COMPUTING
(Higher)

Second Edition – published 2006

NOTE OF CHANGES TO ARRANGEMENTS
SECOND EDITION PUBLISHED OCTOBER 2006

SCOTTISH QUALIFICATIONS AUTHORITY

COURSE TITLE: **Computing**

COURSE NUMBER: **C206 12**

National Course Specification

Course Details	Core skills statement amended to reflect core skill information.
National Unit Specification(s):	No changes

National Course Specification

COMPUTING (Higher)

COURSE CODE C206 12

COURSE STRUCTURE

This Course has two mandatory Units and one optional Unit:

Mandatory Units:

Unit Code	*Unit Title*	*Credit and Duration*
DF2X 12	*Computer Systems (Higher)*	*1 credit (40 hours)*
DF2Y 12	*Software Development (Higher)*	*1 credit (40 hours)*

Optional Units — one selected from:

Unit Code	*Unit Title*	*Credit and Duration*
DF31 12	*Artificial Intelligence (Higher)*	*1 credit (40 hours)*
DF30 12	*Computer Networking (Higher)*	*1 credit (40 hours)*
DF32 12	*Multimedia Technology (Higher)*	*1 credit (40 hours)*

All Courses include 40 hours over and above the 120 hours for the Units. This may be used for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning and preparation for external assessment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Intermediate 2 Computing
- Standard Grade Computing Studies at Credit level

PROGRESSION

This Course or its Units may provide progression in the following way:

- progression to Advanced Higher Computing
- exit to higher education programmes in Computer Science and related subjects

Administrative Information

Publication date: October 2006

Source: Scottish Qualifications Authority

Version: 02

National Course Specification: (cont)

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CORE SKILLS

This Course gives automatic certification of the following:

Complete Core Skill	Information Technology at SCQF level 5
Core Skill Component(s)	None

CREDIT VALUE

The Higher Computing Course is allocated 24 SCQF credit points at SCQF level 6.

SCQF points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

National Course Specification: Course details

COMPUTING (Higher)

RATIONALE

The development of computing over the last few decades has been significant in terms of speed and scope. It has had an effect on all aspects of our lives, and its future course remains unpredictable. Computing is both a science and a technology, and has wide-ranging social implications. It encompasses a very wide field of study, merging at its boundaries with many other disciplines. It provides us with many increasingly powerful hardware and software tools. Our society requires more and more individuals who have the skills to use these tools, who understand how they work, and who have the ability to develop new and improved tools.

The Higher Course in Computing is not only about learning to use current hardware and software. It is designed to provide candidates with both the necessary knowledge and understanding and the practical problem solving skills to enable them to become the ICT tool designers of the future.

The importance of both knowledge and understanding, and related practical skills are reflected in the two Outcomes of each Unit. The ability to combine knowledge and understanding and practical skills to solve practical problems is a key theme of the Course.

Aims
The aims of the Course are to develop:

- knowledge and understanding of computing concepts
- practical skills in the use of computer hardware and software
- ability to solve problems by applying knowledge, understanding and practical skills
- awareness of the professional, social, ethical and legal implications of computing
- ability to communicate computing concepts clearly and concisely using appropriate terminology

Related to these aims, and underlying the study of computing are a number of **unifying themes** which are developed and exemplified throughout the Units of the Course. These themes are:

- technological development and progress
- factors affecting system performance
- objects and operations
- syntax and semantics
- social, professional, ethical and legal implications
- the relationship between software and hardware
- computing terminology
- the development process as it applies to software and hardware systems

The Course is designed to build on prior learning at Intermediate 2 and Standard Grade Credit level (or their equivalents) and to provide progression to Advanced Higher Computing and to higher education programmes in computer science and related subjects.

National Course Specification: Course details (cont)

COMPUTING (Higher)

COURSE CONTENT

The Course is made up of two mandatory Units, *Computer Systems* and *Software Development*, and a choice of one from three optional Units.

The *Computer Systems* Unit develops an understanding of how computers work. It builds on the foundations laid down in the corresponding Unit at Intermediate 2 level, and in Standard Grade Computing Studies, or other equivalent experience. The *Software Development* Unit develops the candidate's knowledge and skills in developing software through the use of a high level programming language. Because computing is such a wide and rapidly developing field of study, a choice of three optional Units is offered, each one allowing the student to relate their learning in the mandatory Units to a contemporary aspect of applied computing — *Artificial Intelligence*, *Computer Networking* or *Multimedia Technology*.

To ensure consistency of terminology, the meanings of the technical terms used throughout this documentation (including the Unit Specifications) were taken from the British Computer Society's publication *A Glossary of Computing Terms*, 10th edition, pub. Addison–Wesley, 2002. This glossary of terms will be used as a reference for all internal and external assessments, and its use is encouraged in all teaching and learning activities.

The Unit Specifications have been fully developed and provide detailed support notes to assist assessors in their understanding of Outcomes and Performance Criteria. The detailed content for each Unit is provided in the form of a table in the content/context section of each Unit Specification.

National Course Specification: Course details (cont)

COMPUTING (Higher)

Content statements

The following pages of content statements describe in detail the knowledge and understanding which a candidate should be able to demonstrate in the external Course assessments, which will sample across these content statements. In order to achieve a Course award, candidates must also demonstrate an appropriate level of problem solving skills (application, analysis, synthesis and evaluation) based on these content statements.

This table defines the terms 'knowledge and understanding' and 'problem solving' as used in these arrangements in terms of the terminology used in Bloom's Taxonomy of Learning:

Arrangements	***Bloom's Classification***	***Typical skill/words***
Knowledge and Understanding	*Knowledge*	*recall of information (list, state, define, label, describe, name, identify)*
	Comprehension	*interpreting information in own words, grasping meaning (interpret, explain, discuss, predict, summarise, classify)*
Problem Solving	*Application*	*application to new situations (apply, demonstrate, show, relate, explain)*
	Analysis	*identification of patterns, recognising relationships (analyse, arrange, order, explain, connect, infer, compare, categorise)*
	Synthesis	*generalise, create new ideas, bring together from different sources, draw conclusions, predict (integrate, modify, design, compose, plan, arrange)*
	Evaluation	*make judgements, assess ideas, compare ideas, evaluate data (judge, evaluate, recommend, justify)*

Throughout the Course, candidates should be made aware of common hardware and software and should be able to resolve common problems as they occur.

National Course Specification: Course details (cont)

Higher Computing: Computer Systems (mandatory Unit)

The candidate must demonstrate knowledge and understanding, practical skills and problem solving based on the following content statements:

Data representation

- Representation of positive numbers in binary including place values and range up to and including 32 bits
- Conversion from binary to decimal and vice versa
- Description of the representation of negative numbers using two's complement using examples of up to 8 bit numbers
- Description of the relationship between the number of bits assigned to the mantissa/exponent and the range and precision of floating point numbers
- Conversion to and from bit, byte, Kilobyte, Megabyte, Gigabyte, Terabyte. (Kb, Mb, Gb, Tb)
- Description of Unicode and its advantages over ASCII
- Description of the bit map method of graphic representation using examples of colour/greyscale bit maps
- Description of the relationship of bit depth to the number of colours using examples up to and including 24 bit depth (true colour)
- Description of the vector graphics method of graphic representation
- Description of the relative advantages and disadvantages of bit mapped and vector graphics
- Description of the relationship between the bit depth and file size
- Explanation of the need for data compression using the storage of bit-map graphic files, as examples

Computer structure

- Detailed description of the purpose of the ALU and control unit
- Description of the purposes of registers: to hold data being processed, instructions being executed, and addresses to be accessed
- Description of the function of the data bus and the address bus
- Description of the read, write and timing functions of the control lines
- Identification of other control lines, including reset and interrupt lines
- Simple description, referring to the appropriate buses and control lines, of the steps in the fetch-execute cycle
- Description of the following elements of computer memory: registers, cache, main memory, backing storage
- Distinction between the above elements of memory according to function and speed of access
- The concept of addressability
- Description and evaluation of the following measures of performance: clock speed, MIPS, FLOPS, and application based tests
- Description of the effect the following factors have on system performance: data bus width, use of cache memory, rate of data transfer to and from peripherals
- Description of current trends in computer hardware, including increasing clock speeds, increasing memory and backing storage capacity

National Course Specification: Course details (cont)

Higher Computing: Computer Systems (mandatory Unit) (cont)

Peripherals

- Description of the use and advantages of buffers and spooling
- Description of a suitable selection of hardware, including peripherals, to support typical tasks including production of a multimedia catalogue, setting up a LAN in a school, development of a school website
- Justification of the hardware selected in terms of appropriate characteristics including resolution, capacity, speed, cost and compatibility
- Description of the features, uses and advantages of solid state storage devices including flash cards
- Description of the development trends in backing storage devices
- Description of the following functions of an interface: buffering, data format conversion (serial to parallel and analogue to digital), voltage conversion, protocol conversion, handling of status signals
- Distinction between parallel and serial interfaces
- Description and explanation of the current trends towards increasing interface speeds and wireless communication between peripherals and CPU

Networking

- Comparison of LANs, WANs, Intranet and Internet work in terms of transmission media, bandwidth, geographical spread and functions
- Distinction between a mainframe with terminals and a network of computers
- Descriptive comparison of peer-to-peer networks and client server networks
- Description of the functions of file, print and web servers
- Description of a node and a channel
- Description of bus, star, ring and mesh topologies using the terms node and channel
- Description of the consequences for each of the above topologies of node and channel failure
- Simple description of the functions and uses of a hub, switch and router
- Identification of the need for a network interface card (NIC)
- Description and explanation of the trends towards higher bandwidth and wireless communications
- Description of the following technical reasons for the increasingly widespread use of networks:
  - advances in computer hardware, including processors, main memory capacity, backing storage, data transfer rates
  - improved network related software, including browsers and network operating systems
- Description of the misuse of networks for the following illegal purposes: breaching copyright, hacking and planting viruses
- Description of the application of the Computer Misuse Act, the Copyright Designs and Patents Act and the Data Protection Act to the misuse of networks

Computer software

- Description of the function of a bootstrap loader
- Description and exemplification of the main functions of a single user operating system: interpreting users commands, file management, memory management, input/output management, resource allocation, managing processes
- Definition of a utility program
- Description of utility programs (including virus checker, disk editor and defragmenter)
- Description of the standard file formats for graphics files: jpeg, gif, TIFF
- Description of a suitable selection of software to support typical tasks including production of a multimedia catalogue, setting up a LAN in a school, development of a school website

National Course Specification: Course details (cont)

Higher Computing: Computer Systems (mandatory Unit) (cont)

- Description and exemplification of software compatibility issues (including memory and storage requirements, and OS compatibility)
- Classification of viruses by type of file infected: file virus, boot sector virus, macro virus
- Description of the following virus code actions: replication, camouflage, watching, delivery
- Distinction between a virus, a worm and a trojan horse
- Description of anti-virus software detection techniques: use of checksum, searching for virus signature, heuristic detection and memory resident monitoring

National Course Specification: Course details (cont)

Higher Computing: Software Development (mandatory Unit)

The candidate must demonstrate knowledge and understanding, practical skills and problem solving based on the following content statements:

Software development process

- Explanation of the iterative nature of the software development process
- Description of the purposes of the software specification, and its status as a legal contract
- Explanation of the importance of each stage (analysis, design, implementation, testing, documentation, evaluation, maintenance) of the development process
- Identification of the personnel at each stage (client, systems analyst, project manager, programmer, independent test group) and brief description of their roles
- Description and exemplification of pseudocode and one graphical design notation (structure diagram or other suitable) including data flow
- Description and exemplification of top-down design and stepwise refinement
- Explanation of the need for systematic and comprehensive testing
- Explanation of the need for documentation at each stage
- Evaluation of software in terms of robustness, reliability, portability, efficiency and maintainability
- Description and exemplification of corrective, adaptive and perfective maintenance

Software development languages and environments

- Description and comparison of procedural, declarative and event-driven languages
- Comparison of the functions, uses and efficiency of compilers and interpreters
- Description of the features and uses of scripting language (including creating and editing a macro)
- Explanation of the need for and benefits of scripting languages
- Description of the use of module libraries

