieve a merit grade, learners must achieve all the pass and the four merit criteria.

M1 builds on P2 by requiring learners to refine their complex spreadsheet model to improve efficiency. Examples include introducing shortcuts, or other methods to aid navigation, as well as improving the presentation by applying different styles and formatting techniques. The spreadsheet model must be presentable and user friendly.

For M2, learners can use the graphs or charts they have developed for P4 as a method of analysing and interpreting data from their spreadsheet model. Alternatively, learners could use sub-totals or pivot tables, data sorting and data comparison (trends for example) techniques to analyse data. Learners will need to demonstrate that they are using these techniques to interpret the complex spreadsheet model.

M3 builds on P6 by requiring learners to compare different automation methods including macros, Active X control, Control Toolbox and Visual Basic.

M4 builds on P9 by requiring learners to produce technical documentation which includes the required hardware and software resources, instructions and an explanation of calculations used in the spreadsheet model.

To achieve a distinction grade, learners must achieve all the pass, merit criteria and two distinction criteria.

D1 builds on P1 by discussing further how organisations can use interpretation methods to analyse data.

Finally, for D2, learners must evaluate their spreadsheet model and consider feedback from others. Learners should be able to reflect on their performance in building a spreadsheet model, and what hurdles they have overcome to achieve the desired result. Did the spreadsheet model meet the given requirements? What did other people think of the spreadsheet model? Learners must also include sensible recommendations for improvements.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, D1	Embracing Complexity	A company has asked you to provide information on how spreadsheets can be used to solve complex problems, and how to use tools to analyse data.	Theory/practical exercises
P2–P6, M1–M3	Making it Presentable	You have convinced the company that spreadsheet models are the best way to analyse data. The company wants you to develop a complex spreadsheet to meet their needs. Exploit the full use of spreadsheet software by using advanced formulae, features and functions, and present data using charts and graphs. The company is now looking to take its work on sophistication even further, exploiting the software as much as it can with automated features.	Portfolio

Criteria covered	Assignment title	Scenario	Assessment method
P7–P9, M4, D2	Going to the Next Level	The company would like to feel comfortable knowing that the spreadsheet model has been fully tested. Perform testing of the spreadsheet model. The company would also like to train their staff on the use of the spreadsheet model.	Portfolio

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

This unit forms part of the BTEC in IT sector suite. This unit has particular links with the following unit titles in the IT suite:

Level 1	Level 2	Level 3
	Unit 27: Spreadsheet Modelling	

Essential resources

Learners will need access to appropriate hardware and software.

Employer engagement and vocational contexts

The use of vocational context is essential in the delivery and assessment of this unit. Learners will require access to computer equipment to enable them to gain a practical awareness and enable them to apply their knowledge and understanding in a practical situation.

There is a range of organisations that may be able to help to centres engage and involve local employers in the delivery of this unit, for example:

- Learning and Skills Network – www.vocationallearning.org.uk
- Local, regional business links – www.businesslink.gov.uk
- National Education and Business Partnership Network – www.nebpn.org
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei.

Indicative reading for learners

Textbooks

Day A – *Mastering Financial Mathematics with Excel* (Financial Times Prentice Hall, 2005) ISBN 0764597809

Hart-Davis G – *How to Do Everything with Microsoft Office Excel 2003* (McGraw-Hill Education, 2003) ISBN 0072230711

Heathcote R – *Further Excel 2000-2003* (Payne-Gallway Publishers, 2004) ISBN 1904467768

Koneman P – *Advanced Projects for Microsoft Excel 2000* (Prentice Hall, 2000) ISBN 0130885444

Simonn J – *Excel Data Analysis, 2nd Edition* (Hungry Minds Inc US, 2005) ISBN 0764597809

Zapawa T – *Excel Advanced Report Development* (Hungry Minds Inc US, 2005) ISBN 0764588117

Websites

http://office.microsoft.com/en-us/excel/default.aspx

http://support.openoffice.org/index.html

www.free-training-tutorial.com

Unit 53: Web Server Scripting

Unit code: A/601/0443

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

To enable understand and use web server scripting and investigate the common issues surrounding its use.

Unit introduction

When designing and building websites, a key issue for developers is the amount of control they can exert over how tasks are carried out. Client-side scripting embedded in web pages can give additional functionality but, because the code is executed after the page has been loaded, there is little control and this approach can lead to hacking vulnerabilities and errors.

