SCOTTISH QUALIFICATIONS AUTHORITY

INFORMATION SYSTEMS
Advanced Higher

Second edition – published December 1999

SCOTTISH QUALIFICATIONS AUTHORITY

NOTE OF CHANGES TO ADVANCED HIGHER ARRANGEMENTS SECOND EDITION

COURSE TITLE: Information Systems (Advanced Higher)

COURSE NUMBER: C054 13

National Course Specification

Course Details:

Details of the instruments for external assessment	coursework – amended

National Unit Specification

D306 13	***Information Systems Project (AH)***
Support notes	Guidance on approaches to assessment for this unit
	Details at Outcomes 1 to 3 regarding the project have been amended

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National Course Specification

INFORMATION SYSTEMS (ADVANCED HIGHER)

COURSE NUMBER C054 13

COURSE STRUCTURE

The course has two mandatory units and one optional unit as follows:

Mandatory units

D299 13	***Database Systems (AH)***	***0.5 credit (20 hours)***
D306 13	***Information Systems Project (AH)***	***1.5 credits (60 hours)***

Optional units – choose one from:

D301 13	***Multimedia (AH)***	***1 credit (40 hours)***
D307 13	***Natural Language Processing (AH)***	***1 credit (40 hours)***
D308 13	***Systems Analysis and Design (AH)***	***1 credit (40 hours)***

In common with all courses, this course includes 40 hours over and above the 120 hours for the component units. This is for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning, and preparation for external assessment. This time is an important element of the course and advice on its use is included in the course details.

RECOMMENDED ENTRY

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

- Information Systems course at Higher level
- equivalent

Administrative Information

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 02

National Course Specification: general information (cont)

COURSE Information Systems (Advanced Higher)

CORE SKILLS

CORE SKILLS

This course gives automatic certification of the following:

Complete core skills for the course	I T H Problem Solving H
Additional core skills components for the course	None

For information about the automatic certification of core skills for any individual unit in this course, please refer to the general information section at the beginning of the unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Course Specification: course details

COURSE Information Systems (Advanced Higher)

RATIONALE

Information and its associated technologies has been widely identified as having a unique and key role in many aspects of modern life. This is recognised, for example, in the inclusion of information technology (IT) as a core skill within many contemporary qualifications. Technological developments in hardware and software mean that a wide range of data types can be stored and processed in digital form to provide useful information. Developments in communication technologies have ensured that information is widely accessible. Such developments are themselves generating demand for further access to information.

In parallel with these developments has come recognition of the need to adopt a systematic approach to handling information and working with information systems. For example, disciplined approaches to the provision of information to meet user requirements have long been recognised and are well established in database design. Methodical approaches should be underpinned by technical considerations in collecting, storing, processing and communicating data in a meaningful form. Information is a vital resource to individuals and organisations and, as such, is worthy of detailed study.

The Information Systems course at Advanced Higher level builds on the corresponding course at Higher level. A central theme of Information Systems courses at every level is the development of the candidates' knowledge and understanding of contemporary database systems, and units with this title appear within the core of every course. This course also features an extended project to provide candidates with a vehicle for applying their knowledge and understanding of information systems. The optional units provide opportunities for candidates to develop their skills in specialist aspects of information systems, such as multimedia or artificial intelligence (AI) systems.

The aims of the course are:

- to develop intellectual stimulus and academic rigour
- to provide an opportunity for candidates to apply their knowledge and understanding in the context of a project
- to provide an opportunity for candidates to specialise in particular aspects of information systems
- to foster confidence and enjoyment in the use of IT systems

The knowledge and skills gained as part of this course should enable the candidate to play a full and active role within the 'information society'.

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

COURSE CONTENT

Information Systems courses draw on existing National Certificate provision, supplemented by new units, as appropriate. A number of topics are identified as important at various levels within the framework of provision. These multi-level topics relate to the following areas:

- database systems
- computer applications
- attributes of information
- contemporary information systems (such as the Internet and multimedia)
- contemporary developments
- social, ethical and legal implications

To help the teacher/lecturer ensure that the treatment of any one of these topics is coherent, a progression matrix has been produced for each of computer applications, database and multimedia topics. These matrices are part of the Subject Guide. They define the contents of these topics at each level and ensure that candidates working through the framework have a progressive experience. They are also helpful to teachers/lecturers in understanding the content of a unit at a given level and units should be considered in the context of these tables.

While each unit has an appropriate mix of knowledge and skills represented within the outcomes, certain units may have more cognitive or practical outcomes than others. The proportion of outcomes relating to practical or cognitive competencies will depend on the domain of the unit. However, the number of practical and cognitive outcomes in a course context is broadly balanced.

Unit specifications provide detailed support notes to assist teachers/lecturers in their interpretation of the outcomes and performance criteria. The support notes provide details about content in the context of an individual unit; this documentation provides details about content in a course context.

Topics that appear within several units have implications for whole-course teaching, and further guidance on this is given in the Approaches to learning and teaching section. The Subject Guide will provide additional guidance on teaching and learning.

To ensure consistency of terminology, the meaning of the technical terms used throughout this documentation is taken from the British Computer Society's publication entitled *A Glossary of Computing Terms* which is published by Longman. A glossary of the IT terms used within National courses and units will be published in due course.

The course has a mandatory and optional structure which provides candidates with an element of choice in the selection of the component units. Database systems are a central theme within all Information Systems courses, and units with this title appear within the mandatory section of courses at every level. A critical aspect of courses at this level is the ability of candidates to demonstrate an analytical approach to project planning and problem solving. These dual objectives are reflected in the nature of the mandatory units (Database Systems and Information Systems Project). The optional units permit a degree of specialisation. Candidates can select units which focus on specific aspects of information systems. The Multimedia unit extends candidates' knowledge of multimedia and involves them in producing a multimedia product. The Natural Language Processing unit introduces the candidate to aspects of artificial intelligence and knowledge-based systems and the Systems Analysis and Design unit specialises in this important area of information systems design.

Added benefit from undertaking the course

There is added benefit to be derived from taking the units as part of a course rather than as discrete units. In addition to guaranteed coherence, a course also provides opportunity to integrate learning, teaching and assessment across all outcomes within the course. Learning and teaching can apply to a wide range of contexts across several units and a single instrument of assessment can contribute towards several outcomes. Undertaking the units as a coherent programme offers a number of benefits:

- taken together, the component units offer opportunities for delivery as a coherent, integrated, holistic experience
- balance and breadth of candidates' experiences and learning will be promoted
- both specific and core skills may be explored and developed
- skills and abilities developed through holistic and integrated activity support learning as a whole
- candidates' abilities to sustain effort and concentration, come to conclusions, make decisions, complete a process, and evaluate their work are developed

Unit contents

The detailed contents of each unit are defined within the respective unit specification and are not further described within this course documentation. However, the section entitled *Relationship of the course to component units* describes the course in the form of a syllabus which teachers/lecturers may find helpful and familiar.

ASSESSMENT

To gain the award of the course, the candidate must achieve all the component units of the course, as well as the external assessment. External assessment will provide the basis for grading attainment in the course award.

When units are taken as component parts of a course, candidates will have the opportunity to demonstrate achievement beyond that required to attain each of the unit outcomes. This attainment may, where appropriate, be recorded and used to contribute towards course estimates, and to provide evidence for appeals. Additional details are provided, where appropriate, with the exemplar assessment materials.