High level programming language constructs

- Description and exemplification of the following constructs in pseudocode and an appropriate high level language: string operations (concatenation and substrings), formatting of I/O, CASE (or equivalent multiple outcome selection)
- Description and exemplification of real, integer and boolean variables; and 1-D arrays
- Description and exemplification of procedures/subroutines/subprograms, user-defined functions, modularity, parameter passing (in, out, in/out), call by reference/value, local and global variables, scope

Standard algorithms

- Description and exemplification of the following standard algorithms in pseudocode and an appropriate high level language:
  - linear search
  - counting occurrences
  - finding min/max

National Course Specification: Course details (cont)

Higher Computing: Artificial Intelligence (optional Unit)

The candidate must demonstrate knowledge and understanding, practical skills and problem solving based on the following content statements:

The development of artificial intelligence

- Definitions of human intelligence and artificial intelligence
- Descriptions of aspects of intelligence (including language, learning, cognitive ability, problem solving skills, memory, creativity)
- Explanation of the difficulties of determining an accurate and agreed definition of intelligence.
- Explanation of the inherent flaws of the Turing test as a method for determining the existence of artificial intelligence
- Description of the change in emphasis from modelling the human brain to producing systems exhibiting 'intelligent behaviour'
- Description of the need for knowledge representation techniques (including semantic nets and logic programming)
- Explanation of the need for a restricted domain
- Identification of languages: LISP (functional), Prolog (declarative/logic)
- Description of difference between declarative and imperative languages
- Explanation (with examples) of:
  - the success and failures of game playing programs from simple early examples to contemporary complex examples exhibiting intelligence
  - the successes and failures of language processing (including Eliza, SHRDLU, chatterbots and contemporary applications)
  - the scope and limitations of expert systems
- Explanation of the effects of hardware developments (including faster processors, more memory, and increasing backing store capacity) on the field of AI
- Description of the implementation and advantages of parallel processing
- Description of the practical problems associated with AI despite advances in hardware/software

Applications and uses of artificial intelligence

Artificial neural systems (ANS):

- Comparison of a human neuron with an artificial neuron
- Description of the structure of a neural net (including artificial neuron, links, weights, layers)
- Comparison of a neural net with the human brain
- Description of 'learning' through iterative process as opposed to algorithmic programming
- Explanation that a neural net may be a software model or hard-wired

Vision systems

- Description of the problems of interpreting 2D images of 3D objects
- Description of the stages of computer vision (image acquisition, signal processing, edge detection, object recognition, image understanding)

Natural language processing (NLP):

- Identification of the main stages of NLP (speech recognition, natural language understanding (NLU), natural language generation, speech synthesis)
- Explanation of some difficulties in NLP (including ambiguity of meaning; similar sounding words; inconsistencies in grammar of human language; changing nature of language)
- Identification of applications of NLP (including automatic translation, speech driven software, NL search engines, NL database interfaces)

Smart/embedded technology:

- Description of examples of the use of intelligent software to control devices (including car engine control systems; domestic appliances)

National Course Specification: Course details (cont)

Higher Computing: Artificial Intelligence (optional Unit) (cont)

Intelligent robots:

- Explanation of the difference between dumb and intelligent robots
- Description of contemporary research and developments
- Description of possible social and legal implications of the increasing use of intelligent robots
- Descriptions of practical problems (including processor power, power supply, mobility, vision recognition, navigation, path planning, pick and place, and strategies used to overcome these problems)

Expert systems

- Description of the components of an expert system (knowledge base, inference engine, user interface with justification/explanation, working memory)
- Distinction between an expert system and an expert system shell
- Description of contemporary applications of expert systems
- Description of advantages of expert systems (including permanence, cost effectiveness, consistency, portability)
- Description of disadvantages of expert systems (including narrow domain, lack of 'common sense', need for expertise to set up and maintain, inability to acquire new knowledge, inflexibility)
- Description of moral issues (including medical implications)
- Description of legal issues (including responsibility when advice is wrong)

Search techniques

- Comparison of depth-first and breadth-first search (order of visiting nodes, memory implications, advantages and disadvantages, need for backtracking), and exemplification on a search tree
- Description and exemplification of combinatorial explosion
- Description and exemplification of use of heuristics to reduce search time/space

Knowledge representation

- Description of the software development process as it applies to declarative language programming
- Creation of a semantic net from given problem statement
- Description and exemplification of the following features in Prolog (or similar declarative language):
  - multi–argument clauses
  - recursive and non recursive rules
  - complex queries: (multiple variable, conjunction of queries)
  - negation
  - inheritance
- Explanation of the concepts of goal, sub-goal, instantiation, matching
- Explanation of complex manual trace: multiple level including backtracking
- Explanation of the importance of the order of rules

National Course Specification: Course details (cont)

Higher Computing: Computer Networking (optional Unit)

The candidate must demonstrate knowledge and understanding, practical skills and problem solving based on the following content statements:

Network protocols

- Name and description of the seven layers of the OSI model
- Brief explanation of the purpose of common protocols (TELNET, HTTP, FTP, SMTP)
- Description of an IP address (structure — 4 octets, classes — ABCD, limitations)
- Description of Name services (name resolution); DNS (domain names, host name resolution)

Network applications

- Description of a web page using HTML tags (start, header, body, title, style, font size, alignment, section headers)
- Explanation of the advantages and disadvantages of browsers and microbrowsers for use with wireless data (WAP)
- Description of a web page using WML tags (wireless markup language)
- Description of the methods used by search engines to build its indexes (spiders, meta-search engines)
- Description of the advantages of e-commerce
- Implication of fraud in e-sales payment and how it is overcome
- Description of the social implications of networks; information rich and information poor, the family, the community and employment
- Description of the ethical implications of networks; personal privacy and censorship
- Description of the implications of the Regulation of Investigatory Powers Act 2000

Network security

- Description of security measures: user access rights to data — file and folder permissions, user access rights to hardware
- Description of computer and network security requirements (confidentiality, data integrity and availability)
- Description of threats to network security in terms of passive (monitoring of transmission) and active (modification of the data stream or the creation of a false stream) attacks
- Description of the denial of service attack:
  - effect: disruption or denial of services to legitimate users
  - costs of attack: system downtime, lost revenue and labour involved in identifying and reacting to an attack
  - intent: malicious, personal or political
  - types of attacks: bandwidth consumption, resource starvation, programming flaws and routing and DNS attacks
- Comparison of Internet content filtering methods: firewalls, Internet filtering software and walled gardens
- Description of how a firewall can protect a LAN with an Internet connection from outside attacks.
- Description of disaster avoidance; use of anti-virus software, use of fault tolerance components, use of uninterrupted power supply, regular maintenance
- Description of backup strategy: backup server, mirror disks, tape, backup schedule

National Course Specification: Course details (cont)

Higher Computing: Computer Networking (optional Unit) (cont)

Data transmission

- Description of synchronous and asynchronous data transmission
- Description of error checking in data transmission (parity and CRC)
- Description of the process of transmitting data over a network using TCP/IP
- Description of CSMA/CD and its implications for network performance
- Description of network switching (circuit and packet switching) and its implications for network performance
- Description of the application of modern wireless communication methods:
  - WPAN — connect mobile phones, mobile computers and other portable handheld devices
  - wireless LAN — connecting a mobile LAN
  - wireless WAN — connection in rural and heavily built-up areas
- Description of the speed and bandwidth of the types of Internet connections (dialup, cable modem, leased line, ISDN and ADSL)
- Explanation of which type of connection would be most appropriate in a given context
- Description of function of network interface card
- Explanation for the need of a MAC address when transmitting data over a network

National Course Specification: Course details (cont)

Higher Computing: Multimedia Technology (optional Unit)

The candidate must demonstrate knowledge and understanding, practical skills and problem solving based on the following content statements:

Development process for multimedia applications

- Description of the software development process as it applies to the development of multimedia applications
- Description of methodologies used in the creation or definition of a multimedia application, including:
  - WYSIWYG editors and text editors to create web pages
  - authoring software to create multimedia applications
  - presentation software to create presentations
- Description of the methodologies and requirements for the display of a multimedia application, including streaming of multimedia data and embedded files
- Explanation and exemplification of the terms 'codec' and 'container' file

Bit-mapped graphic data

- Description of the hardware used to capture still graphic data, including: digital camera (array CCD, memory card storage medium), scanner (linear CCD), role of ADC
- Description of the storage of graphic data in compressed and uncompressed file formats, including simple description of the techniques used within each file for compression and data storage, including: bitmap (indexed colour or CLUT), 24-bit bitmap and compressed bitmap (RLE), GIF (animation, (non)-interlaced, LZW), JPEG (description of factors involved), PNG (CLUT or RGB, transparency, compressed)
- Description of RGB colour codes and their effect on the overall colour produced
- Calculations using the relationship: File Size = pixels x colour depth (bits)
- Calculation of number of pixels from height, width and resolution
- Explanation of the following image related terms: dithering. anti-aliasing, increase resolution (re-sampling)
- Description of features of graphics cards involved in displaying 2D graphics, including: role of DAC, role of GPU/DSP (to allow effects to be applied by hardware)

Digitised sound data

- Description of soundcard in its use to capture sound data including role of ADC
- Description of the storage of sound data in compressed and uncompressed file formats, including simple description of the techniques used within each file for compression and data storage, including: RAW (PCM), RIFF (ADPCM) (including WAV), MP3 (description of factors involved)
- Description of the following terms in relation to audio files: bit-rate to describe data throughput for a sound file; normalising sound files
- Calculations using the relationship: File Size (bytes) = Sampling Frequency (Hz) x Sound Time (s) x Sampling Depth (bytes) x Channels
- Explanation of the following sound related terms: clipping, stereo, surround sound, fade
- Description of features of sound cards, including: role of DAC, role of DSP (to allow hardware decoding of sound files)

National Course Specification: Course details (cont)

Higher Computing: Multimedia Technology (optional Unit) (cont)

Video data

- Technical description of hardware required to capture digital and analogue video: digital video camera (array CCD), web cam (array CCD), video capture card (role of ADC and role of DSP to allow hardware encoding of data stream including into MPEG format)
- Description of the storage of video data in compressed and uncompressed file formats, including simple description of the techniques used within each file for compression and data storage and the inclusion of sound within the file, including: uncompressed AVI, MPEG (description of factors involved)
- Description of term bit-rate to describe data throughput for a video file
- Calculations using the relationship: File Size (bytes) = pixels per frame x Colour Depth (bytes) x Video Time (s) x Frame Rate (fps)
- Description of the main features and applications of video editing software with multiple clips, including: timeline, transition, sequencing
- Description of features of graphics cards for output of video, including: role of DAC, role of DSP (to allow hardware decoding of data stream including MPEG files)

Vector graphics data

- Description of features of vector formats: object oriented data storage, more storage efficient than bitmap storage, output quality matches hardware capability, conversion to bitmap formats
- Description of common attributes of vector graphic objects:
  - drawing (shape, position, size, rotation, line, fill)
  - 3D image (shape, position, size, rotation, texture)
- Description of basic features and structures of vector graphic file types, including methods used to implement common attributes listed above for these file types: SVG, VRML/WRL

Synthesised sound data

- Description of common attributes of notes stored as MIDI data (instrument, pitch, volume, duration, tempo)
- Description of advantages and disadvantages of storing sound as MIDI data

Implications of the use of multimedia technology

- Description of trends and changes in contemporary technologies that facilitate the convergence of technologies in relation of multimedia capabilities, including:
  - communications (buses, wireless standards, increasing bandwidth), including USB, Firewire, WiFi, Bluetooth
  - storage technologies (decreasing size and price, increasing capacity), including optical, magnetic, holographic
  - processor (increasing power)
  - display technologies, including real and virtual 3D displays, and flat displays

National Course Specification: Course details (cont)

COMPUTING (Higher)

ASSESSMENT

To achieve the Course award the candidate must pass the Units as well as the Course assessment**.** The candidate's grade is based on the Course assessment.

The Course is made up of two mandatory Units and one from a choice of three optional Units.

Unit assessment
Unit assessment consists of a knowledge test and practical skills checklist. The knowledge test is a closed book test, under supervision, lasting no more than 45 minutes. The practical skills can either be demonstrated in a single extended task or a number of smaller tasks.

Further details about the Unit assessment can be found in each of the Unit Specifications.