Web server scripting is code written 'server-side' and executed before the page is loaded. This means that complex tasks can be created and programming is generally more secure. The skills and knowledge developed in this unit are particularly valuable because security and reliability are common issues for businesses.

The types of operation that can be influenced include handling files on the server, security systems such as password protection, and accessing databases. Server scripting can be used, for example, to gather statistics about the website, including how many visitors have viewed each page. Data such as this can be used to generate revenue from people wishing to advertise on a popular website.

Another function that web server scripting can relate to is the use of environmental arguments. The user's computer system is scanned to obtain their screen resolution, browser type and other information. Each web page in a website can be made several times to suit a variety of environments. The user is then automatically redirected to the page which best suits their environment. This facility can enhance user enjoyment but has ethical implications if used inappropriately.

Learners will understand the principles of server-side web scripting and be able to create functionality using a web server script. Learners should also understand the security and ethical issues surrounding this area of IT.

Learning outcomes

On completion of this unit a learner should:

1 Understand the principles of web server scripting

2 Be able to use web server scripting

3 Understand the issues affecting web server scripting.

Unit content

1 Understand the principles of web server scripting

Web server scripting languages: server-side versus client-side; web server scripting languages eg ASP, JSP, PHP, Cold Fusion, Perl, Ruby on Rails, Django

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

Features: advantages eg interpreted scripts as alternative to compiled code, run as lower overhead code inside web server plugins, hide web server interface inside economical APIs; disadvantages eg increased complexity, reduced performance, code is interpreted not compiled

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

2 Be able to use web server scripting

Programming: functionality eg file manipulation such as uploading, security features such as login systems and error logging, accessing databases, generating statistics, environmental arguments

Documentation: requirements specification; internally documented code

Testing and debugging: test plan structure eg test, date, expected result, actual result, corrective action; error messages; other eg specialist software debugging tools

3 Understand the issues affecting web server scripting

Security: specific problems eg coding vulnerabilities, bad scripting leaving backdoors, SSL, password liabilities

Ethical: issues eg scanning PCs without consent, faking statistics to obtain advertising deals based on visitor numbers

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain the principles of web server scripting	M1 compare server-side and client-side scripting	D1 evaluate the combined use of client and web server scripting
P2 use web server scripting to identify a user's browser and screen resolution		
P3 upload files to a web server using web server scripting	M2 edit the content of a text file on a web server using web server scripting	
P4 implement, test and document a simple login system using web server scripting	M3 create a multi-user, dynamic login system using web server scripting	
P5 implement, test and document a web content management system to meet a defined need	M4 implement an error log for a website using web server scripting.	D2 create a web application to generate website statistics using web server scripting
P6 explain the issues surrounding web server scripting.		D3 recommend ways to improve web security when using web server scripting.

Essential guidance for tutors

Delivery

Learning outcome 1 could define what web server scripting is and what languages are used, together with an appreciation of what can be carried out server side as opposed to client side. It is probably easiest to deliver this by whole-class teaching, possibly backed up with handouts and using some directed study to add interest.

This basic understanding will lead into the advantages of web server scripting. A useful method is for the class to put forward their ideas of advantages, possibly in small groups feeding back to the whole, and then for the tutor to lead a discussion on the items they put forward. The tutor can ensure that the final list covers the main elements (see the unit content learning outcome 1).

Having discussed the advantages it is essential that learners are aware of the disadvantages of web server scripting. This can be delivered in a similar way to the advantages, and there may be benefits from delivering the two elements together.

Having dealt with the background to the subject, delivery of the practical aspects is next. Learning outcome 2 involves using a scripting language and could be delivered by the tutor demonstrating a wide a variety of programming techniques followed by learner exercises to gain practise in using the techniques. It is beneficial for learners to see examples of good documentation including explanations of control structures within the code along with suitable test plans. Tutors should demonstrate the use of debugging tools and discuss list of potential error messages and their meanings.

Learning outcome 3 considers security issues and ethical issues. A good way of delivering material on security issues is to get the learners to discuss what they perceive to be issues in this area. The will no doubt have discussed security in other units and it is always good to extract what they already know and transfer that knowledge to a different situation. The tutor can ensure that sufficient real issues are discussed. Using small case studies to consider security issues is a useful way to illustrate the techniques used to recognise these issues.