Further information on the key principles of assessment is provided in the paper *Assessment* (HSDU, 1996) and in *Managing Assessment* (HSDU, 1998).

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

DETAILS OF THE INSTRUMENTS FOR INTERNAL ASSESSMENT

Each unit specification suggests a way of integrating assessment *within* that unit. The following table summarises the suggested integration of assessment for the units within the Information Systems course at Advanced Higher level.[4]

	DATABASE SYSTEMS Outcomes		**INFORMATION SYSTEMS PROJECT** Outcomes			**SYSTEMS ANALYSIS AND DESIGN** Outcomes		
Assessment	1	2	1	2	3	1	2	3
1	✓	✓						
2			✓	✓	✓			
3						✓		
4							✓	✓

Table 1 – Assessment matrix for Information Systems at Advanced Higher level

Note that this table illustrates *internal integration*. It is also possible to combine assessment *between* units. Internal integration provides all the advantages of integration (reduced time for assessment, more holistic activity, etc) while retaining the discrete identity of each unit and affording the inherent benefits of a unitised system.

The above table illustrates how the eight outcomes within the component units can be assessed using four instruments of assessment. Outline details of each instrument of assessment follow.

Assessment 1

This assessment combines both of the outcomes within the Database Systems unit. The assessment would be in the form of an assignment which would involve the candidate in normalising a data source (Outcome 1) and producing a data model for this source (Outcome 2).

Assessment 2

This assessment combines all the outcomes within the Information Systems Project unit. The assessment would be in the form of a project which would involve the candidate in analysing a problem (Outcome 1), implementing an automated solution to that problem (Outcome 2), and evaluating the solution against defined criteria (Outcome 3).

Assessment 3

This assessment is simply the unit assessment for Outcome 1 within the Systems Analysis and Design unit as described within the unit specification and is not further described here.

Assessment 4

This assessment combines Outcomes 2 and 3 from the Systems Analysis and Design unit. The assessment would be in the form of a practical assignment which would involve the candidate in analysing and documenting an existing (manual) information system (Outcome 2) and then designing a computerised model of that system (Outcome 3).

[4] Assuming that the optional unit is *Systems, Analysis and Design*.

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

These outline descriptions give an indication of the type of assessment that could be used to integrate assessment, and thereby reduce the assessment burden on candidates and staff. They are provided for illustration only. Fully developed assessment specifications will be provided as part of the National Assessment Bank.

DETAILS OF THE INSTRUMENTS FOR EXTERNAL ASSESSMENT

External (course) assessment should provide opportunities to demonstrate:

- retention of knowledge, understanding and skills over a longer period of time
- the integration of knowledge, understanding and skills acquired in component 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 Information Systems at Advanced Higher level will consist of two components with weightings as follows:

- coursework 50%
- written examination 50%

Coursework

The coursework component is a project designed to appraise candidates' practical skills developed in the mandatory unit Database Systems. The project will be created as the work of the unit Information Systems Project, and should be produced under controlled conditions. Coursework should involve problem-analysis and design, implementation and evaluation of practical solutions. Candidates must provide evidence relating to these abilities. This should consist of:

- evidence of analysis
- details of the method of solution
- examples of implementation
- an evaluation of the solution

The Information Systems coursework provides an excellent opportunity to bring together the diverse knowledge and skills acquired as part of the component units (such as normalisation, data modelling, project planning and systems design) in the context of a single, coherent assessment activity.

Written examination

Comprising a single paper of 2 hours' duration. The examination will be set and marked by SQA. The paper will be divided into two sections:

- **Section 1** will allow candidates the opportunity to demonstrate retention of the knowledge, understanding and problem solving skills relating to the core units through the use of extended-response questions that sample across the course content
- **Section 2** will be sub-divided to provide questions on each optional unit and will provide candidates with the opportunity to demonstrate the ability to integrate the knowledge, understanding and problem solving skills acquired in the component units; and apply knowledge, understanding and problem solving skills to more complex, or less familiar contexts through the use of extended response questions

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

GRADE DESCRIPTIONS

Success in the course at grades C, B and A will be determined by the sum of performances in both components (coursework and written examination). These performances will be assessed through detailed marking schemes and the resulting mark will be used to grade the candidate's overall performance.

The characteristics of candidates' performance at grade C and at grade A are described below. These descriptions will assist examiners in setting examination papers and will help assessors and moderators in determining a national standard for candidates' coursework. The descriptions relate to the previously stated objectives of external assessment (see above).

GRADE DESCRIPTIONS AT 'C'	GRADE DESCRIPTIONS AT 'A'
• **Retention of knowledge, understanding and skills over a longer period of time**	
Candidates are able to identify and describe *some* facts and concepts to the standard defined within the performance criteria.	Candidates are able to identify and describe *most* facts and concepts to the standard defined within the performance criteria.
Candidates are able to apply their skills in the context of an integrated assessment that encompasses outcomes from more than one unit to the standards defined by the related performance criteria.	Candidates are able to apply their skills in the context of an integrated assessment that encompasses outcomes from more than one unit to standards that *exceed* the related performance criteria.
• **The integration of knowledge, understanding and skills acquired in component units**	
Candidates are able to apply their knowledge and skills in the context of specific units.	Candidates are able to integrate knowledge and understanding acquired *in different component units*.
Candidates are able to apply their skills in the context of a practical coursework which integrates outcomes from more than one unit.	Candidates are able to apply their skills in the context of a practical coursework which integrates outcomes from more than one unit *and skills are comfortably transferred and synthesised.*

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

GRADE DESCRIPTIONS AT 'C'	GRADE DESCRIPTIONS AT 'A'
• **Application of knowledge, understanding and skills in more complex contexts**	
Candidates are able to apply their knowledge and understanding in simple contexts, directly related to the component units.	Candidates are able to apply their knowledge and understanding in contexts that derive from outcomes in more than one unit.
The artefact that results from practical activity meets the standards defined by the associated performance criteria.	The artefact that results from practical activity *exceeds* the standards defined by the associated performance criteria (which may relate to quality or speed).
• **Application of knowledge, understanding and skills in less familiar contexts**	
Candidates are able to apply their knowledge and understanding in familiar contexts.	Candidates are able to apply their knowledge and understanding in less familiar contexts.
Candidates are able to carry out defined tasks to the standards defined in the associated performance criteria.	Candidates are able to resolve non-routine problems that arise during their practical activity.

Table 2 – Grade descriptions for Information Systems course at Advanced Higher level

Relationship of the course to the component units

The course consists of three component units, plus an additional 40 hours of study. An external examination tests candidates' knowledge and understanding of the content covered in all three units and their ability to demonstrate and to integrate skills acquired throughout the course.

The criteria for a grade C in this course closely reflect the level of competence required for success in the component units. However, the external assessment of the course makes specific additional demands on the candidates.

The following table summarises the course in the form of a (brief) syllabus and relates each topic to a component unit. The topics were previously described in the course contents section.