DETAILS OF THE INSTRUMENTS FOR COURSE ASSESSMENT

Course assessment should provide opportunities to demonstrate:

- retention of knowledge, understanding and skills over a longer period of time
- integration of knowledge, understanding and skills acquired in Units
- application of knowledge, understanding and skills in more complex contexts
- application of knowledge, understanding and skills in less familiar contexts

The Course assessment for Computing at Higher level will consist of two components:

- question paper
- practical coursework task

The purpose of the question paper is to assess the candidate's competence to integrate and retain knowledge and understanding and demonstrate higher order cognitive abilities across the contents of all the Units, and in varied contexts, and to demonstrate the ability to communicate computing concepts clearly.

The practical coursework task provides candidates with the opportunity to demonstrate and integrate the practical skills, knowledge and understanding from the Units, and apply these in a more complex practical context.

Practical coursework task

Candidates will undertake a practical coursework task provided by SQA. The task may be undertaken in 'open book' conditions, but under supervision, to ensure that the work presented is the candidate's own work. The task will be marked using a marking scheme provided by SQA, but be subject to moderation. The marking scheme will provide a mark out of 60, which will be submitted directly to SQA.

National Course Specification: Course details (cont)

COMPUTING (Higher)

Question paper
The question paper will comprise a single paper of 2 hours and 30 minutes duration. The total marks available will be 140. The examination will be set and marked by the SQA. The paper will be composed of three sections:

SECTION 1 (30 marks)
This will consist of objective and short response questions which sample across the content statements of the two mandatory Units. These questions will test both knowledge and understanding and problem solving, Approximately 2/3 of the marks will be for knowledge and understanding, and 1/3 for problem solving. The problem solving will be based in familiar contexts and be of a fairly straightforward nature. Candidates will be expected to tackle all questions.

SECTION 2 (60 marks)
This will consist of questions requiring extended responses requiring structuring and reasoning. These questions will involve both knowledge and understanding and problem solving. Approximately 1/3 of the marks will be for knowledge and understanding, and 2/3 for problem solving and will be set in less familiar and more complex contexts than those in Section 1. The questions will sample across the content statements associated with the mandatory Units, and will require some integration of knowledge across the two Units. Candidates will be expected to tackle all questions.

SECTION 3 (50 marks)
This will have three sub-sections, one for each of the optional Units. Candidates will be expected to tackle all the questions within one sub-section. The questions will require extended responses from candidates. Approximately 1/3 of the marks will be for knowledge and understanding, and 2/3 for problem solving as in section 2, and the questions, which will sample across the content statements for the optional Unit, will also require some integration of knowledge from the mandatory Units.

Further details about assessment for this Course can be found in NAB materials, the Course Assessment Specification, the specimen question paper and the specimen coursework task.

Note: refer to the table on page 6 of these arrangements for guidance on the meaning of the terms 'knowledge and understanding' and 'problem solving' in this context.

National Course Specification: Course details (cont)

COMPUTING (Higher)

GRADE DESCRIPTIONS AT A AND C

The candidate's grade will be based on the total score obtained from the Course assessment by adding the marks from the practical coursework task and the question paper. The descriptions below indicate the nature of achievement required for the award at grade C and A in the Course.

GRADE C	GRADE A
♦ **retention of knowledge, understanding and skills over a longer period of time**	
Candidates are able to describe and explain **some** of the facts and concepts to the standard defined by the Performance Criteria.	Candidates are able to describe and explain **most** of the facts and concepts to the standard defined by the Performance Criteria.
Candidates are able to demonstrate **some** practical skills to the standards defined by the Performance Criteria.	Candidates are able to demonstrate **most** of the practical skills to the standards defined by the Performance Criteria.
♦ **integration of knowledge, understanding and skills acquired in component Units**	
Candidates are able to demonstrate their knowledge and understanding in the context of specific Units.	Candidates are able to demonstrate the **integration** of knowledge and understanding from more than one Unit.
Candidates are able to demonstrate their practical skills in the context of specific Units.	Candidates are able to demonstrate the **integration** of practical skills from more than one Unit.
♦ **application of knowledge, understanding and skills in more complex contexts**	
Candidates are able to apply knowledge and understanding to solve problems in straightforward contexts relating to a single Unit.	Candidates are able to apply knowledge and understanding to solve problems in **more complex contexts relating to more than one Unit.**
Candidates are able to apply practical skills to solve problems in straightforward contexts relating to a single Unit.	Candidates are able to apply practical skills to solve problems in **more complex contexts relating to more than one Unit.**
♦ **application of knowledge, understanding and skills in less familiar contexts**	
Candidates are able to apply knowledge, understanding and skills to solve problems in familiar contexts.	Candidates are able to apply and **transfer** knowledge, understanding and skills to solve problems in **less familiar contexts** .
Candidates are able to carry out defined tasks to the standards defined in the Performance Criteria.	Candidates are able to **resolve non-routine problems** that arise during practical activity, **by independent research.**

National Course Specification: Course details (cont)

COMPUTING (Higher)

ESTIMATES AND APPEALS

Estimates

In preparing estimates, evidence of performance should be considered across the breadth of coverage of the content of the Course and must take account of performance in both of the Course components, the practical coursework task and the question paper. Further advice on the preparation of estimates is given in the Course Assessment Specification.

Appeals

Evidence used to support appeals for the question paper component must come from an integrated test (or tests) adequately reflecting the Course content and Grade Descriptions.

Although a 'prelim' examination is not mandatory, it can provide the opportunity for a candidate to demonstrate problem solving skills, integration across Units, and the application of knowledge in more complex and less familiar contexts as in the external examination. Any prelim should replicate the style, level of demand and mark allocation of the Specimen SQA examination.

Centres that submit an integrated test or prelim that only covers the knowledge and understanding of Units 1 and 2 should also submit an additional test covering the knowledge and understanding of Unit 3. Furthermore, this additional test must integrate some knowledge and understanding from Unit 1 and Unit 2.

The practical coursework task which has been completed and marked internally (with the mark submitted to SQA by the due date) is expected to represent a candidate's best practical work. Additional evidence of problem solving in practical contexts does not require to be submitted for appeals.

While it is acceptable for centres generating their own test materials to draw on past SQA question papers or commercial papers from previous years, such papers **must not** be used in their entirety. Where material from past papers is used, a judicious selection of items and/or appropriate adaptation is required to make this acceptable as evidence to support an appeal. Items from past SQA papers may also be supplemented or replaced by internally devised materials.

Whatever approach is taken to the creation of prelim papers or other assessment items, centres must be certain that the material has not been seen previously by the candidates.

NABs are designed to allow candidates to demonstrate the knowledge and understanding and practical skills required to pass the Units. NABs do not provide opportunities for the candidate to demonstrate problem solving skills, integration across Units, and application of knowledge in more complex and less familiar contexts, and therefore do not provide sufficient evidence for appeals.

QUALITY ASSURANCE

All National Courses are subject to external marking and/or moderation. External markers, visiting examiners and moderators are trained by SQA to apply national standards. SQA is currently seeking to assist centres by preparing exemplification of standards materials in a number of subject areas. This will be rolled out to all subjects in due course.

National Course Specification: Course details (cont)

COMPUTING (Higher)

The Units of all Courses are subject to internal moderation and may also be chosen for external moderation. This is to ensure that national standards are being applied across all subjects.

Courses may be assessed by a variety of methods. Where marking is undertaken by a trained marker in their own time, markers meetings are held to ensure that a consistent standard is applied. The work of all markers is subject to scrutiny by the Principal Assessor and a PA report is published for all subjects.

APPROACHES TO LEARNING AND TEACHING

The five main aims of the Course are to develop:

- knowledge and understanding of computing concepts
- practical skills in the use of computer hardware and software
- ability to solve problems by applying knowledge, understanding and practical skills
- appreciation of the professional, social, ethical and legal implications of computing
- ability to communicate computing concepts clearly and concisely using appropriate terminology

There is no prescriptive 'best way' to approach the teaching and learning of this Course. However a holistic approach is recommended which relates each of these aims to the computing facts and concepts being studied. Within each Unit, there is a combination of knowledge and understanding with practical problem solving skills. Those delivering the Course are encouraged to provide learning experiences which blend together the acquisition of knowledge and understanding, the development of practical skills and opportunities to apply these to solve problems.

Throughout the Course, reference should be made to professional, social, ethical and legal implications where appropriate, and to 'real world' applications. Candidates should be encouraged to develop the use of appropriate computing terminology to communicate their understanding.

Related to the Course aims, a number of unifying themes have been identified which should be used to bring a coherence to the Course. Most of these themes can be illustrated and exemplified in each of the Units of the Course. These themes include:

- technological development and progress
- factors affecting system performance
- objects and operations
- syntax and semantics
- social, professional, ethical and legal implications
- the relationship between software and hardware
- computing terminology
- the development process as it applies to software and hardware systems

The Course has been designed to articulate with the Intermediate 2 Computing Course. The content/context grids in the support notes for each Unit show how the content and contexts at Higher extend and deepen the Intermediate 2 Unit content. This should assist assessors who have to work with bi-level classes to design an appropriate Course plan.

National Course Specification: Course details (cont)

COMPUTING (Higher)

APPROACHES TO LEARNING AND TEACHING (cont)

Candidates will require individual access to appropriate computer hardware and software throughout the Course. More detailed guidance is given within the support notes for each Unit.

Those who are presenting the Course are encouraged to make use of the wide range of teaching and learning materials (both paper-based and electronic) which have been developed to support this Course.

The Units of the Course may be taught sequentially or in parallel (or a combination of these). When taught sequentially, the two mandatory Units should be taught before the optional Unit, as the optional Units are designed to build on and exemplify key concepts of *Software Development* and *Computer Systems* within contemporary developing areas of computing. The practical coursework task is designed to allow candidates to demonstrate and integrate practical skills and knowledge they have developed within Units, and so should not be undertaken until at least the two mandatory Units have been covered.

A typical Course plan might therefore take the form:

August — December	Software Development
August — December	Computer Systems
January	practical coursework task
January	preparation for prelim examination(s)
February — March	optional Unit
April	flexible time

Preliminary examinations, if used, should be timed to allow maximum coverage of the three Course Units. This can be achieved by holding the prelim as late as possible (end of March), or by having an early prelim covering two Units, with a supplementary prelim later covering the third Unit and integration with the mandatory Units.

The teaching and learning and internal assessment of the three Units of the Course is designed to be completed within 120 hours. This includes practical activities in preparation for the practical coursework task. As centres are advised to allow 160 hours for the delivery of a National Course, this leaves up to 40 hours of flexible time.

Use of the additional 40 hours

Appropriate activities for this time include:

- an introduction to the Course
- revision of required prior learning
- consolidation and integration of learning
- remediation and re-assessment
- formative assessment (class tests)
- preliminary examination(s)
- preparation for external assessment
- completion of the practical coursework task
- extending the range of study

National Course Specification: Course details (cont)

COMPUTING (Higher)

SPECIAL NEEDS

This Course Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

COMPUTING IN A BROADER CONTEXT

A number of national initiatives and programmes have been designed to promote themes that are important to contemporary society such as citizenship and enterprise. These themes contribute to individual subjects and Courses by making connections beyond the subject boundaries and enrich the learning experience. Similarly, the specialist knowledge and skills developed through study of a particular subject contributes to the understanding of these themes.

There are several opportunities within Computing (Higher) for those who are delivering the course to help candidates make links to cross-curricular themes. Some suggestions are given below.

Cross–curricular theme	Course content
Enterprise in Education	Focused career education through understanding of careers in ICT. Understanding the world of work through working knowledge of converging technologies. Understanding the opportunities presented by e-commerce and the advantages and disadvantages of it.
Education for Citizenship	Understanding the rights and responsibilities underpinning society as they are affected by: ♦ copyright ♦ hacking and planting viruses ♦ the law, eg Computer Misuse Act Developing citizenship skills by locating, using and communicating ideas using ICT.
Financial Education	Making informed decisions based on the functions and features of network systems, personal computers, peripherals and computer packages.
Health Education	Relationships based on the principle of respect for the rights and properties of others where this is intellectual property on the WWW.