Finally, learners will address ethical issues. It may be that they will not understand what the term means and a brief introduction by the tutor may be necessary. This could lead on to group discussion that feeds back their thoughts to the whole class. The tutor can lead whole-class discussions. Using case studies to identify ethical issues is a good way of reinforcing the information.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
Server scripting language: • whole-class exercise – tutor presentation on web server scripting languages, followed by practical exercise for learners • individual exercise – using tutor-provided materials, learners work to understand advantages of web server scripting • individual exercise – using tutor-provided materials, learners work to understand advantages of web server scripting.
Assignment 1 – What is Web Server Scripting?
Using web server scripting: • whole-class exercise – tutor demonstrates various aspects of programming, followed by class practical • individual exercise – use a tutor-provided checklist of documentation • whole-class exercise – tutor presentation on testing, followed by creating a test plan after looking at examples.
Assignment 2 – Programming for the Web Server
• whole-class exercise – tutor-led discussion on specific security problems • whole-class exercise – tutor-led discussion on examples and case studies of ethical issues.
Assignment 3 – Complete Programming Examples
Assignment 4 – Issues

Assessment

It is suggested that this unit is assessed using four assignments as summarised in the *Programme of suggested assignments* table.

In the suggested scenario the learners are working for a web development company where they get involved in all sorts of activities. The current activity is to produce materials that will be supplied pre-event to a group of applicants for positions within the company. The information in the materials will be used in the interviewing of the applicants.

Some of the evidence required to complete the assignments could be naturally occurring within their work for other units within the qualification, or for other courses they are undertaking, and tutors are encouraged to use such evidence.

All of the criteria associated with this assignment are to do with writing server side scripts. Note that formal design, documentation and testing are not required for these scripts, although at level 3 one should expect to see some evidence of functionality.

In all cases it is expected that the assessor will supply a statement of authenticity for the learner work.

To gain a pass for the unit, learners must successfully complete all of the pass criteria.

In order to gain a merit grading, learners must achieve all of the pass criteria, and all of the merit criteria.

In order to gain a distinction grading, learners must achieve all of the pass criteria, all the merit criteria and all of the distinction criteria.

Assignment 1 – What is Web Server Scripting?

P1 is about the principles of web server scripting. The learner will explain the principles incorporating the four areas covered in the content.

Criterion M1 asks for a comparison of server side with client side scripting. This should be about functionality, comparing what can be done with each, the benefit of one over the other and the disadvantages of one over another. Each statement made should be supported with an example.

Criterion D1 asks the learner to evaluate the use of client side scripting and server side scripting together. This should be done by the use of examples. These examples must reflect something where both client side and server side scripting are used together; there is no restriction on what can be used.

Assignment 2 – Programming for the Web Server

P2 and P3 require the learner to create and implement scripts in a language of their choice.

P2 requires the learner to create a script to identify the user's browser and screen resolution. A copy of the server side script together with the outcome of action (browser and resolution) is the desired evidence for this criterion.

For criterion P3 the learner must create a script to upload a file, for example a text file to the server. Evidence should show the before and after absence and presence of the file together with a copy of the script.

For M2 the script allows editing the content of a text file on the server. This can be the text file loaded for P3 or a different text file. Editing can be anything that demonstrably changes the contents of the file. The change should form part of the evidence together with a copy of the script.

Assignment 3 – Complete Programming Examples

P4 and P5 require the learner to create and implement scripts in a language of their choice.

For criterion P4 learners are implementing, testing and documenting a simple login system. Copies of the documented code, statement of need, test plan and results together with any other relevant documentation are the evidence required for this criterion. A similar approach can be used for P5.

M3 involves creating a multi-user dynamic login system, which could be developed from the simple concept undertaken for criterion P4.

For M4 learners are to implement, test and document an error log for a website. Copies of the documented code, statement of need, test plan, test results and any associated document or screen print will form evidence for this criterion.

The script for D2 generates website statistics. Evidence should be a copy of the statistics together with a copy of the script.

Assignment 4 – Issues

Evidence for P6 requires the learner to explain security and ethical issue that might arise from the use of web server scripting. This evidence could be presented in an information leaflet, but any form of descriptive evidence would be appropriate.