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

	Component unit(s)	Outcome(s)
Database systems Candidates should be able to:		
• normalise a data source to third normal form • produce a logical data model for a normalised data source	Database Systems Database Systems	1 2
Contemporary information systems Candidates should be able to:		
• demonstrate an analytical approach to project planning • implement a solution to a problem • evaluate completed work in the form of a project report	Information Systems Project Information Systems Project Information Systems Project	1 2 3
Candidates should select one topic from the following: **Contemporary information systems: multimedia** Candidates should be able to:		
• design a multimedia product • plan the production of a multimedia product • implement the product design as permitted by the timescale • evaluate the multimedia product	Multimedia Multimedia Multimedia Multimedia	1 2 3 4
Contemporary developments in information systems Candidates should be able to:		
• outline the motivation for natural language processing and the context within which it is carried out • analyse natural language in respect of the levels of processing and knowledge required for analysis • apply and evaluate parsing and generation techniques with respect to example sentences • describe further techniques that are used in natural language processing	Natural Language Processing Natural Language Processing Natural Language Processing Natural Language Processing	1 2 3 4

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

	Component unit(s)	Outcome(s)
Attributes of information: information organisation Candidates should be able to:		
• describe the stages of the systems analysis and design cycle	Systems Analysis and Design	1
• analyse and document a simple manual information system	Systems Analysis and Design	2
• design a simple computerised information system	Systems Analysis and Design	3

Table 3 – Course summary for Information Systems at Advanced Higher level

APPROACHES TO LEARNING AND TEACHING

Advice on the delivery of each component unit is given within the support notes section of each unit specification. The Subject Guide provides generic advice applicable to all computing-related courses and units. This section provides further guidance on learning and teaching in a course context. In addition to the unit and course documentation and the Subject Guide, support materials will be provided to assist teachers/lecturers in their delivery of courses and units.

In designing the Information Systems courses, a number of topics were identified as important at various levels within the framework of provision. These multi-level topics relate to the following areas:

- database systems
- computer applications
- attributes of information
- contemporary information systems (such as the Internet and multimedia)
- contemporary developments
- social, ethical and legal implications

Each of these topics appears in various units at various levels. For example, database systems appear within the Information Systems courses at every level. The identification of these themes permits the teacher/lecturer to take a more holistic approach when discussing any of these topics so that knowledge and skills gained as part of one unit can contribute to another (at the same level or another level). The following table illustrates how these topics are distributed between units within the Advanced Higher course.

National Course Specification: course details (cont)

COURSE Information Systems (Advanced Higher)

INTEGRATIVE TOPIC	DATABASE SYSTEMS	INFORMATION SYSTEMS PROJECT	MULTI-MEDIA	NATURAL LANGUAGE PROCESSING	SYSTEMS ANALYSIS and DESIGN
Computer applications	✓	✓	✓		
Information attributes	✓	✓	✓	✓	✓
Database systems	✓	✓			✓
Contemporary systems			✓	✓	
Contemporary developments				✓	
Implications					

Table 4 – Integration of learning and teaching within the Information Systems course at Advanced Higher level

The above table illustrates that information attributes feature in several units within this course and this realisation can help teachers/lecturers deliver this topic in an integrated manner.

Each unit specification has a section on learning and teaching and this, together with the above advice on learning and teaching in a course context, should assist teachers/lecturers in delivering the component units. This material will be produced in paper and digital format and made freely available to schools and colleges. These topics also appear within Information Systems courses at other levels. An integrated approach to topics within (and between) Information Systems courses will help to ensure efficient and effective teaching and learning. The table illustrates that candidates can acquire knowledge and skills in a holistic manner rather than from teaching on an outcome by outcome (or even unit by unit) basis. The identification of these integrative topics will help teachers/lecturers deliver the necessary knowledge and skills in a 'natural' manner.

An important objective of the course is to stimulate candidates' interest in, and enjoyment of, information technology. Candidates (and teachers/lecturers) have a great deal of freedom within this course to select topics of personal interest. For example, the Information Systems Project unit can be related to an area of personal interest; the Database Systems unit can focus on familiar data; and the Systems Analysis and Design unit can be related to an information system that the candidate has chosen to explore. The cumulative effect is a tailored course which reflects the candidates' personal interests or vocational objectives.

A variety of support materials will be produced to assist teachers/lecturers in their delivery of the component units and exemplar assessment materials will be provided as part of a National Assessment Bank. A wide range of learning media is available to assist teachers/lecturers in delivering computing-related topics. These materials are available in a variety of formats (such as videotape and CD ROM). The Internet is a rich source of learning and teaching materials for Information Systems courses. An important part of candidates' learning is the acquisition and development of a technical vocabulary and a glossary to define the meaning of the terms used within this documentation will be provided in due course.

Each unit specification has a section on learning and teaching and this, together with the above advice on learning and teaching in a course context, should assist teachers/lecturers and lecturers in delivering the component units. Further details on learning and teaching are provided in the Subject Guide that provides additional information on the delivery of Information Systems courses and units.

Use of the additional 40 hours

The course allows 40 hours of additional flexible time. Appropriate activities that could be undertaken might include:

- preparing for external assessment
- remediation and re-assessment
- consolidation of learning
- formative assessment
- preparation of practical coursework for course assessment
- extending the range of study
- developing study skills
- visits

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 and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SUBJECT GUIDES

A Subject Guide to accompany the Arrangements documents has been produced by the Higher Still Development Unit (HSDU) in partnership with the Scottish Consultative Council on the Curriculum (SCCC) and Scottish Further Education Unit (SFEU). The Guide provides further advice and information about:

- support materials for each course
- learning and teaching approaches in addition to the information provided in the Arrangements document
- assessment
- ensuring appropriate access for candidates with special educational needs

The Subject Guide is intended to support the information contained in the Arrangements document. The SQA Arrangements documents contain the standards against which candidates are assessed.

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Database Systems (Advanced Higher)

NUMBER D299 13

COURSE Information Systems (Advanced Higher)

SUMMARY

This unit is designed to further develop candidates' knowledge and understanding of data analysis and structuring techniques.

OUTCOMES

1 Normalise a data source to third normal form.
2 Produce a data model for a normalised data source.

RECOMMENDED ENTRY

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

- Database Systems (Higher) unit
- Information Systems course at Higher level
- equivalent

CREDIT VALUE

0.5 credit at Advanced Higher.

Administrative Information

Superclass: CD

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

UNIT Database Systems (Advanced Higher)

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Database Systems (Advanced 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

Normalise a data source to third normal form.

Performance criteria

(a) The data source is correctly represented in unnormalised form.
(b) Repeating groups of data items are removed to new entities.
(c) Data items which are only partially dependent on entity keys are removed to new entities.
(d) Data items which are not directly dependent on entity keys are removed to new entities.
(e) Unique keys are correctly chosen for each entity.

Note on range for the outcome

There are no specific requirements as to the range of contexts within which the outcome and performance criteria should be demonstrated. For further guidance on the range of content to be covered, see support notes.

Evidence requirements

Performance evidence that the candidate can normalise a data source to third normal form as detailed in PCs (a) to (e). This should be provided by a record of the normalisation process showing unnormalised, first normal, second normal and third normal forms of a data source involving at least ten data items and five entities.

OUTCOME 2

Produce a data model for a normalised data source.

Performance criteria

(a) Appropriate names are chosen for all entities and data items.
(b) A data dictionary is correctly compiled.
(c) All events associated with the data source are correctly identified.
(d) An entity/event matrix is accurately constructed.
(e) Entity life history diagrams accurately represent the effect of all events.

Note on range for the outcome

There are no specific requirements as to the range of contexts within which the outcome and performance criteria should be demonstrated. For further guidance on the range of content to be covered, see support notes.

National Unit Specification: statement of standards (cont)

UNIT Database Systems (Advanced Higher)

Evidence requirements

Performance evidence that the candidate can produce a data model for a data source involving at least five entities normalised to third normal form as detailed in the performance criteria. This should be provided by a data dictionary for PCs (a) and (b); an entity/event matrix for PCs (c) and (d); and entity life histories for PCs (c) and (e).