National Unit Specification: general information

UNIT Computer Systems (Higher)

NUMBER DF2X 12

COURSE Computing (Higher)

SUMMARY

This Unit is designed to develop knowledge and understanding of the principles of computer systems and practical skills related to computer systems through the use of contemporary hardware and software. This knowledge, understanding and these practical skills may then be applied by the candidate to solve practical problems related to computer systems. It is designed for candidates undertaking the Higher Computing Course, but is also suitable for anyone wishing to extend and deepen their experience of computer systems beyond Intermediate 2 level, or candidates who are interested in supplementing practical skills in IT with a knowledge of how computer systems work.

OUTCOMES

1. Demonstrate knowledge and understanding of a range of facts, ideas and terminology related to the principles, features and purposes of computer systems.
2. Demonstrate practical skills in the context of computer systems using contemporary hardware and software.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Intermediate 2 Computer Systems Unit
- Intermediate 2 Computing
- Standard Grade Computing Studies at Credit level

Administrative Information

Superclass: CD

Publication date: April 2004

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Computer Systems (Higher)

CREDIT VALUE
1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skill components in this Unit.

National Unit Specification: statement of standards

UNIT Computer Systems (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding of a range of facts, ideas and terminology related to the principles, features and purposes of computer systems.

Performance Criteria

a) A range of computing terminology is used appropriately.
b) Technically accurate descriptions and explanations are related to practical and familiar contexts.
c) Conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence Requirements
Written or oral evidence that the candidate can describe and explain the principles, features and purposes of computer systems accurately and concisely. Evidence should be obtained using questions in a closed book test, under supervision, lasting no more than 45 minutes. The test must sample content (see Computing (Higher) Course content) in each of the following areas:

- data representation
- computer structure
- peripherals
- networking
- computer software

(The content statements are also reproduced for convenience as a table in the support notes for this Unit.)

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: statement of standards (cont)

UNIT Computer Systems (Higher)

OUTCOME 2

Demonstrate practical skills in the context of computer systems using contemporary hardware and software.

Performance Criteria

a) A range of appropriate features of hardware is used effectively and efficiently.
b) An appropriate range of features of software is used effectively and efficiently.
c) Practical tasks are planned and organised with minimal guidance.
d) Practical tasks are undertaken in an appropriate range of familiar contexts.

Evidence Requirements

Observation checklist showing that the candidate has demonstrated practical skills at an appropriate level in four of the following contexts:

- use of standard OS functions
- use of utility software
- use of standard file formats for graphics files
- accessing a LAN using a network client
- accessing the Internet for WWW, e–mail and file transfer

Hard copy evidence should be provided for **one** of these activities.

These practical skills may all be demonstrated in a single extended task, or in a number of smaller tasks.

The practical skills should be demonstrated in the context and at a level defined by the content statements (see Computing Higher Course content).

The candidate will be allowed access to books, notes and online help while completing the tasks.

(The content statements are also reproduced for convenience as a table in the support notes for this Unit.)

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Computer Systems (Higher)

This part of the Unit Specification is offered as guidance.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content for this Unit is detailed below (and also in the National Course Specifications: Course details.)

Content statements in the left–hand column describe the content covered in the corresponding Unit at Intermediate 2 level, and are included here to clarify the context for the new learning for this Unit. They indicate the prior learning required by the candidate before undertaking new learning within this Unit.

Content statements in the right-hand column define the content for this Unit.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

Content Statements: Data Representation	
Intermediate 2	Higher
Representation of positive numbers in binary using examples up to and including 8 bits.	Representation of positive numbers in binary including place values and range up to and including 32 bits. Conversion from binary to decimal and vice versa.
Advantages of using binary numbers.	
	Description of the representation of negative numbers using two's complement using examples of up to 8 bit numbers.
Description of floating point representation of real numbers using the terms mantissa and exponent.	Description of the relationship between the number of bits assigned to the mantissa/exponent and the range and precision of floating point numbers.
Conversion to and from bit, byte, Kilobyte, Megabyte (Kb ,Mb). *Description of file sizes, backing storage and main memory capacities using the terms: bit, byte, Kilobyte, Megabyte, Gigabyte, Terabyte (Kb, Mb, Gb, Tb).*	Conversion to and from bit, byte, Kilobyte, Megabyte, Gigabyte, Terabyte (Kb, Mb, Gb, Tb).
Description of the ASCII code including control characters. *Description of the term character set.*	Description of Unicode and its advantages over ASCII.
Description of bit map method of graphic representation using examples of black and white bit maps. *Calculation of storage requirements.*	Description of the bit map method of graphic representation using examples of colour/greyscale bit maps. Description of the relationship of bit depth to the number of colours using examples up to and including 24 bit depth (true colour).
	Description of the vector graphics method of graphic representation.
	Description of the relative advantages and disadvantages of bit mapped and vector graphics.
	Description of the relationship between the bit depth and file size.
	Explanation of the need for data compression using the storage of bit-map graphic files, as examples.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

Content Statements: Computer Structure	
Intermediate 2	Higher
Description of the purpose of a processor. *List the parts of a processor as ALU, control unit and registers.*	A detailed description of the purpose of the ALU and control unit. Description of the purposes of registers: to hold data being processed, instructions being executed, and addresses to be accessed.
Representation of the structure of a computer in the form of a simple 5 box diagram representing: input devices, processor/main memory, output devices, and backing storage.	Description of the function of the data bus and the address bus. Description of the read, write and timing functions of the control lines. Identification of other control lines, including reset and interrupt lines.
	A simple description, referring to the appropriate buses and control lines, of the steps in the fetch-execute cycle.
Distinction between main memory and backing storage. *Description of the features and uses of RAM and ROM.*	Description of the following elements of computer memory: registers, cache, main memory, backing storage. Distinction between the above elements of memory according to function and speed of access.
	The concept of addressability.
Description of the uses of embedded, palmtop, laptop, desktop and mainframe computers. *Comparison of features of embedded, palmtop, laptop, desktop and mainframe computers: type and speed of processor, size of main memory, backing storage, input and output devices.*	Description and evaluation of the following measures of performance: clock speed, MIPS, FLOPS, and application based tests.
Description of clock speed as a simple indicator of system performance.	Description of the effect the following factors have on system performance: data bus width, use of cache memory, rate of data transfer to and from peripherals.
	Description of current trends in computer hardware, including increasing clock speeds, increasing memory and backing storage capacity.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

Content Statements: Peripherals	
Intermediate 2	Higher
Description of the features, functions and uses of the following input devices: keyboard, mouse, microphone, touchpad, digital camera, scanner, webcam.	Description of the use and advantages of buffers and spooling.
Comparison of input devices using appropriate characteristics including resolution, capacity, speed of data transfer, cost.	
Description of the features, functions and uses of a monitor, LCD panel, inkjet and laser printers, loudspeakers.	Description of a suitable selection of hardware, including peripherals, to support typical tasks including production of a multimedia catalogue, setting up a LAN in a school, development of a school website.
Comparison of output devices using appropriate characteristics including resolution, capacity, speed of data transfer, cost.	Justification of the hardware selected in terms of appropriate characteristics including resolution, capacity, speed, cost and compatibility.
Magnetic storage: description of the features, functions and uses of current magnetic storage devices and media including floppy drive, hard drive, zip drive, magnetic tape drive.	
Optical storage: description of the features, functions and uses of current optical storage devices and media including CD-ROM, CD-R, CD-RW, DVD-ROM, rewritable DVD.	Description of the features, uses and advantages of solid state storage devices including flash cards. Description of the development trends in backing storage devices.
Comparison of storage devices using appropriate characteristics including type of access, capacity, speed of data transfer, cost.	
Description of the need for interfaces with reference to the following functions: compensating for differences in speed between the CPU and peripherals, data conversion from analogue to digital forms and temporary data storage.	Description of the following functions of an interface: buffering, data format conversion (serial to parallel and analogue to digital), voltage conversion, protocol conversion, handling of status signals.
	Distinction between parallel and serial interfaces.
	Description and exemplification of current trends towards increasing interface speeds and wireless communication between peripherals and CPU.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

Content Statements: Networking	
Intermediate 2	Higher
Description of the following features of LANs, WANs and the Internet: transmission media, bandwidth, geographical spread and functions.	Comparison of LANs, WANs, Intranet and Internetwork in terms of transmission media, bandwidth, geographical spread and functions.
	Distinction between a mainframe with terminals and a network of computers.
Description of the functions of a client and server on a network.	Descriptive comparison of peer-to-peer networks and client server networks.
Description of the benefits of networks.	Description of the functions of file, print and web servers.
Description of the following features and functions of e–mail: sending, reading, replying, setting up an address book, setting up mailing lists, setting up folders.	Description of a node and a channel. Description of bus, star, ring and mesh topologies using the terms node and channel. Description of the consequences for each of the above topologies of node and channel failure.
Description of the features and functions of the World Wide Web: web pages, hyperlinks, browser, search engines.	Simple description of the functions and uses of a hub, switch and router.
	Identification of the need for a network interface card (NIC).
	Description and explanation of the trends towards higher bandwidth and wireless communications.
Description of the following economic factors which have led to the development of computer networks: ♦ *falling cost of telecommunication technologies and services* ♦ *shared access to expensive equipment* ♦ *geographic spread of organisations* ♦ *demand for up-to-date information*	Description of the following technical reasons for the increasingly widespread use of networks: ♦ advances in computer hardware, including processors, main memory capacity, backing storage, data transfer rates ♦ improved network related software, including browsers and network operating systems
Description of the main features of the Computer Misuse Act, the Copyright Designs and Patents Act and the Data Protection Act.	Description of the misuse of networks for the following illegal purposes: breaching copyright, hacking and planting viruses. Description of the application of the Computer Misuse Act, the Copyright Designs and Patents Act and the Data Protection Act to the misuse of networks.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

Content Statements: Computer Software	
Intermediate 2	Higher
Distinction between an operating system and an application program with examples of each.	Description of the function of a bootstrap loader.
	Description and exemplification of the main functions of a single user operating system: interpreting users commands, file management, memory management, input/output management resource allocation, managing processes.
	Definition of a utility program. Description of four utility programs (including virus checker and disc editor and defragmenter).
Explanation of the need for standard file formats. *Description of the standard file formats for text files: text, ASCII, rich text file.*	Description of the standard file formats for graphics files: jpeg, gif, TIFF.
Identification of data objects and operations in the context of word processing, databases, spreadsheets and graphics packages.	Description of a suitable selection of software to support typical tasks including production of a multimedia catalogue, setting up a LAN in a school, development of a school website.
	Description and exemplification of software compatibility issues (including memory and storage requirements, and OS compatibility).
Definition of a virus. *Description of how a virus operates.* *Description of common symptoms of virus infection: displaying unwanted messages, unusual visual/sound effects, computers rebooting unexpectedly, unwanted generation of e-mails.* *Description of how viruses are spread via floppy disk, homemade CDs,'fun' websites and e–mail attachments.*	Classification of viruses by type of file infected: file virus, boot sector virus, macro virus, program virus. Description of the following virus code actions: replication, camouflage, watching, delivery.
	Distinction between a virus, a worm and a trojan horse.
Explanation of the need for anti-virus software.	Description of anti-virus software detection techniques: use of checksum, searching for virus signature, heuristic detection and memory resident monitoring.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and software throughout this Unit. While the learning may be achieved in the context of one computer system, candidates will benefit from having some experience of an alternative operating system.

The two Outcomes should be delivered in an integrated way rather than sequentially. For Outcome 2, the practical activities should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 1.

Candidates who have completed the *Computer Systems* Unit at Intermediate 2 level should already have covered the content listed in the left–hand column of the content grids, but may need to revise this material before progressing to the right–hand column.

The amount of time spent on each area of content will vary depending on the teaching methodology used and the ability and prior experience of the candidates. However, the following times may act as a rough guide:

data representation	6 hours
computer structure	7 hours
peripherals	5 hours
networking	9 hours
computer software	9 hours

1½ hours should be set aside to:

- administer the Outcome 1 test
- gather evidence for Outcome 2

A further 2½ hours is allowed for remediation and re-assessment if required.

If the Unit is delivered as part of a Course, the Course documentation will provide further information on teaching and learning in a Course context, including the identification of a number of ‘themes’ to facilitate holistic learning across the Course.