D3 is an extension of P6

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	What is Web Server Scripting?	Your manager has asked you to produce the pre-event material for the applicants of a staff recruitment programme.	Web pages. Annotated prints of the web pages.
P2, P3, M2	Programming for the Web Server	You are to create the scripts the applicants will require for their interview.	Copies of code. Annotated prints. Screen grabs. Statement of authenticity.
P4, P5, M3, M4, D2	Complete Programming Examples	Using web server scripting you are to prepare copies of documentation and testing of scripts for a simple login system and an error log, plus an example of a multi-user system which uses scripts.	Copies of the documentation. Test plan and test results. Copies of scripts. Any additional documentation. Statements of authenticity and functionality.
P6, D3	Issues	You are to produce an information leaflet for the applicants outlining the security and ethical issues surrounding web server scripting.	Information leaflet.

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

This unit forms part of the BTEC in IT sector suite. This unit has particular links with the following unit titles in the IT suite:

Level 1	Level 2	Level 3
Unit 17: Website Development	Unit 20: Client Side Customisation of Web Pages	Web Server Scripting
Unit 34: Website Production	Unit 28: Website Production and Management	Web Applications Development

Essential resources

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 3 National Occupational Standards for IT (ProCom):

- 6.2 IT Security Management.

Indicative reading for learners

Textbooks

Elliot, G – *Website Management* (Lexden Publishing Limited, 2007) ISBN-10: 1904995217, ISBN-13: 978-1904995210

Websites

msdn.microsoft.com/en-us/library/aa239615(VS.60).aspx

www.build-your-website.co.uk/Server-Scripting.htm

www.w3schools.com/

Unit 54: Multimedia Design

Unit code: T/601/0439

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

To enable learners to understand how multimedia is used in business and be able to create multimedia products to meet business needs.

Unit introduction

The interactive multimedia industry is one of the fastest moving sectors in the world. Those hoping to make a career in this sector will need to be able to produce high quality products which requires creativity, a firm grasp of interactive media design principles and good planning skills. The qualities and skills developed in this unit are applicable to all of the various strands within the interactive media sector.

Learners will develop their understanding of the terminology, nature and scope of the interactive media industry and should be encouraged to investigate a range of existing interactive media products. They will learn how to design professional products by developing core skills (such as how to plan for the use of interactive features**,** transitions and effects) and applying established principles. They will also have the opportunity to develop and apply creative thinking skills. Learners learn how to plan and manage projects. To ensure that final products are both legal and ethical they will also learn about important issues such as copyright and ownership.

The unit involves the use of authoring software and the creative integration of audio and visual material to produce a final product. It is essential that the product is focused on the business needs of the user. Screen design and layout are important but the final functioning interactive media product created for this unit must meet the business objectives and be easy to use and understand.

Learners will develop an understanding of multimedia products through investigations and experimentation. Competent learners should demonstrate that they are able to select and use a wide range of multimedia software tools and techniques.

Learning outcomes

On completion of this unit a learner should:

1 Understand how multimedia is used to meet business objectives

2 Be able to design multimedia products to meet business needs

3 Be able to develop multimedia products

4 Be able to present multimedia products

5 Be able to review multimedia products.

Unit content

1 Understand how multimedia is used to meet business objectives

Multimedia: types eg sound, animation, still and moving images

Business requirements: target audience; purpose; platform

Business objectives: promotion and advertising eg web pages, digital posters, virtual tours; education and training eg simulations, e-learning packages; entertainment and leisure eg computer games, virtual reality

Audience: profiles eg age, gender, culture, race, class, business, interests, IT literacy

2 Be able to design multimedia products to meet business needs

Multimedia products: interactive eg information points, digital stories, virtual tours; limited interactivity eg digital posters, adverts, quizzes, movies

Design: features eg content, navigation, mix of digital components, interactivity

Specification: input methods eg keyboard, mouse, voice recognition, touch screen, stylus, digital video or still camera, microphone; number of pages; features; audience

Content: types eg text, images, graphics, video, sound, animation; interactive features eg transitions, menus, submenus, buttons, links, pop-ups, video clips, sound clips; legal requirements: acknowledgment of sources; avoiding plagiarism; permissions; copyright law eg on music downloads, use of images

Design documentation: presentation methods eg storyboards, scripts, flow charts, annotations, visuals, timelines; layout eg size, frames, orientation, consistency