National Unit Specification: support notes

UNIT Database Systems (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

This unit may be delivered as a stand-alone unit or in combination with other units as part of the Information Systems course at Advanced Higher level. The details of content given earlier provide information on the delivery and assessment of this unit within the context of a coherent course.

Corresponding to Outcomes 1 and 2

This unit is the last in a series of units relating to database systems (corresponding units exist at Intermediate 2 and Higher levels).

This unit deals with the analysis of an existing data source as a precursor to the design and implementation of a computer-based system. The importance of this as a total process is critical – it is what distinguishes competent and efficient use of database software from casual use of a computer application package.

The terminology used in the performance criteria and *Note on the range for the outcomes* is generic and should be interpreted as follows: a 'data structure' is composed of 'entities' (which can be implemented as files or tables) which, in turn, contain groups of 'data items' (often referred to as fields) in records.

There are a number of different conventions as to the form which the products of this unit should take. Examples based on Version 4 of SSADM (Structured Systems Analysis and Design Methodology) are given at appropriate points below. These are intended only to provide guidance on the level of content and are not intended to be prescriptive – any other convention may be chosen for use.

Outcome 1

This outcome deals with the formal process of data normalisation to third normal form, and the performance criteria cover the stages in this process.

PC (a) relates to the first stage of the process: representation of the data source in unnormalised form (UNF).

PC (b) relates to the first normal form (1NF) from which repeating groups have been eliminated.

PC (c) relates to the second normal form (2NF) from which partial and transitive dependencies have been eliminated.

PC (d) relates to the third normal form (3NF) which is defined by the following rules:

1 there is only one value which each data item in a 3NF entity can have for a given value of the key(s); and
2 the value of each data item in a 3NF entity is directly and wholly dependent on the key(s).

PC (e) relates to all of the above stages.

Example of presentation of normalisation (based on an invoice as the data source):

UNF	1NF	2NF	3NF
Customer Number	Customer Number	Customer Number	Customer Number
Customer Name	Customer Name	Customer Name	Customer Name
Customer Address	Customer Address	Customer Address	Customer Address
Customer Tel No	Customer Tel No	Customer Tel No	Customer Tel No
Invoice Number			
Invoice Date	Customer Number	Invoice Number	Invoice Number
Stock Code	Invoice Number	Customer Number	*Customer Number
Stock Description	Invoice Date	Invoice Date	Invoice Date
Quantity	Stock Code	Stock Code	Invoice Total
Price	Stock Description	Stock Description	*Dept. Number
Invoice Total	Quantity	Quantity	
Dept Number	Price	Price	Invoice Number
Dept Name	Invoice Total	Invoice Total	Stock Code
	Dept Number	Dept Number	Quantity
	Dept Name	Dept Name	Price
			Stock Code
			Stock Description
			Dept Number
			Dept Name

Keys are shown underlined in the above example, data items which are keys in other entities are marked by an asterisk(*).

Outcome 2

This outcome completes the process of analysing a data source begun by the normalisation described in Outcome 1.

PCs (a) and (b) are concerned with the compilation of a data dictionary describing the normalised data source. The data dictionary should include the following items: entity name, item name, description and characteristics (type/size, range, required/optional, key). Guidance should be provided as to the suitable naming of data items (the parallels with high-level language programming can be drawn). This should include naming conventions and the use of meaningful names.

National Unit Specification: support notes (cont)

UNIT Database Systems (Advanced Higher)

An **extract** from a data dictionary is shown below:

ITEM	ENTITY	DESCRIPTION	TYPE/SIZE	RANGE OR VALIDATION	REQ'D	KEY
Cust_name	Customer file	Customer name	Alpha (30)		Y	N
Cust_no	Customer file	Customer number	Alpha (6)		Y	Y
… (etc)						
Invh_Cust_No	Invoice header file	Customer number	Alpha (6)	Existing Cust_no	Y	*
Invh_Date	Invoice header file	Invoice date	Date		Y	N
Invh_No	Invoice header file	Invoice number	Alpha (6)	X?????	Y	Y

PC (c) relates to the events which are associated with the data source.

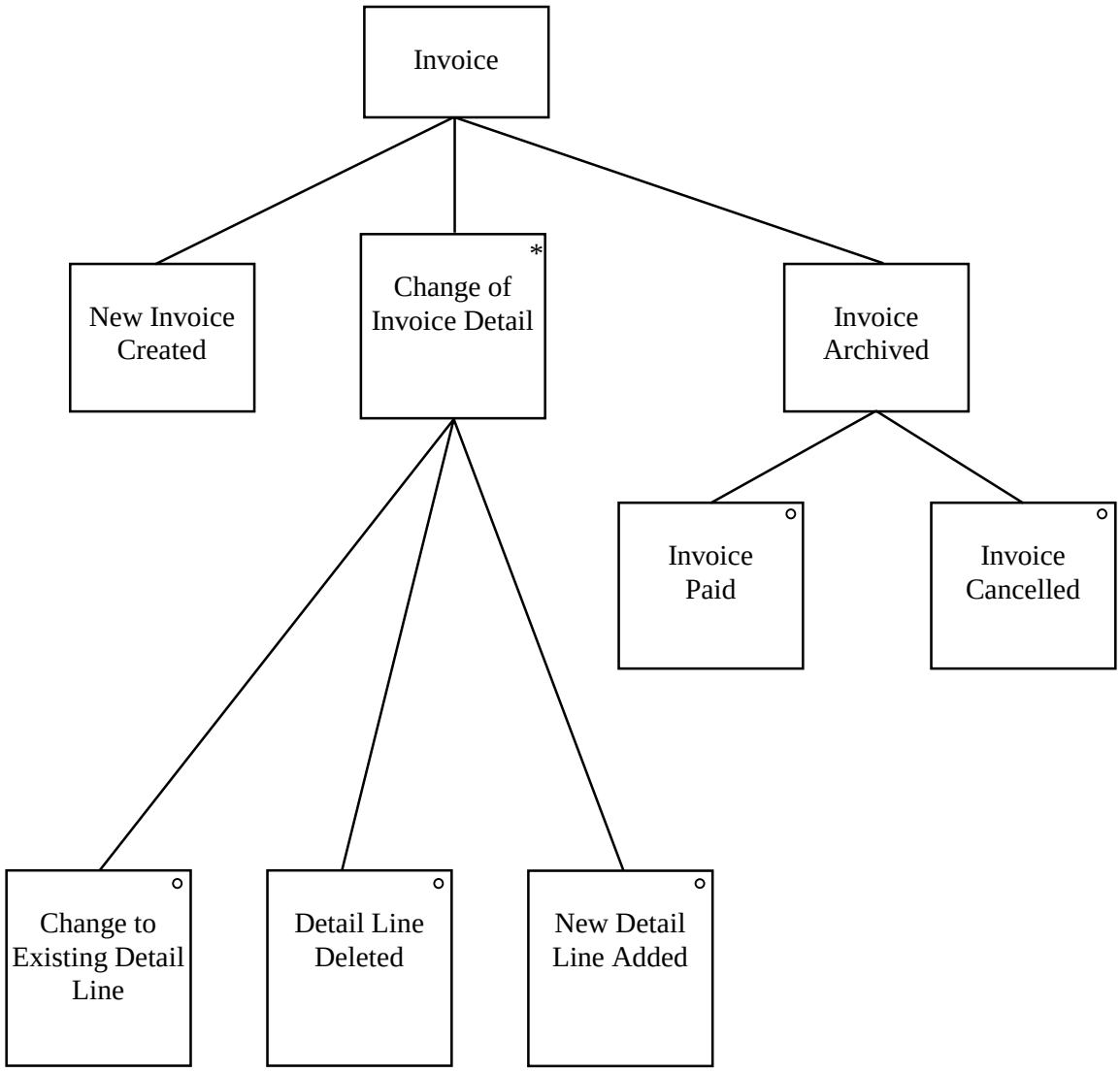
In the invoice example shown above, the events include such things as: invoice creation, invoice amendment, gaining a new customer, stock item deletion and closure of a shop.