National Unit Specification: support notes (cont)

UNIT Computer Systems (Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank tests have been created specifically to assess Outcome 1 of the Unit. This assessment consists of a closed book test, and must be conducted under examination conditions. In order to gain success in this Outcome, the candidate must achieve at least the cut-off score for the test. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

Outcome 2 requires the candidate to demonstrate practical skills while using contemporary hardware and software. These practical skills may be demonstrated in the context of a number of relatively small tasks. The skills will normally be demonstrated by the candidate during the teaching and learning activities of the Unit, rather than as separate formal assessment activities. The candidate will be allowed access to books, notes and online help while completing the tasks.

To gain success in this Outcome, the candidate must demonstrate practical skills at an appropriate level in four of the following contexts, defined in the content statements (see Computing Higher Course content).

- use of standard OS functions
- use of utility software
- use of standard file formats for graphic files
- accessing a LAN using a network client
- accessing the Internet for WWW, email and file transfer

Hard copy evidence should be provided for any **one** of these activities. Note that this need not be formal documentation — print outs and screen shots showing appropriate activities are adequate.

A pro-forma observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

All evidence must be retained by the centre. The assessment of this Unit is subject to moderation by SQA.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

National Unit Specification: general information

UNIT Software Development (Higher)

NUMBER DF2Y 12

COURSE Computing (Higher)

SUMMARY

This Unit is designed to develop knowledge and understanding of software development and to develop practical skills in software development through the use of a high level language within an appropriate software development environment. In particular, it will develop and consolidate candidates' familiarity with standard language constructs and algorithms, and enable candidates to develop modular programs combining standard constructs. On completion of the Unit, the candidate should be able to apply this knowledge and understanding, and these skills to solve practical problems.

It is designed for candidates undertaking the Higher Computing Course, but is also suitable for anyone wishing to extend and deepen their experience of software development beyond Intermediate 2 level.

OUTCOMES

1. Demonstrate knowledge and understanding of the principles of software development, software development languages and environments, high level language constructs and standard algorithms.
2. Demonstrate practical skills in the context of software development, using contemporary hardware and an appropriate software development environment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Intermediate 2 Software Development Unit
- Intermediate 2 Computing
- Standard Grade Computing Studies at Credit Level

Administrative Information

Superclass: CB

Publication date: April 2004

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Software Development (Higher)

CREDIT VALUE
1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skill components in this Unit.

National Unit Specification: statement of standards

UNIT Software Development (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding of the principles of software development, software development languages and environments, high level language constructs and standard algorithms.

Performance Criteria

a) A range of computing terminology is used appropriately.
b) Technically accurate descriptions and explanations are related to practical and familiar contexts.
c) Descriptions of high level language constructs and standard algorithms are correct.
d) Conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence Requirements

Written or oral evidence that the candidate can describe and explain the principles of software development accurately and concisely. Evidence should be obtained using questions in a closed book test, under supervision, lasting no more than 45 minutes. The test must sample content (see Computing (Higher) Course content) in each of the following areas:

- the software development process
- software development languages and environments
- high level programming language constructs
- standard algorithms

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: statement of standards (cont)

UNIT Software Development (Higher)

OUTCOME 2

Demonstrate practical skills in the context of software development, using contemporary hardware and an appropriate software development environment.

Performance Criteria

a) A range of appropriate hardware is used effectively and efficiently.
b) A range of appropriate features of software is used effectively and efficiently.
c) Practical tasks are planned and organised with minimal guidance.
d) Practical tasks are undertaken in an appropriate range of familiar contexts.

Evidence Requirements

Observation checklist showing that the candidate has carried out practical activities, demonstrating all of the following practical skills, as defined in the content statements (see Computing (Higher) Course Content).

- analysis and design
- implementation of two appropriate language constructs
- implementation of two standard algorithms
- implementation of parameter passing
- testing of software
- producing documentation
- evaluating software

Hard copy evidence should be provided of implementation and one other of these skills.

These practical skills may all be demonstrated in a single extended software development task, or in a number of smaller tasks.

The candidate will be allowed access to books, notes and online help while completing the task(s).

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Software Development (Higher)

This part of the Unit Specification is offered as guidance.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content for this Unit is detailed below (and also in the National Course Specifications: Course details.) Content statements in the left hand column describe the content covered in the corresponding Unit at Intermediate 2 level, and are included here to clarify the context for the new learning for this Unit. They indicate the prior learning required by the candidate before undertaking new learning within this Unit. Content in the right hand column is the new content for this Unit.

Content Statements: Software development process	
Intermediate 2	Higher
Description of the stages (in order) of the software development process: analysis, design, implementation, testing, documentation, evaluation, maintenance.	Explanation of the iterative nature of the software development process. Description of the purposes of the software specification and its status as a legal contract. Explanation of the importance of each stage (analysis, design, implementation, testing, documentation, evaluation, maintenance) of the development process.
	Identification of the personnel at each stage (client, systems analyst, project manager, programmer, independent test group) and brief description of their roles.
Description and exemplification of pseudocode and one graphical design notation (structure diagram or other suitable).	Description and exemplification of pseudocode and one graphical design notation (structure diagram or other suitable) including data flow.
	Description and exemplification of top-down design and stepwise refinement.
Description and exemplification of appropriate test data (normal, extreme and exceptional).	Explanation of the need for systematic and comprehensive testing.
Description of the features of a user guide and a technical guide.	Explanation of the need for documentation at each stage.
Evaluation of software in terms of fitness for purpose, user interface and readability.	Evaluation of software in terms of robustness, reliability, portability, efficiency and maintainability.
	Description and exemplification of corrective, adaptive and perfective maintenance.

National Unit Specification: support notes (cont)

UNIT Software Development (Higher)

Content Statements: Software development languages and environments	
Intermediate 2	Higher
Description and comparison of machine code and high level languages.	Description and comparison of procedural, declarative and event-driven languages.
Explanation of the need for translation; Description of the functioning of interpreters and compilers.	Comparison of the functions, uses and efficiency of compilers and interpreters.
Description of the process of recording a macro and assigning it to a keystroke; Description of examples of the use of macros.	Description of the features and uses of scripting language (including creating and editing a macro) Explanation of the need for and benefits of scripting languages.
Description of the features and use of a text editor.	Description of the use of module libraries.

Content Statements: High level programming language constructs	
Intermediate 2	Higher
Description and exemplification of the following constructs in pseudocode and an appropriate high level language: ♦ *input and output, assignment, arithmetical operations (+,-,*,/,^) and logical operators (AND, OR, NOT)* ♦ *fixed loops, conditional loops, simple and complex conditions, conditional statements (IF), nested loops*	Description and exemplification of the following constructs in pseudocode and an appropriate high level language: ♦ string operations (concatenation and substrings) ♦ formatting of I/O ♦ CASE (or equivalent multiple outcome selection)
Description and exemplification of numeric and string variables and 1-D arrays.	Description and exemplification of real, integer and boolean variables and 1-D arrays.
Description and exemplification of pre-defined functions.	Description and exemplification of procedures/subroutines, user-defined functions, modularity, parameter passing (in, out, in/out), call by reference/value, local and global variables, scope.

National Unit Specification: support notes (cont)

UNIT Software Development (Higher)

Content Statements: Standard Algorithms	
Intermediate 2	Higher
Description and exemplification of the following standard algorithm in an appropriate high level language: ♦ *input validation*	Description and exemplification of the following standard algorithms in pseudocode and an appropriate high level language: ♦ linear search ♦ counting occurrences ♦ finding min/max
Recognition of appropriate use of the following standard algorithms: ♦ *input validation* ♦ *find min/max,* ♦ *count occurrences,* ♦ *linear search*	

National Unit Specification: support notes (cont)

UNIT Software Development (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and an appropriate software development environment throughout this Unit. While the learning will usually be achieved in the context of a single software development environment, candidates will benefit from having some experience of alternative software development environments.

The two Outcomes should be delivered in an integrated way rather than sequentially. For Outcome 2, the practical activities should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 1. These practical activities can be used to generate evidence for Outcome 2.

Candidates who have completed the *Software Development* Unit at Intermediate 2 level should already have covered the content listed in the left–hand column of the content statement grids, but may need to revise this material before progressing to the right–hand column.

The main purpose of this Unit is to develop and consolidate candidates' experience of standard language constructs and algorithms, and develop these into extended modular programs.

The amount of time spent on each content area will vary depending on the teaching methodology used and the ability and prior experience of the candidates. However, the following times are suggested as a rough guide:

software development process	4 hours
languages and environments	6 hours
language constructs	14 hours
standard algorithms	12 hours

1½ hours should be set aside to:

- administer the Outcome 1 test
- gather evidence for Outcome 2

A further 2½ hours is allowed for remediation and re-assessment if required.

If the Unit is delivered as part of a Course, the Course documentation will provide further information on teaching and learning in a Course context, including the identification of a number of 'themes' to facilitate holistic learning across the Course.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank tests have been created specifically to assess Outcome 1 of the Unit. This assessment consists of a closed book test, and must be conducted under examination conditions. In order to gain success in this Outcome, the candidate must achieve at least the cut-off score for the test. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

Outcome 2 requires the candidate to demonstrate practical skills while developing software using an appropriate high level language environment. These practical skills may all be demonstrated in a single extended software development task, or in a number of smaller tasks. The skills will normally be demonstrated by the candidate during the teaching and learning activities of the Unit, rather than as separate formal assessment activities. The candidate will be allowed access to books, notes and online help while completing the task(s).

To gain success in this Outcome, the candidate must demonstrate practical skills in the following contexts and at an appropriate level as defined by the content statements (see Computing (Higher) Course content):

- analysis and design (including data flows)
- implementation of two language constructs
- implementation of two standard algorithms
- implementation of parameter passing and subroutines
- testing of software
- producing user and technical documentation
- evaluating software

A pro-forma observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

Hard copy evidence is required of implementation and one other of these skills; this need not be formal documentation — it could include hand-written notes on design, hard copy of coding, or screen shots demonstrating implementation and/or testing.

All evidence must be retained by the centre. The assessment of this Unit is subject to moderation by SQA.

National Unit Specification: support notes (cont)

UNIT Software Development (Higher)

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

National Unit Specification: general information

UNIT Artificial Intelligence (Higher)

NUMBER DF31 12

COURSE Computing (Higher)

SUMMARY
This Unit is designed to develop knowledge and understanding of the principles of artificial intelligence together with some of the concepts associated with the representation and processing of knowledge. Candidates are also provided an opportunity to apply this knowledge to solve practical problems through the use of contemporary hardware and software. It is designed as an option for candidates undertaking the Higher Computing Course, but is also suitable for anyone wishing to extend and deepen their experience of artificial intelligence beyond Intermediate 2 level.

OUTCOMES
1. Demonstrate knowledge and understanding of a range of facts, ideas and terminology relevant to the development, applications and features of artificial intelligence.
2. Demonstrate practical skills in the context of artificial intelligence using contemporary software and hardware.

RECOMMENDED ENTRY
While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Intermediate 2 Artificial Intelligence Unit
- Intermediate 2 Computing
- Standard Grade Computing Studies at Credit level

Administrative Information

Superclass: CB

Publication date: April 2004

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Artificial Intelligence (Higher)

CREDIT VALUE
1 credit at Higher (6 SCQF credit points SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skill components in this Unit.

National Unit Specification: statement of standards

UNIT Artificial Intelligence (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding of a range of facts, ideas and terminology relevant to the development, applications and features of artificial intelligence.

Performance Criteria

a) A range of computing terminology is used appropriately.
b) Technically accurate descriptions and explanations are related to practical and familiar contexts.
c) Conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence Requirements

Written or oral evidence that the candidate can describe and explain the principles, features and purposes of artificial intelligence accurately. Evidence should be obtained using questions in a closed book test, under supervision, lasting no more than 45 minutes. The test must sample content (see Computing Higher Course content) in the following areas:

- the development of artificial intelligence
- applications and uses of artificial intelligence
- search techniques
- knowledge representation

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: statement of standards (cont)

UNIT Artificial Intelligence (Higher)

OUTCOME 2

Demonstrate practical skills in the context of artificial intelligence using contemporary software and hardware.

Performance Criteria

a) A range of appropriate hardware and software is used effectively and efficiently.
b) An appropriate range of features of declarative languages is selected and used effectively.
c) Practical tasks are planned and organised with minimal guidance.
d) Practical tasks are undertaken in an appropriate range of familiar contexts.