3 Be able to develop multimedia products

Combine information: tools eg insert, size, position, wrap, order, group

Edit multimedia products: layout eg size, crop, position, proportion, guides, styles, templates, font, size, orientation, colour, alignment

File formats: types eg jpg, png, svg, mp3, mpg

Test: review for eg functionality, usability, accessibility, performance, ccompleteness, accuracy; review against requirements

Quality problems: sound eg noise, volume; images eg levels, contrast, unwanted content; text eg clarity, spelling, grammar, structure

4 Be able to present multimedia products

Display: devices eg PC, laptop, mobile device, TV

Display multimedia outcomes: setup eg quarter screen, full screen, thumbnail, screen resolution, data bandwidth, transmission speeds, output media; constraints eg speed of delivery, size of files, end user hardware and software configuration

Navigation techniques: click; scroll; menus; submenus

Playback: controls eg start, stop, fast forward, rewind, pause

Settings: visual eg brightness, contrast, screen resolution, colour balance, monochrome; sound eg volume, treble, bass, balance; animation eg speed

5 Be able to review multimedia products

Gather feedback: methods eg interview, observation, questionnaire; outcomes eg identify errors, suggest further enhancements, comment on performance

Test users: representatives of the target audience

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain how multimedia is used to meet business objectives		
P2 design a multimedia product for a specified business need [RL 3]	M1 demonstrate initiative and imagination in meeting user requirements	
P3 identify how the elements of the content will be sourced		
P4 develop a functional multimedia product for a specified business need	M2 demonstrate advanced skills in producing a complex product	D1 produce a complex, high quality, fit for purpose multimedia product
P5 set up software and display devices appropriately to display multimedia outcomes		
P6 review a multimedia product using user feedback.	M3 adapt a product in line with user feedback.	D2 reflect on feedback, suggesting future developments.

Essential guidance for tutors

Delivery

Centres are encouraged to make use of guest speakers from the interactive multimedia industry and arrange visits to local businesses where possible. To keep up to date with developments in the industry it would be useful for learners to attend local trade shows and events organised locally by sector organisations. Subscriptions should be made to some of the many good publications available for each of the sectors both in print and online. The Skillset website (www.skillset.org) is a good source of information, news and statistics with a section dedicated to interactive multimedia.

This unit is intended to develop an understanding of how multimedia products are used to meet business objectives, and a good start point is to look at the range of practical applications of interactive multimedia authoring such as entertainment, education and training; and the formats and platforms to which they are published (eg PC, MAC, kiosks, handheld devices, CD/DVD ROM, web server). Learners should be aware of the work of professional publishers within interactive multimedia and develop knowledge of the skills and techniques associated with appropriate authoring software. This will also help learners to develop a structured critical approach to interactive media production, and provides learners with some idea of the sort of skills they themselves will need to develop.

When delivering the theory aspect of the unit ie legal requirements, formal lectures and independent study should be the main methods for teaching. Advantage should be taken of the websites of the regulatory and professional bodies and learners should be encouraged to debate ethical issues in class and develop personal views. Professional magazines and trade journals will allow a study of topics currently debated within the industry.

Learners should apply the standards and design principles applicable to interactive multimedia products. Learners should be able to understand the functions and limitations of a range of authoring applications eg interactive multimedia authoring, sound, image and video editing applications.

This unit could be covered later in the programme so that learners may already have developed skills such as sound and video production and will be capable of producing complex and professional looking products. An alternative approach would be to cover the unit at the start of the programme to give a good introduction to each of the interactive multimedia elements that may be taught later. In that case it may be necessary to provide assets (such as sound and video) or to use existing asset libraries to support the learning of the unit.

It is suggested that teaching follows the logical pattern presented in the learning outcomes, with study of principles covered first, followed by development of a learner's own interactive multimedia product ideas, which can be implemented using authoring software and finally published to match a client brief. The concepts of interactive multimedia authoring could be delivered through a mix of lectures, demonstrations, discussions and investigations of existing products. Knowledge could then be applied through a variety of activities and short practical exercises. Learners should have ample opportunities to experiment with and use industry standard software.