PCs (d) and (e) deal with ways of representing the interaction of events and entities. **Part** of an entity/event matrix is shown below:

	CUSTOMER	INVOICE HEADER	INVOICE DETAIL	STOCK	DEPTS.
New Customer	C				
Create Invoice	R	C	C	R	R
Amend Invoice Line	R	M	M	R	
Add Invoice Line	R	M	C		
Delete Stock Item				D	
… (etc)					

Key: C create, D delete, M modify, R read.

An example of an entity life history is shown below:



Sequence is from left to right; * iteration, ° selection.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

A candidate-centred, resource-based learning approach is recommended. While the distribution of time between the outcomes will vary, candidates might be expected to complete each outcome within the following timescale:

Outcome 1 ..... 6 hours
Outcome 2 ..... 14 hours

National Unit Specification: support notes (cont)

UNIT Database Systems (Advanced Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres may use the instruments of assessment which are considered to be most appropriate. Examples of instruments of assessment which could be used are as follows:

Outcome 1 Assignment involving the candidate in normalising a data source to third normal form.

Outcome 2 Assignment involving the candidate in producing a data model of a normalised data source.

During the work of the unit, candidates should have several opportunities to develop their practical skills, and should be assessed at appropriate points. Terminology should be presented in context throughout the module. Where the candidate is unsuccessful in achieving an outcome, provision should be made for additional support and re-assessment.

The two assessments shown could sensibly be treated as components of a single, integrated assessment, taking the form of a case study, which starts with normalisation of a data source and concludes with the production of a logical data model of that source.

Where this unit is delivered as part of the Advanced Higher Information Systems course, assessment of the outcomes could be integrated with assessment of the unit entitled Information Systems Project (AH).

Written evidence may take various forms including handwriting and word processed text or other forms of written communication that are more suited to candidates with physical disabilities.

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 alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Information Systems Project (Advanced Higher)

NUMBER D306 13

COURSE Information Systems (Advanced Higher)

SUMMARY

This unit develops the ability to analyse an information systems problem and to design, implement and document a computer-based solution.

OUTCOMES

1 Demonstrate an analytical approach to project planning.
2 Implement a solution to a problem.
3 Evaluate completed work in the form of a project report.

RECOMMENDED ENTRY

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

- Information Systems course at Higher level
- equivalent

CREDIT VALUE

1.5 credits at Advanced Higher.

Administrative Information

Superclass: CY

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

UNIT Information Systems Project (Advanced Higher)

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	Problem Solving	H
Core skills components for the unit	None	

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Information Systems Project (Advanced 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 an analytical approach to project planning.

Performance criteria

(a) Main stages of the analytical approach are accurately identified.
(b) Project proposal is clear and concise.
(c) Project specification is clear and accurate.
(d) Selected strategy is appropriate to the nature of the problem.
(e) Design of the solution is clear and complete.

Note on range for the outcome

There are no specific requirements as to the range of contexts within which the outcomes and performance criteria should be demonstrated. For further guidance on the range of content to be covered, see the support notes.

Evidence requirements

Written or oral evidence that the candidate can demonstrate an analytical approach to an information systems problem as detailed in PCs (a) to (e).

OUTCOME 2

Implement a solution to a problem.

Performance criteria

(a) Hardware, software and information resources are used efficiently and effectively.
(b) Implemented solution adheres closely to the design.
(c) The solution is tested systematically using appropriate test data.

Note on range for the outcome

There are no specific requirements as to the range of contexts within which the outcomes and performance criteria should be demonstrated. For further guidance on the range of content to be covered, see support notes.

Evidence requirements

Performance evidence that the candidate can implement a solution as detailed in PCs (a) to (c).

National Unit Specification: statement of standards (cont)

UNIT Information Systems Project (Advanced Higher)

OUTCOME 3

Evaluate completed work in the form of a project report.

Performance criteria

(a) Report is clear, concise and coherent.
(b) The solution is documented accurately, using appropriate vocabulary.
(c) Actual achievement is appraised against original objectives set.
(d) Requirements for further development work are established.

Note on range for the outcome

There are no specific requirements as to the range of contexts within which the outcomes and performance criteria should be demonstrated. For further guidance on the range of content to be covered, see support notes.

Evidence requirements

Written evidence that the candidate can evaluate completed work in the form of a project report as specified by PCs (a) to (d).

National Unit Specification: support notes

UNIT Information Systems Project (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 60 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

This unit may be delivered as a stand-alone unit or in combination with other units as part of the Information Systems course at Advanced Higher level. The details of content given earlier provide information on the delivery and assessment of this unit within the context of a coherent course.

Corresponding to Outcomes 1 to 3

The unit outcomes relate to planning, implementation and evaluation. It is important that the implementation aspect should not be emphasised at the expense of the other two. Candidates should be aware of the importance of systematic project planning and the need for rigorous review of the completed product.

This unit has little taught content. It is assumed that candidates will bring any prerequisite knowledge and skills from their previous study and that they will be able to identify sources of information accurately and communicate information efficiently. Knowledge and understanding of the project topic should be communicated in the project report. Candidates should be able to describe technical concepts using appropriate vocabulary and explain the relevance of information systems concepts to the problem being solved.

Outcome 1

This outcome relates to demonstrating an analytical approach to project planning. The main stages of the analytical approach should be identified accurately. The candidate should be able to analyse a problem specification and identify each of the main stages, with regard to planning, implementation, testing and reporting. The candidate should be able to produce a timetable, allocating a suitable amount of time to each of the stages identified above, and identifying key dates for each stage.

The project proposal should be clear and concise. The candidate should be able to identify a suitable problem and prepare a project proposal. The candidate should be able to negotiate the terms of the project in a mature manner.

The project specification should be clear and accurate. The candidate should be able to produce a project specification that fully describes the problem being investigated and agree this with the project sponsor. The candidate should be able to define the boundaries of the problem and describe the requirements of the system in terms of inputs, processes, outputs and performance.

The selected strategy should be appropriate to the nature of the problem. The candidate should be able to analyse a project specification and identify possible strategies for the solution of the problem. The candidate should be able to investigate the feasibility of alternative strategies, and select and justify a strategy for the solution of the problem.

The design of the solution should be clear and complete. The candidate should be able to identify suitable hardware, software and information resources. The candidate should be able to describe fully the design of the solution using an appropriate medium and design appropriate criteria against which to evaluate the solution.

Outcome 2

This outcome relates to implementing a solution to a problem. Hardware and software should be used efficiently and effectively. The candidate should be able to use hardware and software independently and resolve difficulties by reference to technical documentation.

The implemented solution should adhere closely to the design. The candidate should be able to implement systematically the system design and explain any differences between the design and the solution.

The solution should be tested systematically using appropriate test data. The candidate should be able to design a suitable strategy for testing, and choose and justify appropriate test data.