Evidence Requirements

Observational checklist showing that the candidate has demonstrated of the following skills in the context and at a level defined by the content statements (see Computing (Higher) Course content):

- construction of a knowledge base of facts and rules
- implementation of recursion, inheritance or negation
- creation of queries to elicit information from a knowledge base
- testing a knowledge base
- evaluating an expert system

Hard copy evidence should be provided of the knowledge base constructed.

The practical skills may all be demonstrated in a single extended task, or in a number of smaller tasks.

The candidate will be allowed access to books, notes and online help while completing the task(s).

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Artificial Intelligence (Higher)

This part of the Unit Specification is offered as guidance.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content for this Unit is detailed below (and also in the National Course Specifications: Course details.)

Content statements in the left–hand column describe the content covered in the corresponding Unit at Intermediate 2 level, and are included here to clarify the context for the new learning for this Unit. They indicate the prior learning required by the candidate before undertaking new learning within this Unit. Content in the right–hand column is the new content for this Unit.

Content Statements: The development of artificial intelligence	
Intermediate 2	Higher
Description of human intelligence (including the ability to communicate, retain knowledge, solve problems). *Description of the Turing test and explanation of its rationale.*	Definitions of human intelligence and artificial intelligence. Descriptions of aspects of intelligence (including language, learning, cognitive ability, problem solving skills, memory, creativity). Explanation of the difficulties of determining an accurate and agreed definition of intelligence. Explanation of the inherent flaws of the Turing test as a method for determining the existence of artificial intelligence. Description of the change in emphasis from modelling the human brain to producing systems exhibiting 'intelligent behaviour'.
Explanation of the need for a different approach to programming which could represent knowledge.	Description of the need for knowledge representation techniques (including semantic nets and logic programming). Explanation of the need for a restricted domain. Identification of languages: LISP (functional), Prolog (declarative/logic). Description of difference between declarative and imperative languages.

National Unit Specification: support notes (cont)

UNIT Artificial Intelligence (Higher)

Simple description of: ♦ *the development of game playing programs from simple early examples to contemporary complex examples exhibiting intelligence* ♦ *the development of language processing from Eliza to chatterbots and contemporary applications* ♦ *the development of expert systems*	Explanation (with examples) of: ♦ the success and failures of game playing programs from simple early examples to contemporary complex examples exhibiting intelligence ♦ the successes and failures of language processing (including Eliza, SHRDLU, chatterbots and contemporary applications) ♦ the scope and limitations of expert systems
Identification of hardware developments (including faster processors, more memory, and increasing backing store capacity) which have assisted the development of AI.	Explanation of the effects of hardware developments (including faster processors, more memory, and increasing backing store capacity*)* on the field of AI. Description of the implementation and advantages of parallel processing. Description of the practical problems associated with AI despite advances in hardware/software.

Content Statements : Applications and Uses of AI	
Intermediate 2	Higher
Artificial neural systems: *Simple description of a neural network as an electronic model of the brain consisting of many interconnected simple processors.* *Description of uses and examples of artificial neural systems (including learning to read postcodes; stock market prediction; debt risk assessment; other examples of pattern recognition).* *Description of advantages and disadvantages of artificial neural systems.*	**Artificial neural systems (ANS):** Comparison of a human neuron with an artificial neuron. Description of the structure of a neural net (including artificial neuron, links, weights, layers). Comparison of a neural net with the human brain. Description of 'learning' through iterative process as opposed to algorithmic programming. Explanation that a neural net may be a software model or hard-wired.
Vision systems: *Explanation of the need to interpret/make sense of visual input.* *Description of applications (including industrial, military use, satellite photo interpretation).*	**Vision systems:** Description of the problems of interpreting 2D images of 3D objects. Description of the stages of computer vision (image acquisition, signal processing, edge detection, object recognition, image understanding).

Speech recognition: *Description of applications (including word processor, punctuation commands, disabled users, cars, military, mobile phones).* *Description of characteristics (training for each voice pattern, control instructions, influence of background noise, factors affecting accuracy).*	**Natural language processing (NLP):** Identification of the main stages of NLP (speech recognition, natural language understanding (NLU), natural language generation, speech synthesis). Explanation of some difficulties in NLP (including ambiguity of meaning; similar sounding words; inconsistencies in grammar of human language; changing nature of language). Identification of applications of NLP (including automatic translation, speech driven software, NL search engines, NL database interfaces).
Handwriting recognition: *Description of common applications (including palmtops and tablet PCs).* *Explanation of possible need to train the system.*	**Smart/embedded technology:** Description of examples of the use of intelligent software to control devices (including car engine control systems; domestic appliances).
Intelligent robots: *Description of:* ♦ *types of sensors used* ♦ *contemporary applications (including automated delivery, pipe inspection, bomb disposal, exploration of unknown environments)* ♦ *advantages of intelligent robots*	**Intelligent robots:** Explanation of the difference between dumb and intelligent robots. Description of contemporary research and developments. Description of possible social and legal implications of the increasing use of intelligent robots. Descriptions of practical problems (including processor power, power supply, mobility, vision recognition, navigation, path planning, pick and place, and strategies used to overcome these problems).
Expert systems: *Description of purpose of expert systems.* *Description of advantages of expert systems over human experts, including:* ♦ *expertise always available* ♦ *reduced wage bill* ♦ *combines expertise of several experts* ♦ *less chance of errors* *Description of contemporary applications of expert systems:* *Description of social, legal and ethical issues related to the use of expert systems (including loss of jobs, training issues, public reactions, loss of human expertise).*	**Expert systems:** Description of the components of an expert system (knowledge base, inference engine, user interface with justification/explanation, working memory). Distinction between an expert system and an expert system shell. Description of contemporary applications of expert systems. Description of advantages of expert systems (including permanence, cost effectiveness, consistency, portability). Description of disadvantages of expert systems (including narrow domain, lack of 'common sense', need for expertise to set up and maintain, inability to acquire new knowledge, inflexibility). Description of moral issues (including medical). Description of legal issues (including responsibility when advice is wrong).

National Unit Specification: support notes (cont)

UNIT Artificial Intelligence (Higher)

Content Statements: Search techniques	
Intermediate 2	Higher
Exemplification of problem solving by search. *Construction of a simple search tree.* *Description of breadth-first and depth-first search and exemplification on a search tree.*	Comparison of depth-first and breadth-first search (order of visiting nodes, memory implications, advantages and disadvantages, need for backtracking), and exemplification on a search tree. Description and exemplification of combinatorial explosion. Description and exemplification of use of heuristics to reduce search time/space.

Content Statements: Knowledge representation	
Intermediate 2	Higher
	Description of the software development process as it applies to declarative language programming.
Construction of semantic net to represent simple relationships and facts.	Creation of a semantic net from given problem statement.
Description and exemplification of the following features in Prolog (or similar declarative language): ♦ *simple facts (single/double argument)* ♦ *simple rules (up to two sub-goals)* ♦ *simple queries (true/false, single variable)* ♦ *operators: and, >, <, =*	Description and exemplification of the following features in Prolog (or similar declarative language): ♦ multi-argument clauses ♦ recursive and non recursive rules ♦ complex queries: (multiple variable, conjunction of queries) ♦ negation ♦ inheritance
Explanation of the concepts of goal and sub-goal.	Explanation of the concepts of goal, sub-goal, instantiation, matching.
Perform simple manual trace: one rule/level.	Perform complex manual trace: multiple level including backtracking.
	Description and exemplification of inheritance Creation of rules involving inheritance.
	Explanation of the importance of the order of rules.

National Unit Specification: support notes (cont)

UNIT Artificial Intelligence (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and software throughout this Unit.

The two Outcomes should be delivered in an integrated way rather than sequentially. For Outcome 2, the practical activities should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 2, whenever this is possible. At the very least, candidates should carry out practical tasks using Prolog, and have experience of consulting and evaluating an expert system which could be a simple one prepared for the purpose, or a commercial example. Practical illustrations of other applications and uses of artificial intelligence should be provided where suitable hardware and software is available.

Candidates who have completed the *Artificial Intelligence* Unit at Intermediate 2 level should already have covered the content listed in the left–hand column of the content grids, but may need to revise this material before progressing to the right–hand column.

The amount of time spent on each area of content will vary depending on the teaching methodology used and the ability and prior experience of the candidates. However, the following times are suggested as a rough guide:

development of artificial intelligence	6 hours
applications and uses of artificial intelligence	8 hours
search techniques	4 hours
knowledge representation	18 hours

1½ hours should be set aside to:

- administer the Outcome 1 test
- gather evidence for Outcome 2

A further 2½ hours is allowed for remediation and re-assessment if required.

If the Unit is delivered as part of a Course, the Course documentation will provide further information on teaching and learning in a Course context, including the identification of a number of ‘themes’ to facilitate holistic learning across the Course.

National Unit Specification: support notes (cont)

UNIT Artificial Intelligence (Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank tests have been created specifically to assess Outcome 1 of the Unit. This assessment consists of a closed book test, and must be conducted under examination conditions. In order to gain success in this Outcome, the candidate must achieve at least the cut-off score for the test. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

Outcome 2 requires the candidate to demonstrate practical skills while using contemporary hardware and software. These practical skills will normally be demonstrated in a single extended task or a number of relatively small tasks. The skills will normally be demonstrated by the candidate during the teaching and learning activities of the Unit, rather than during separate formal assessment activities. The candidate will be allowed access to books, notes and online help while demonstrating the skills. The practical skills should be demonstrated in the context and at a level defined by the content statements (see Computing (Higher) Course content).

To gain success in this Outcome, the candidate must demonstrate practical skills in the following contexts:

- construction of a knowledge base of facts and rules
- implementation of recursion, inheritance or negation
- creation of queries to elicit information from a knowledge base
- testing a knowledge base
- evaluating an expert system

Hard copy evidence should be provided for the knowledge base constructed.

Note: the candidate is only required to evaluate an expert system, not to construct one.

A pro-forma observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

All evidence must be retained by the centre. The assessment of this Unit is subject to moderation by SQA.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

National Unit Specification: general information

UNIT Computer Networking (Higher)

NUMBER DF30 12

COURSE Computing (Higher)

SUMMARY
This Unit is designed to develop knowledge and understanding of the principles of networking and practical skills related to networking through the use of contemporary hardware and software. This knowledge, understanding and practical skills may then be applied by the candidate to solve practical problems related to networking. It is designed for candidates undertaking the Higher Computing Course, but is also suitable for anyone wishing to extend and deepen their experience of computer networking beyond Intermediate 2 level.

OUTCOMES
1. Demonstrate knowledge and understanding of a range of facts, ideas and terminology relevant to the principles, features and purposes of networking.
2. Demonstrate practical skills in the context of networking using contemporary hardware and software.

RECOMMENDED ENTRY
While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Intermediate 2 Computer Networking Unit
- Intermediate 2 Computing
- Standard Grade Computing Studies at Credit level

Administrative Information

Superclass: CB

Publication date: April 2004

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Computer Networking (Higher)

CREDIT VALUE
1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skill components in this Unit.

National Unit Specification: statement of standards

UNIT Computer Networking (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding of a range of facts, ideas and terminology relevant to the principles, features and purposes of networking.

Performance Criteria

a) A range of computing terminology is used appropriately.
b) Descriptions and explanations are related to practical and familiar contexts.
c) Conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence Requirements
Written or oral evidence that the candidate can describe and explain the principles, features and purposes of networking correctly. Evidence should be obtained using questions in a closed book test, under supervision, lasting no more than 45 minutes. The test must sample content (see Computing (Higher) Course content) in each of the following areas:

- network applications
- network security
- data transmission
- network protocols

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: statement of standards (cont)

UNIT Computer Networking (Higher)

OUTCOME 2
Demonstrate practical skills in the context of networking using contemporary hardware and software.

Performance Criteria
a) A range of appropriate hardware is used effectively and efficiently.
b) An appropriate range of features of software is used effectively and efficiently.
c) Practical tasks are planned and organised with minimal guidance.
d) Practical tasks are undertaken in an appropriate range of familiar contexts.