Since this unit encourages learners to express imaginative skills, it is appropriate that some critical self-reflective practice is undertaken. This professional skill will encourage a habit of lifelong value in any possible future career. Tutors will need to provide plenty of time for learners to plan and develop graphic specifications, as they will be key to the success of the multimedia project.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to unit content • Understanding the Industry – Technology/Process/Content • Business objectives • Audiences Mixture of tutor led sessions, research and directed learning.
Assignment 1: criterion P1
Using the software – tools and techniques • Combining, editing, manipulating, file formats Mixture of demonstration, exercises, directed learning over a number of sessions.
Understanding the Project Specification • Concept: Audience/Purpose/ Content • Practical considerations: Schedule/Resources • Technical Factors: Schedule/Distribution • Roles & Responsibilities Mixture of tutor led sessions, research, discussion and directed learning.
Planning a Multimedia Project • Stages of design • Design tools • Design documentation • Legal requirements Mixture of tutor led sessions, research, exercises and directed learning.
Assignment 2: criteria P2, P3, M1

Topic and suggested assignments/activities and/assessment
Testing and reviewing • Functional testing • Gathering and using feedback Exercises, peer group reviews
Presenting • Display devices, Controls, Settings
Assignment 3: criteria P4, P5, M2, D1

Assessment

The suggested assessment of this unit is by four assignments as summarised in the Programme of Suggested Assignments (PSA) table below. A specific scenario has been suggested here but any topic providing sufficient scope to cover the assessment criteria may be used to suit particular learners. The tutor could either produce a standard specification for all learners or agree specifications with individual learners that provide sufficient scope to cover all elements of interactive multimedia authoring.

A possible scenario for these assignments could be based on a new enterprise with a retail section considering broadening and improving their current market position. Although they have an informational website, they have not yet developed a facility for mail order or for potential customers to contact them electronically.

For P1, learners must explain how multimedia is used to meet business requirements. This could be evidenced by a presentation with the explanations of the media backed up with examples of different uses in business contexts. Reference should be made to how the media meet the business objectives and are fit for purpose in terms of meeting the needs of the intended audience. A good range of different audience types should be included.

A range of design documentation should be produced as evidence for P2. The documentation should start with an introduction outlining the original business requirement. The design should demonstrate an understanding of the types of content that are possible and when they are appropriate.

For P3, when identifying sources reference should be made to legal requirements.

For M1, there should be a sense of thoughtfulness in the learner's work. For example the storyboards that outline the navigation and content will denote why they have chosen to use particular images, fonts, music etc to engage with their chosen audience and will demonstrate that experimentation and multiple solutions had been produced when considering the organisation and layout of information to be included within their projects. Learners will have shown initiative in determining requirements and trying different approaches and demonstrated imagination in their layouts etc. Although subjective to assess, there should be evidence that learners have gone beyond using standard design elements.

For P4 learners should produce and set up a functional, easy to use multimedia product that is fit for purpose. Learners are expected to be able to use a wide range of tools and techniques as appropriate to the software being used.

P5 requires the product to be set up on different platforms to demonstrate understanding of how this is done. Evidence can be by witness statements, screen shots, printouts etc.

For M2, advanced skills should be demonstrated, appropriate to the software being used, in creating a complex product.

For D1, learners will produce an interactive media product to an agreed specification of technical quality that reflects near-professional standards. They will evidence acquisition of imaginative assets from a variety of conventional and other sources, the assets being well tailored to meet the planned needs of the product. The product will implement the concepts, principles and standards of interactive media authoring with flair. A full range of authoring tools will be used during the production.

Much of the work for assignment 4 will be undertaken as part of the development in assignment 3. It has been separated here simply to reduce the amount of work being submitted at one time. Tutors may split the workload in any way they feel appropriate.

Reviewing for P6 should include feedback from users. Learners should review the responses, determine any changes that could be made and, for M3, adapt their product accordingly. Evidence for M3 should include retesting.

For D2, the final product will have been fully tested and reviewed in the light of user feedback, with all errors detected and either corrected or identified as an area for future development.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1	Why multimedia?	You are to give a presentation to a new business explaining how the business could make use of multimedia.	Presentation Handouts
P2, P3, M1	My design is…	The business has asked you to design an interactive website to develop their mail order facility.	Design documentation Presentation Report on legal issues
P4, P5, M2, D1	All singing, all dancing	The design has been approved – now create the site.	Screen shots Annotated printouts etc Witness statement Observation records
P6, M3, D2	Does it work?	Fully test, review and adapt your multimedia product.	Test documentation User reviews Evaluation

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:

- Unit 22: Developing Computer Games
- Unit 28: Website Production Management
- Unit 30: Digital Graphics and Computers

This unit has links to e-skills UK IT Professional NOS, particularly the areas of competence 4.4 Systems Analysis, 4.7 Systems Design and 5.1 Systems Development.