Outcome 3

This outcome relates to evaluating the completed work in the form of a project report. The report should be clear, concise and coherent. It should conform to any standards of presentation or format issued to the candidate.

The solution should be documented accurately, using appropriate vocabulary. The candidate should be able to document a solution both internally (where appropriate) and externally. The candidate should be able to produce (as appropriate): technical documentation, user guide, release notes and tutorial information.

The actual achievement should be appraised against the original objectives set. The candidate should be able to give a clear explanation of why any original objectives were not met.

Requirements for further development work should be established. This may include additional work required to meet the original objectives or further work which could extend the original objectives.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

A candidate-centred, resource-based learning approach is recommended. To enliven learning, the use of video, audio and multimedia learning aids is recommended.

While the distribution of time between the outcomes will vary, candidates might be expected to complete each outcome within the following timescale:

Outcome 1 ..... 10 hours
Outcome 2 ..... 20 hours
Outcome 3 ..... 10 hours

National Unit Specification: support notes (cont)

UNIT Information Systems Project (Advanced Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres may use the instruments of assessment which are considered to be most appropriate. Examples of instruments of assessment which could be used are as follows:

Outcomes 1 to 3 — A single project covering all outcomes and performance criteria. This project should be sufficiently complex to allow all performance criteria to be met, but simple enough to be completed within the duration of the unit. The project topic will be an information system which builds on the knowledge and skills developed in the mandatory unit Database Systems. Suitable projects might be based on a membership database, or a stock database or similar.

During the work of the unit, candidates should have several opportunities to develop their practical skills and should be assessed at appropriate points. Terminology should be presented in context throughout the unit. Where the candidate is unsuccessful in achieving an outcome, provision should be made for additional support and re-assessment.

Written evidence may take various forms including handwriting and word processed text; or other forms of written communication that are more suited to candidates with physical disabilities.

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 alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Multimedia (Advanced Higher)

NUMBER D301 13

COURSE Information Systems (Advanced Higher)

SUMMARY

This unit is designed to provide candidates with the knowledge and skills required to design and construct a multimedia product.

OUTCOMES

1 Design a multimedia product.
2 Plan the production of a multimedia product.
3 Implement the product design as permitted by the timescale.
4 Evaluate the multimedia product.

RECOMMENDED ENTRY

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

- Hypermedia (H) unit
- Multimedia Technology (H) unit
- Software Development (H) unit
- Information Systems course at Higher level
- equivalent

Administrative Information

Superclass: CE

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

UNIT Multimedia (Advanced Higher)

CREDIT VALUE

1 credit at Advanced Higher.

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Multimedia (Advanced 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

Design a multimedia product.

Performance criteria

(a) A suitable product is identified.
(b) An appropriate target audience is identified.
(c) The content of the product is accurately defined.
(d) The structure of the product is clearly defined.
(e) The design is consistent with the target medium.

Note on range for the outcome

Content: text; graphics; audio.
Structure: modular; standard structural features.

Evidence requirements

Written evidence that the candidate can design a multimedia product as detailed in PCs (a) to (e) across all classes in the range.

OUTCOME 2

Plan the production of a multimedia product.

Performance criteria

(a) Select appropriate hardware and software for creating and running the product.
(b) Construct a project plan incorporating realistic timescales.
(c) The media elements are assembled efficiently and effectively.
(d) The product complies with copyright legislation.

Note on range for the outcome

Hardware: input; output; processing; storage.
Software: authoring package; audio software; graphics software.
Media elements: text; graphics; audio.

Evidence requirements

Written evidence that the candidate can plan the production of a multimedia product as detailed in PCs (a) to (d) for all classes in the range.

National Unit Specification: statement of standards (cont)

UNIT Multimedia (Advanced Higher)

OUTCOME 3

Implement the product design as permitted by the timescale.

Performance criteria

(a) Media elements are imported and manipulated correctly.
(b) Hardware and software are used efficiently and effectively.
(c) The solution adheres to design specification.
(d) Problems encountered are successfully resolved.

Note on range for the outcome

Media elements: text; graphics; audio.

Evidence requirements

Performance evidence that the candidate can implement the product design as detailed in PCs (a) to (d) for all classes in the range.

OUTCOME 4

Evaluate the multimedia product.

Performance criteria

(a) Implementation of the multimedia product is accurately described.
(b) Actual achievement is appraised against original objectives.
(c) Requirements for further development work are established.
(d) Sources are acknowledged in an appropriate manner.

Note on range for the outcome

There are no specific requirements as to the range of contexts within which the outcomes and performance criteria should be demonstrated. For further guidance on the range of content to be covered, see support notes.

Evidence requirements

Written or oral evidence that the candidate can evaluate the multimedia product as detailed in PCs (a) to (d).

National Unit Specification: support notes

UNIT Multimedia (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

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

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

This unit may be delivered as a stand-alone unit or in combination with other units as part of the Information Systems course at Advanced Higher level. The details of content given earlier provide information on the delivery and assessment of this unit within the context of a coherent course.

This unit is the final one in a series of Multimedia units. Related units exist at Access, Intermediate 1, Intermediate 2 and Higher levels. As such, candidates are expected to possess well developed software skills prior to undertaking this unit.

For the purposes of this unit, the term 'graphics' is taken to include all forms of graphical images including clipart, original drawings, diagrams, graphs and charts, animations and video. Candidates should not be expected to create their own video images, nor create their own animations, but they should be capable of incorporating video images and animations into a multimedia product.

Corresponding to Outcomes 1 to 4

Outcome 1

This outcome relates to the design of a multimedia product. Candidates are expected initially to identify a suitable product. The potential range is enormous, since the only real restriction is that the identified product should be capable of meeting the performance criteria for the unit.

Possible topics might include (but are not confined to): a biography; a current or historical event; a description or review of a film or television programme or a musical or dramatic performance; a tourist guide to an area; a computer-assisted learning package on a specific topic.

The choice is limited only by the imagination of the candidate and the availability of resources to create the product. Candidates should ideally select a topic in which they have a personal interest as this will enhance motivation and may give access to a wider range of content, eg existing collections of sounds, graphics, etc.

Candidates should also identify the target audience for the proposed product. The product should be suitable in terms of content and appropriate to the age of the intended audience.

The content of the proposed product must be accurately defined. Candidates should be able to list all the text, audio clips and graphics which they propose incorporating into their finished product.

Note that it is not necessary for candidates to create the content themselves. They can make use of existing content, subject to legal restrictions. The structure of the product should be clearly defined in terms of its breakdown into modules and its use of 'programming' techniques such as loops and selection. This may usefully be achieved by the use of a graphical technique such as storyboards.

The design of the product must be suitable for the intended medium, eg CD ROM or the World Wide Web.

National Unit Specification: support notes (cont)

UNIT Multimedia (Advanced Higher)

Outcome 2

This outcome relates to planning the production of a multimedia product. Planning should be carried out prior to implementation of the product. Candidates should select appropriate hardware and software for creating and running the project. Choice will obviously be constrained by the hardware and software available to them. This should be of sufficient range and variety to enable a realistic choice to be made.

Hardware related to input includes mice, scanners, keyboards, etc. Hardware related to output includes graphics cards, monitors and printers. Hardware related to processing includes processors and coprocessors. Hardware related to storage includes both internal storage (RAM) and external storage (hard and floppy disks, tapes).