Evidence Requirements
Observation checklist showing that the candidate has demonstrated practical skills at an appropriate level in **three** of the following contexts:

- designing and setting up a simple network that allows resource sharing between at least two computer systems
- allocating an IP address
- creation of user accounts on a simple local area network
- creation of a simple web page using HTML

Hard copy evidence should be provided for **one** of these activities.

These practical skills may all be demonstrated in a single extended task, or in a number of smaller tasks.

The practical skills should be demonstrated in the context and at a level defined by the content statements (see Higher Course content).

The candidate will be allowed access to books, notes and online help while completing the tasks.

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Computer Networking (Higher)

This part of the Unit Specification is offered as guidance.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content for this Unit is detailed below (and also in the National Course Specifications: Course details.)

Content statements in the left–hand column describe the content covered in the corresponding Unit at Intermediate 2 level, and are included here to clarify the context for the new learning for this Unit. They indicate the prior learning required by the candidate before undertaking new learning within this Unit.

Content in the right hand column is the new content for this Unit.

Content Statements: Network protocols	
Intermediate 2	Higher
	Name and description of the seven layers of the OSI model.
	Brief explanation of the purpose of common protocols (TELNET, HTTP, FTP, SMTP).
	Description of an IP address: ♦ structure — 4 octets ♦ classes — ABCD ♦ limitations
Brief description of the need for Name services (name resolution).	Description of Name services (name resolution); DNS (domain names, host name resolution).

National Unit Specification: support notes (cont)

UNIT Computer Networking (Higher)

Content Statements: Network applications	
Intermediate 2	Higher
Description of services provided by the Internet: World Wide Web, electronic mail and file transfer.	
Explanation of the structure of: ♦ *an e-mail address* ♦ *a URL (uniform resource locator)*	
Description of a web page as a text document with hyperlinks.	Description of a web page using HTML tags (start, header, body, title, style, font size, alignment, section headers).
Explanation of the purpose of a browser. Brief description of the functions of a browser (access the www, provide facilities including file transfer and e-mail).	
Description of browsers and microbrowsers for use with wireless data (WAP).	Explanation of the advantages and disadvantages of browsers and microbrowsers for use with wireless data (WAP). Description of a web page using WML tags (wireless markup language).
Description of hyperlinks, search engines and navigation.	Description of the methods used by search engines to build its indexes (spiders, meta-search engines).
Description of a situation when an ISP (Internet service provider) is required. Explanation of the purpose of an ISP.	
Description of e-commerce: the use of the Internet in conducting business and providing a service (e-government, e-business, e-marketing and e-sales).	Description of the advantages of e-commerce. Implication of fraud in e-sales payment and how it is overcome.
Description of current converging technologies in the home (home appliances with built in additional functionality such as internal and external communication capability.)	Description of the social implications of networks; information rich and information poor, the family, the community and employment.
Description of the main implications for business and education of the growth of network technology and the Internet.	Description of the ethical implications of networks; personal privacy and censorship.
Description of main features of the Regulation of Investigatory Powers Act 2000.	Description of the implications of the Regulation of Investigatory Powers Act 2000.
Description of appropriate code of conduct in the use of e-mail and Internet.	

National Unit Specification: support notes (cont)

UNIT Computer Networking (Higher)

Content Statements: Network security	
Intermediate 2	Higher
Description of security measures: ♦ *physical* ♦ *software — password and user ID*	Description of security measures: ♦ user access rights to data — file and folder permissions ♦ user access rights to hardware
Brief explanation of the use and advantages of encryption.	Description of computer and network security requirements (confidentiality, data integrity and availability). Description of threats to network security in terms of passive (monitoring of transmission) and active (modification of the data stream or the creation of a false stream) attacks.
	Description of the denial of service attack: ♦ effect: disruption or denial of services to legitimate users ♦ costs of attack: system downtime, lost revenue and labour involved in identifying and reacting to an attack ♦ intent: malicious, personal or political ♦ types of attacks: bandwidth consumption, resource starvation, programming flaws and routing and DNS attacks
Explanation of the need for filtering Internet contents in education, home and commercial companies.	Comparison of Internet content filtering methods: firewalls, Internet filtering software and walled gardens.
	Description of how a firewall can protect a LAN with an Internet connection from outside attacks.
Description of potential threats to networks; ♦ *node failure* ♦ *software failure* ♦ *channel failure* *Description of the need for a backup strategy.*	Description of disaster avoidance: ♦ use of anti-virus software ♦ use of fault tolerance components ♦ use of uninterrupted power supply. ♦ regular maintenance Description of backup strategy: ♦ backup server ♦ mirror disks ♦ tape ♦ backup schedule

National Unit Specification: support notes (cont)

UNIT Computer Networking (Higher)

Content Statements: Data transmission	
Intermediate 2	Higher
Description of the three types of transmission; unicast, broadcast and multicast.	Description of synchronous and asynchronous data transmission.
Description of the dual use made of networks in voice and data transmission.	Description of error checking in data transmission (parity and CRC).
	Description of the process of transmitting data over a network using TCP/IP.
	Description of CSMA/CD and its implications for network performance.
	Description of network switching (circuit and packet switching) and its implications for network performance.
Description of modern wireless communication methods: ♦ *wireless personal area network (WPAN)* ♦ *wireless LAN* ♦ *wireless WAN*	Description of the application of modern wireless communication methods: ♦ WPAN — connect mobile phones, mobile computers and other portable handheld devices ♦ wireless LAN — connecting a mobile LAN ♦ wireless WAN — connection in rural and heavily built-up areas
Description of the types of connections to the Internet (dialup modem, ADSL, cable modem, leased line and ISDN). *Explanation of the term broadband.*	Description of the speed and bandwidth of the types of Internet connections (dialup, cable modem, leased line, ISDN and ADSL). Explanation of which type of connection would be most appropriate in a given context.
Description of the additional hardware requirements for a wireless LAN (receiver, transmitter and wireless NIC).	Description of function of network interface card. Explanation for the need of a MAC address when transmitting data over a network.

National Unit Specification: support notes (cont)

UNIT Computer Networking (Higher)

List of abbreviations :

Intermediate 2

ADSL	Asymmetric Digital Subscriber Line
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
LAN	Local Area Network
NIC	Network Interface Card
URL	Uniform Resource Locator
WAP	Wireless Application Protocol
WLAN	Wireless Local Area Network
WPAN	Wireless Personal Area Network
WWAN	Wireless Wide Area Network

Higher

ADSL	Asymmetric Digital Subscriber Line
CRC	Cyclic Redundancy Check
CSMA/CD	Carrier Sense Multiple Access Collision Detection
DNS	Domain Name System
FTP	File Transfer Protocol
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
ISDN	Integrated Services Digital Network
MAC	Media Access Control
TELNET	TCP/IP standard network virtual terminal protocol
WAP	Wireless Application Protocol
WML	Wireless Markup Language
WPAN	Wireless Personal Area Network
WAN	Wide Area Network

National Unit Specification: support notes (cont)

UNIT Computer Networking (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and software throughout this Unit. While the learning may be achieved in the context of one computer system, candidates will benefit from having some experience of alternative operating systems.

The two Outcomes should be delivered in an integrated way rather than sequentially. For Outcome 2, the practical activities should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 1.

Candidates who have completed the networking Unit at Intermediate 2 level should already have covered the content listed in the left–hand column of the content grids, but may need to revise this material before progressing to the right–hand column.

The amount of time spent on each area of content will vary depending on the teaching methodology used and the ability and prior experience of the candidates. However, the following times, and teaching order, are suggested as a rough guide:

network applications	10 hours
network security	12 hours
data transmission	8 hours
network protocols	6 hours

1½ hours should be set aside to:

- administer the Outcome 1 test
- gather evidence for Outcome 2

A further 2½ hours is allowed for remediation and re-assessment if required.

If the Unit is delivered as part of a Course, the Course documentation will provide further information on teaching and learning in a Course context, including the identification of a number of ‘themes’ to facilitate holistic learning across the Course.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank tests have been created specifically to assess Outcome 1 of the Unit. This assessment consists of a closed book test, and must be conducted under examination conditions. In order to gain success in this Outcome, the candidate must achieve at least the cut-off score for the test. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

Outcome 2 requires the candidate to demonstrate practical skills while using contemporary hardware and software. These practical skills may be demonstrated in a single extended task or a number of relatively small tasks, undertaken by the candidate during the teaching and learning activities of the Unit, rather than as separate formal assessment activities. The candidate will be allowed access to books, notes and on-line help while completing the task(s). The practical skills should be demonstrated in the context defined in the content statements (see Computing (Higher) Course content).

National Unit Specification: support notes (cont)

UNIT Computer Networking (Higher)

To gain success in this Outcome, the candidate must demonstrate practical skills at an appropriate level in **three** of the following contexts, as defined by the content statements (see Computing (Higher) Course content):

- designing and setting up a simple network that allows resource sharing between at least two computer systems
- allocating an IP address
- creation of user accounts on a simple local area network
- creation of a simple web page using HTML

Hard copy evidence should be provided for **one** of these activities. Note that this evidence need not be formal reports; it could consist of a printout or a screen shot from any of the practical activities.

A pro-forma observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

All evidence must be retained by the centre. The assessment of this Unit is subject to moderation by SQA.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

National Unit Specification: general information

UNIT Multimedia Technology (Higher)

NUMBER DF32 12

COURSE Computing (Higher)

SUMMARY

This Unit is designed to develop knowledge and understanding of the principles of multimedia technology and to develop practical skills in the capture, creation and storage of multimedia data through the use of contemporary hardware and software. This knowledge and understanding and these practical skills may then be applied by the candidate to solve practical problems in the context of multimedia applications. It is designed for candidates undertaking the Higher Computing Course, but is also suitable for anyone wishing to extend and deepen their experience of multimedia technology beyond Intermediate 2 level, or those who have practical experience in multimedia applications wishing to develop a secure understanding of the underlying technology.

OUTCOMES

1. Demonstrate knowledge and understanding of the principles, features, purposes and implications of the technologies involved in the capture, creation and storage of multimedia data by contemporary multimedia systems.
2. Demonstrate practical skills in the use of multimedia technology using contemporary hardware and software.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Intermediate 2 Computing
- Intermediate 2 Multimedia Technology Unit
- Standard Grade Computing at Credit level

Administrative Information

Superclass: CE

Publication date: April 2004

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

CREDIT VALUE

1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skill components in this Unit.

National Unit Specification: statement of standards

UNIT Multimedia Technology (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding of the principles, features, purposes and implications of the technologies involved in the capture, creation and storage of multimedia data by contemporary multimedia systems.

Performance Criteria

a) A range of computing terminology is used appropriately.
b) Technically accurate descriptions and explanations are related to practical and familiar contexts.
c) Conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence Requirements

Written or oral evidence that the candidate can describe and explain the principles, features and purposes of multimedia technology. Evidence should be obtained using questions in a closed book test, under supervision, lasting no more than 45 minutes. The test must sample content (see Computing (Higher) Course content) within the following areas:

- development process for multimedia applications
- bit-mapped graphic data
- digitised sound data
- video data
- vector graphics data
- synthesised sound data
- implications of the use of contemporary multimedia technology

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: statement of standards (cont)

UNIT Multimedia Technology (Higher)

OUTCOME 2

Demonstrate practical skills in the use of multimedia technology using contemporary hardware and software.

Performance Criteria

a) A range of appropriate hardware is used effectively and efficiently.
b) An appropriate range of features of software is used effectively and efficiently.
c) Practical tasks are planned and organised with minimal guidance.
d) Practical tasks are undertaken in an appropriate range of familiar contexts.

Evidence Requirements

Observation checklist showing that the candidate has demonstrated practical skills in **four** of the following five contexts:

- use of file formats and settings for graphic bit-mapped graphic data
- use of file formats and settings for video data
- use of file formats and settings for digitised sound data
- use of file formats and settings for vector graphic data or synthesised sound data
- combining two or more data types into a single document or application

Hard copy evidence should be provided for **one** of these activities.

These practical skills may all be demonstrated in a single extended task, or in a number of smaller tasks.

The practical skills should be demonstrated in the context and at a level defined by the content statements (see Computing (Higher) Course content).

The candidate will be allowed access to books, notes and online help while completing the task(s).

(The content statements are also reproduced for convenience as a table in the support notes for this Unit).