Essential resources

Learners will need access to computer hardware with appropriate accessories such as scanners and printers, and to appropriate software such as Director, Flash, Dreamweaver, Fireworks, Adobe PhotoShop/Image Ready etc.

Employer engagement and vocational contexts

Within this unit there are opportunities for tutors to support learners with their understanding of the range of hardware and software currently used as industrial standard. Many of these applications and hardware are now accessible to learners. Providing learners with access to relevant software manufacturers' manuals and other textbooks, the internet, and a range of examples of current multimedia practice should be encouraged.

This unit provides learners with the opportunity to gain knowledge of the styles and conventions of vocational areas such as graphic design, photography, post-production and production management.

Learners will have the opportunity to gain a fundamental knowledge of the creative technical and production practices such as understanding target audiences, copyright law, content production, graphic design, photography, typography, videography and moving image. This unit also presents opportunities for learners to understand wider vocational skills such as communication and planning and organisational skills.

Learners should be encouraged to learn and understand the importance of these principles in context with the work of professional practitioners across the creative arts vocational areas. This unit provides scope for learners to be engaged in 'real life' project briefs.

Indicative reading for learners

Textbooks

Andrews P – *Adobe PhotoShop Elements 8 for Photographers* (Focal Press, 2009) ISBN-10: 0240521897, ISBN-13: 978-0240521893

Chapman Dr.N and Chapman J – *Digital Multimedia* (John Wiley & Sons 2009) ISBN-10: 0470512164, ISBN-13: 978-0470512166

Coupland K – *Web Works Navigation* (Rockport Publishers, 2000)

Danielson R – *Navigation (Website Graphics)* (Rockport Publishers, 2000)

Garrand T – *Writing for Multimedia and the Web* (Focal Press, 2002) ISBN-10: 0240803817, ISBN-13: 978-0240803814

Gatter M – *Software Essentials for Graphic Designers: Photoshop, Illustrator, InDesign, QuarkXPress, Dreamweaver, Flash and Acrobat* (Laurence King, 2006) ISBN-10: 1856694992, ISBN-13: 978-1856694995

Kerman P – *Sams Teach Yourself Macromedia Flash MX in 24 Hours* (Sams, 2003) ISBN-10: 0672325942, ISBN-13: 978-0672325946

Microsoft PowerPoint at a Glance (Perspection, 1999)

Sengstack J – *Sams Teach Yourself Adobe Premiere in 24 hours* (Sams, 2002) Windows Multimedia Authoring Guide (Microsoft Press International, 1991)

Journals

Barron A E and Ivers K – *Interactive Media Projects in Education: Designing, Producing and Assessing* (Libraries Unlimited Inc, 2005)

Chapman N and Chapman J – *Digital Interactive Media* (John Wiley & Sons Ltd, 2004)

Fisher S – *Interactive Media Authoring: Building and Developing Documents* (Academic Press, 1994)

Harrel W – *The Interactive Media Authoring Workshop* (Sybex International, 1996)

LaBarge R – *DVD Authoring and Production* (Osborne McGraw-Hill, 2001)

Vaughan T – *Interactive Media: Making it Work* (McGraw-Hill Education, 2003)

Websites

The following websites, correct at time of publication, may be of interest:

www.collectiveimage.net	
www.digit.com	
www.digitalworkshop.com	Multimedia authoring tools for business
www.hi-res.net	
www.hyperstudio.com	Authoring tools for project-based learning
www.ingredient.co.uk	
www.macromedia.com	The Adobe website
www.matchware.net	Presentation software developers and suppliers
www.mcli.dist.maricopa.edu/authoring/ lorien.ncl.ac.uk/ming/resources/cal/ mmedia.htm	Directory to sites of interest to those authoring for the web
www.sixfootsix.co.uk	
www.skillset.org	
www.state.co.uk	
www.tomatoe.co.uk	
www.useit.com	