It is not intended that candidates should select products which can only be created or run on high-end hardware or software but there should be an appreciation of the factors involved, eg a product which relies heavily on video might require a machine with a faster processor, more memory and specialised display hardware. Similarly, a product with a sophisticated soundtrack may require the use of a high-end sound card.

The software selected should be suitable for creating a genuinely interactive multimedia product, incorporating user interaction, looping and selection. A straightforward presentation graphics package is unlikely to meet these requirements but most multimedia authoring packages should be suitable.

The candidate should construct a project plan defining tasks according to realistic timescales. This can be done using simple manual planning tools such as Gantt charts, or it can be done using project planning software. However, care should be taken to ensure that time is not spent on learning to use a complex project planning package at the expense of the main outcomes of the unit.

Candidates should assemble the required media elements for their multimedia product. As noted above, it is not necessary that they create these elements themselves. Indeed it is likely to be prohibitively difficult to do so within the available timescale.

Rigorous attention should be paid to copyright and intellectual property issues. Candidates should be aware of the laws relating to the use of copyright material in any commercial product. At the time of writing, the Copyright, Design and Patents Act is the most relevant UK legislation. Wherever possible public domain material (or material where the copyright holder has granted a waiver) should be used. Failing this, copyright holders should be contacted and permission sought to use their material.

National Unit Specification: support notes (cont)

UNIT Multimedia (Advanced Higher)

Outcome 3

This outcome relates to the implementation of the product design using an authoring package. No restriction is placed on the type of authoring package to be used, other than the fact that it must be capable of meeting the performance criteria. A very simple authoring package which did not permit looping, branching or user interaction would not be suitable. In particular, it is accepted that the unit may be delivered using either an icon-based or script-based authoring package and that system commands and control structures may be used either by the issuing of explicit commands or the selection of appropriate icons. A tag-based language such as HTML could also be used, although it may be necessary to use extensions (eg CGI scripts, Java) to meet all performance criteria.

The chosen package should be capable of setting the properties of objects (eg colour, size, shape and position of buttons) and of manipulating objects appropriately (eg dragging, dropping, resizing, etc). It should also be capable of handling external events such as mouse movement or clicks and keyboard events, such as entering text or pressing a particular key.

Outcome 4

This outcome relates to the evaluation of the completed multimedia product. The candidate should describe the implementation of the multimedia product, highlighting any problems or difficulties encountered and the steps taken to resolve these. Actual achievement should be appraised against the original objectives set at the planning stage.

Note that it is not necessary for the candidate to achieve all of the original objectives in order to obtain a pass in the unit. However, it is necessary to achieve a sufficient proportion to demonstrate that all necessary performance criteria have been met.

In practice, it is likely that many products will only be partially implemented. This is acceptable as long as all relevant performance criteria are met. The candidate is expected to identify additional work which could be carried out to complete or extend the product, as appropriate. All sources should be acknowledged in an appropriate manner.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

A candidate-centred, resource-based learning approach is recommended. While the distribution of time between the outcomes will vary, candidates might be expected to complete each outcome within the following timescale:

Outcome 1 ..... 5 hours
Outcome 2 ..... 10 hours
Outcome 3 ..... 20 hours
Outcome 4 ..... 5 hours

National Unit Specification: support notes (cont)

UNIT Multimedia (Advanced Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres may use the instruments of assessment which are considered to be most appropriate. Examples of instruments of assessment which could be used are as follows:

Outcome 1 A project specification detailing the audience, aim and content of the design and a structure chart showing the relationship between modules.

Outcome 2 A project proposal document incorporating hardware and software specifications, budget, project plan and media elements.

Outcome 3 An assignment involving the creation of a multimedia product which incorporates a relevant range of media elements and makes appropriate use of control structures.

Outcome 4 An evaluation report describing the implementation of the product, appraising achievement against objectives set, establishing requirements for further development work and acknowledging sources.

During the work of the unit, candidates should have several opportunities to develop their practical skills and should be assessed at appropriate points. Terminology should be presented in context throughout the unit. Where the candidate is unsuccessful in achieving an outcome, provision should be made for additional support and re-assessment. There are opportunities to integrate assessment within this unit.

Written evidence may take various forms including handwriting and word processed text; or other forms of written communication that are more suited to candidates with physical disabilities.

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 alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Natural Language Processing (Advanced Higher)

NUMBER D307 13

COURSE Information Systems (Advanced Higher)

SUMMARY

This unit is designed to provide candidates with the knowledge and skills required to apply and evaluate natural language processing techniques with respect to specific problems.

OUTCOMES

1 Outline the motivation for natural language processing and the context within which it is carried out.
2 Analyse natural language in respect of the levels of processing and knowledge required for analysis.
3 Apply and evaluate parsing and generation techniques with respect to example sentences.
4 Describe further techniques that are used in natural language processing.

RECOMMENDED ENTRY

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

- Expert Systems (H) unit
- Information Systems course at Higher level

Administrative Information

Superclass: CB

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

UNIT Natural Language Processing (Advanced Higher)

CREDIT VALUE

1 credit at Advanced Higher.

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Natural Language Processing (Advanced 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

Outline the motivation for natural language processing and the context within which it is carried out.

Performance criteria

(a) The nature and role of natural language are accurately explained.
(b) The goals for the development of natural language processing are correctly described with respect to human systems and communicating systems.
(c) Potential application areas for natural language processing are correctly described.
(d) The relationship of natural language processing to other artificial intelligence fields and other disciplines is accurately explained.

Note on range for the outcome

Applications: machine translation; text retrieval and question answering; command and control; text analysis; intelligent tutoring systems.

Evidence requirements

Written or oral evidence that the candidate can describe the motivation for natural language processing as detailed in PCs (a) to (d) for all classes in the range.

OUTCOME 2

Analyse natural language in respect of the levels of processing and knowledge required for analysis.

Performance criteria

(a) The processes involved in language comprehension and production are correctly described in terms of levels of structure.
(b) Words are classified into their appropriate types.
(c) Different forms of ambiguity in natural language are correctly defined and exemplified.
(d) Sequences of sentences are analysed in respect of the knowledge required for understanding and disambiguation in relation to the levels of processing.

Note on range for the outcome

Levels: phonology; morphology; syntax; semantics; pragmatics.
Word classes: nouns; verbs; adjectives; adverbs; determiners; prepositions; conjunctions.
Forms of ambiguity: structural ambiguity; form class ambiguity; word sense ambiguity; referential ambiguity.

Evidence requirements

Written or oral evidence that the candidate can analyse natural language as detailed in PCs (a) to (d) for all classes in the range.

National Unit Specification: statement of standards (cont)

UNIT Natural Language Processing (Advanced Higher)

OUTCOME 3

Apply and evaluate parsing and generation techniques with respect to example sentences.

Performance criteria

(a) A simple formal grammar for a subset of a natural language is specified.
(b) Alternative parsing strategies are correctly exemplified with suitable representations.
(c) Exemplar sentences are parsed and represented correctly with respect to this simple grammar and alternative parsing strategies using suitable software are demonstrated.
(d) The coverage of the grammar is correctly specified and demonstrated through testing with the software.
(e) The testing of the coverage of the grammar is methodical and extensive.

Note on range for the outcome

Grammars: phrase structure grammars with variables; parsing; accepting; generating; number agreement; gender agreement.
Structures: noun phrases; verb phrases; prepositional phrases; adjectival phrases; transitive verbs; intransitive verbs.
Parsing strategies: top-down; bottom-up; depth first; breadth first.