The standard to be applied is illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Multimedia Technology (Higher)

This part of the Unit Specification is offered as guidance.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content for this Unit is detailed below (and also in the National Course Specifications: Course details.)

Content statements in the left–hand column describe the content covered in the corresponding Unit at Intermediate 2 level, and are included here to clarify the context for the new learning for this Unit. They indicate the prior learning required by the candidate before undertaking new learning within this Unit.

Content statements in the right–hand column define the new content for this Unit.

Content Statements: Development process for multimedia applications	
Intermediate 2	Higher
Simple description of the software development process as it applies to the development of multimedia applications.	Description of the software development process as it applies to the development of multimedia applications.
Identification of methodologies used in the creation or definition of a multimedia application, including: ♦ *WYSIWYG editors and text editors to create web pages* ♦ *authoring software to create multimedia applications* ♦ *presentation software to create presentations*	Description of methodologies used in the creation or definition of a multimedia application, including: ♦ WYSIWYG editors and text editors to create web pages ♦ authoring software to create multimedia applications ♦ presentation software to create presentations
Simple description of the requirements for the display of a multimedia application, including web browser, file 'player' and executable file.	Description of the methodologies and requirements for the display of a multimedia application, including streaming of multimedia data and embedded files.
	Explanation and exemplification of the terms 'codec' and 'container' file.

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

Content Statements: Bit-mapped graphic data	
Intermediate 2	Higher
Simple description of the hardware used to capture still graphic data, including: ♦ *digital camera (CCD and removable, re-usable storage)* ♦ *scanner (CCD)*	Description of the hardware used to capture still graphic data, including: ♦ digital camera (array CCD, memory card storage medium) ♦ scanner (linear CCD) ♦ role of ADC
Simple description of the storage and limitations of graphic data in compressed and uncompressed file formats, including: ♦ *bitmap (uncompressed)* ♦ *GIF (256 colours, transparency, lossless compression)* ♦ *JPEG (lossy compression)*	Description of the storage of graphic data in compressed and uncompressed file formats, including simple description of the techniques used within each file for compression and data storage, including: ♦ bitmap (indexed colour or CLUT) ♦ 24-bit bitmap and compressed bitmap (RLE) ♦ GIF (animation, (non)-interlaced, LZW) ♦ JPEG (description of factors involved) ♦ PNG (CLUT or RGB, transparency, compressed)
Explanation of the following terms in connection with graphics and description of the relationships between them and their effect on image quality: ♦ *lossy compression* ♦ *resolution (number of pixels)* ♦ *colour depth (number of colours)* ♦ *file size (in bytes, Kb, Mb, Gb)*	Description of RGB colour codes and their effect on the overall colour produced. Calculations using the relationship: File Size = resolution pixels x colour depth (bits). Calculation of number of pixels from height, width and resolution.
Description of the main features and applications of simple bitmap editing and creation software, including: ♦ *painting programs (paintbrush, fill)* ♦ *image editing programs (decrease resolution, alter colour depth, crop, alter brightness and contrast, re-size or scale an image)*	Explanation of the following image related terms: ♦ dithering ♦ anti-aliasing ♦ increase resolution (re-sampling)
Identification of hardware required to display 2D graphics, including graphics card.	Description of features of graphics cards involved in displaying 2D graphics, including: ♦ role of DAC ♦ role of GPU/DSP (to allow effects to be applied by hardware)

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

Content Statements: Digitised sound data	
Intermediate 2	Higher
Identification of hardware required to capture sound data, including sound card and microphone.	Description of soundcard in its use to capture sound data including role of ADC.
Simple description of the storage of sound data in compressed and uncompressed formats, including: ♦ *RAW (uncompressed)* ♦ *RIFF (compressed) (includes WAV)* ♦ *MP3 (lossy compression)*	Description of the storage of sound data in compressed and uncompressed file formats, including simple description of the techniques used within each file for compression and data storage, including: ♦ RAW (PCM) ♦ RIFF (ADPCM) (including WAV) ♦ MP3 (description of factors involved)
Explanation of the following terms in connection with sounds, and description of the relationships between them and their effect on sound quality: ♦ *lossy compression* ♦ *sampling depth/resolution (bytes)* ♦ *sampling frequency (Hz, KHz)* ♦ *sound time (s)* ♦ *file size (in bytes, Kb, Mb, Gb)*	Description of the following terms in relation to audio files: ♦ bit-rate to describe data throughput for a sound file ♦ normalising sound files Calculations using the relationship: File Size (bytes) = Sampling Frequency (Hz) x Sound Time (s) x Sampling Depth (bytes) x Channels.
Description of the main features and applications of simple sound editing software, including: ♦ *decrease sampling frequency* ♦ *decrease sampling depth* ♦ *crop, effects, echo, reverse, volume*	Explanation of the following sound related terms: ♦ clipping ♦ stereo ♦ surround sound ♦ fade
Identification of need for sound card to output sound.	Description of features of sound cards, including: ♦ role of DAC ♦ role of DSP (to allow hardware decoding of sound files)

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

Content Statements: Video data	
Intermediate 2	Higher
Simple description of hardware required to capture digital video (digital video camera or web cam).	Technical description of hardware required to capture digital and analogue video: ♦ digital video camera (array CCD) ♦ web cam (array CCD) ♦ video capture card (role of ADC and role of DSP to allow hardware encoding of data stream including into MPEG format)
Simple description of the storage of video data in compressed and uncompressed formats, including: ♦ *uncompressed AVI* ♦ *MPEG (lossy compression)*	Description of the storage of video data in compressed and uncompressed file formats, including simple description of the techniques used within each file for compression and data storage and the inclusion of sound within the file, including: ♦ uncompressed AVI ♦ MPEG (description of factors involved)
Explanation of the following terms in connection with videos and description of the relationships between them and their effect on video quality: ♦ *lossy compression* ♦ *colour depth (bytes)* ♦ *resolution* ♦ *frame rate (fps)* ♦ *video time (s)* ♦ *file size (in bytes, Kb, Mb, Gb)*	Description of term bit-rate to describe data throughput for a video file. Calculations using the relationship: File Size (bytes) = pixels per frame x Colour Depth (bytes) x Video Time (s) x Frame Rate (fps).
Description of the main features and applications of simple video editing software with single clips, including crop (or trimming).	Description of the main features and applications of video editing software with multiple clips, including: ♦ timeline ♦ transition ♦ sequencing
Identification of need for graphics card to output video data.	Description of features of graphics cards for output of video, including: ♦ role of DAC ♦ role of DSP (to allow hardware decoding of data stream including MPEG files)

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

Content Statements: Vector graphics data	
Intermediate 2	Higher
Description of basic features of vector graphics: ♦ *scalable (independent of resolution)* ♦ *each object is editable* ♦ *layering*	Description of features of vector graphics: ♦ object oriented data storage ♦ more storage efficient than bit-mapped ♦ output quality matches hardware capability ♦ conversion to bitmap formats
Identification of common attributes of vector graphic objects: ♦ *drawing (shape, position, size, rotation, line, fill, layer)* ♦ *3D image (shape, position, size, rotation, texture)*	Description of common attributes of vector graphic objects: ♦ drawing (shape, position, size, rotation, line, fill) ♦ 3D image (shape, position, size, rotation, texture)
Identification of common file types used to store graphics in vector formats, including: ♦ *SVG (scalable vector graphics)* ♦ *VRML (virtual reality mark-up language (or WRL — world description language)*	Description of basic features and structures of vector graphic file types, including methods used to implement common attributes listed above for these file types: ♦ SVG ♦ VRML/WRL

Content Statements: Synthesised sound data	
Intermediate 2	Higher
Description of use of MIDI keyboard or instrument to create sound data in MIDI format.	
Identification of common attributes of notes stored as MIDI data (instrument, pitch, volume, duration, tempo).	Description of common attributes of notes stored as MIDI data (instrument, pitch, volume, duration, tempo).
	Description of advantages and disadvantages of storing sound as MIDI data.

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

Content Statements: Implications of use of multimedia technology	
Intermediate 2	Higher
Description of contemporary technologies and their uses, that demonstrate convergence of technology in relation to multimedia capabilities, including: ♦ *smart Phone* ♦ *pocket PC* ♦ *digital television* ♦ *virtual reality*	Description of trends and changes in contemporary technologies that facilitate the convergence of technologies in relation of multimedia capabilities, including: ♦ communications (buses, wireless standards, increasing bandwidth), including USB, Firewire, WiFi, Bluetooth ♦ storage technologies (decreasing size and price, increasing capacity), including optical, magnetic, holographic ♦ processor (increasing power) ♦ display technologies, including real and virtual 3D displays, and flat displays

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

Glossary of abbreviations:

ADC	Analogue to Digital Converter
API	Applications Program Interface
AVI	Audio Video Interleaved
CCD	Charge Coupled Device
CLUT	Colour Lookup Table
DAC	Digital to Analogue Converter
DSP	Digital Signal Processing
GIF	Graphic Interchange Format
GPU	Graphics Processing Unit
HTML	Hypertext Markup Language
JPEG	Joint Photographic Experts Group
IEEE	Institute of Electronic and Electrical Engineers
LZW	Lempel, Ziv, Welch (compression algorithm)
MIDI	Musical Instrument Digital Interface
MPEG	Motion Picture Expert Group
MP3	MPEG-1 audio layer - 3
PCM	Pulse Code Modulation
PNG	Portable Network Graphics
RAW	“raw” (unprocessed) data
RGB	Red Green Blue
RIFF	Resource Interchange File Format
RLE	Run-Length Encoding
SVG	Scalable Vector Graphics
USB	Universal Serial Bus
VRML	Virtual Reality Markup Language
WRL	World Description Language
WYSIWYG	What You See Is What You Get

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and software throughout this Unit.

The two Outcomes should be delivered in an integrated way rather than sequentially. For Outcome 2, the practical activities should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 1.

Candidates who have completed the *Multimedia Technology* Unit at Intermediate 2 level should already have covered the content listed in the left–hand column of the content grids, but may need to revise this material before progressing to the right–hand column.

The amount of time spent on each area of content will vary depending on the teaching methodology used and the ability and prior experience of the candidates. However, the following times are suggested as a rough guide:

development process for multimedia applications	2 hours
2D graphic data — theory	3 hours
effective use of file formats and settings (2D graphic)	3 hours
sound data — theory	4 hours
effective use of file formats and settings (sound)	3 hours
video data	3 hours
effective use of file formats and settings (video)	3 hours
vector graphics data	3 hours
MIDI sound data	3 hours
implications of the use of contemporary multimedia technology	4 hours
combine multimedia data	5 hours

1½ hours should be set aside to:

- administer the Outcome 1 test
- gather evidence for Outcome 2

A further 2½ hours is allowed for remediation and re-assessment if required.

If the Unit is delivered as part of a Course, the Course documentation will provide further information on teaching and learning in a Course context, including the identification of a number of ‘themes’ to facilitate holistic learning across the Course.

National Unit Specification: support notes (cont)

UNIT Multimedia Technology (Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank tests have been created specifically to assess Outcome1 of the Unit. This assessment consists of a closed book test, and must be conducted under examination conditions. In order to gain success in this Outcome, the candidate must achieve at least the cut-off score for the test. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

Outcome 2 requires the candidate to demonstrate practical skills while using contemporary hardware and software. These practical skills may be demonstrated in a single extended task or a number of relatively small tasks. The skills will normally be demonstrated by the candidate during the teaching and learning activities of the Unit, rather than during separate formal assessment activities. The candidate will be allowed access to books, notes and online help while demonstrating the skills. The practical skills should be demonstrated in the context and at a level defined by the content statements (see Computing (Higher) Course content).

To gain success in this Outcome, the candidate must demonstrate practical skills in **four** of the following five contexts:

- use of file formats and settings for bit-mapped graphic data
- use of file formats and settings for video data
- use of file formats and settings for digitised sound data
- use of file formats and settings for vector graphic data or synthesised sound data
- combining two or more data types into a single document or application

Hard copy evidence must be provided for **one** of these activities. Note that this need not be formal documentation — simple print outs or screen are suitable evidence.

A pro-forma observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

All evidence must be retained by the centre. The assessment of this Unit is subject to moderation by SQA.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).