Evidence requirements

Written or oral evidence that the candidate can specify and exemplify the representation and processing techniques as detailed in PCs (a) to (c) for all classes in the range.

Performance evidence that the candidate can demonstrate the use of software and test the outcome as detailed in PCs (c), (d) and (e).

National Unit Specification: statement of standards (cont)

UNIT Natural Language Processing (Advanced Higher)

OUTCOME 4

Describe further techniques that are used in natural language processing.

Performance criteria

(a) Alternative natural language processing techniques are correctly described.
(b) The examples of natural language processing techniques are illustrated through reference to an appropriate application area.
(c) The techniques are demonstrated through application to a suitable problem using relevant software.

Note on range for the outcome

Techniques: key phrase matching; finite state automata; templates; representations using logic.

Evidence requirements

Written or oral evidence that the candidate can exemplify the techniques as detailed in PC (a) for all classes in the range.

Written or oral evidence that the candidate can illustrate one technique applied to an application area as detailed in PC (b).

Performance evidence that the candidate can demonstrate one example as detailed in PC (c).

National Unit Specification: support notes

UNIT Natural Language Processing (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

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

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

This unit may be delivered as a stand-alone unit or in combination with other units as part of the Information Systems course at Advanced Higher level. The course specification provides additional details regarding the delivery and assessment of this unit within a course context.

Corresponding to Outcomes 1 to 4

For the purposes of this unit, 'natural language' is taken to mean any human language that arises naturally. English will be assumed as the most familiar example of this, though other languages could also be considered. Natural Language Processing addresses both production and comprehension of language, usually in the form of text. The additional problems of processing speech are not addressed in this module, except in so far as phonology is taken as the lowest level of processing, with the representation of phonemes for conversion into graphemes (to construct lexical items or words).

Candidates should not be expected to write computer programs for processing natural language but should be able to supply them with appropriate representations, supporting analysis and exploration of aspects of language.

Outcome 1

a) Natural languages (those that arise naturally, such as English, Chinese, Arabic) should be distinguished from invented languages (such as computer languages, logics and other formal languages). Candidates should be aware of the important function of natural language in human communication, and that language is taken as a sign of intelligence. They should also understand the differences between natural language and other forms of communication (such as sign language and non-human communication), and different modalities (speech versus writing). They should be aware of the ambiguity, complexity and scale of natural language, and the necessity for large amounts of knowledge of different kinds in order to describe it.

b) Artificial Intelligence (AI) has an interest in natural language for two primary reasons. One reason is to provide communicating systems that are able to use natural language. The second reason is to help in the understanding of human systems. AI researchers study natural language in order to provide systems that perform well and are able to communicate, and they also use computational methods to build models to test theories about natural language.

c) Potential application areas:

   i Machine translation: translation of texts, especially Russian-English, Japanese-English and vice-versa. A very difficult problem – thought initially to be easier.

   ii Text retrieval and question answering: interpretation of what information is required by a user, for example, identification of documents in a library search. Generating answers to specific questions based on a database of stored information. A lot of current work on 'interfaces' and 'front-ends' to database systems.

iii Command and control: natural language interaction with devices; speech rather than typing. A lot of work in defence-related areas in the USA, but also work on aids for the physically handicapped and speech-driven word processing.

iv Text analysis: assessing readability of texts; verifying authorship; scanning newspaper stories.

v Knowledge acquisition: used in conjunction with the development of expert systems as a means of getting knowledge from an expert into the system.

vi AI and education: facilitating the educational dialogue; providing question-answering facilities and interactive systems.

vii Theoretical applications: testing linguistic and psychological theories.

d) Relation to other disciplines, including computer science, psychology, linguistics, and language teaching. Relations to other sub-fields of AI including: robotics, planning and search, vision, expert systems, AI and education, automated reasoning, neural networks, machine learning.

Outcome 2

a) The processes involved in language comprehension and understanding can be described in terms of levels of structure: sounds, words, phrases, sentences. Complex processes such as those involved in speech can be decomposed into simpler ones. Knowledge of language may be thought to be made up of rules for manipulating different levels of structure. In comprehension: a sentence is heard (or read); it is analysed into phonemes (units of sound) such as /f/ /ow/ /n/ ; the phoneme sequence is analysed into morphemes (units of meaning) such as 'phon-' '-ing' '-ed'; a dictionary (lexicon) is used to relate these to words; syntactic rules are used to analyse phrases and sentences; semantic rules are used to get meaning; deductive and inferential rules are used for conclusions and to draw inferences from other knowledge. This is a simplistic model, but it serves to suggest the components needed in designing computer systems and in developing psychological models. Comprehension and production may be thought of as inverse processes operating in opposite directions (this is an oversimplification: there is evidence that comprehension may be simpler than production, for example, in spelling and in learning to speak a second language). Language can be structured and analysed at a number of different levels: phonology, morphology, syntax, semantics, pragmatics. Phonology: the relation between words and sounds. Morphology: the formation of words from their parts, the level of structure internal to the word. Morphology includes 'inflectional morphology' (word forms for different versions of the same underlying word) and 'derivational morphology' (new words from old). Syntax: the structuring of words into sentences in a given language grammar. Semantics: the meaning of words, sentences and utterances. Pragmatics: relation to the real world and real world knowledge, discourse (relation between a number of sentences), dialogue (turntaking between different agents in discourse), the use of language.

b) Candidates are expected to be able to identify the following classes of words: nouns, verbs, adjectives, adverbs, determiners, prepositions and conjunctions. The distinctions between content and function words, and between words of open (content) and closed (function) classes should also be understood.

c) Candidates should be able to describe and identify examples of a number of different types of ambiguity, including structural ambiguity, form class ambiguity, word sense ambiguity and referential ambiguity.

d) A number of sentences and sentence pairs should be analysed to consider: whether there is one possible interpretation of each; what information is used to understand them; at what level problems in interpretation occur; cases where the reader often starts with one interpretation and then needs to change it. Examples:

i *List all the assets of the company that **was** bought by IBM.*
*List all the assets of the company that **were** bought by IBM.*
Whether it was assets that were bought, or the company that was bought is indicated by morphology of was or were – what these words agree with.

ii *Who do you want to fight?*
Structural ambiguity – are you fighting or choosing fighters?

iii *The heiress bought the Rolls Royce crashed it.*
Garden path sentence: 'the heiress (who was) bought the Rolls Royce crashed it' – structural ambiguity.

iv *She wrote down where she lived but I lost it.*
Here, 'it' refers to address – which is assumed from world knowledge.

Outcome 3

a) Candidates should be able to define phrase structure grammar rules for sentences, composed of noun phrases and verb phrases, and to extend this to include proper nouns, adjectival phrases, prepositional phrases, transitive and intransitive verbs. They should also be able to extend the grammar by adding an extra argument which can be used for number and gender agreement.

b) Candidates should be able to parse sentences, representing the outcome of the parse using bracketed text or a tree structure. In analysing the structure of a sentence in relation to a grammar they should understand the difference between:

i recognising (or accepting) – testing if a sentence could be produced by the grammar
ii parsing – testing if a sentence could be produced by this grammar and reconstructing the constituents
iii generating – take the grammar and lexicon and produce a sentence.

They should be able to demonstrate the use of both bottom-up parsing and top-down parsing strategies.

Top-down: decomposes the required structure into constituents (sub-goals), then decomposes these until it gets to terminals and tries to match these to the words input.

Bottom-up: combines words into larger constituents and keeps combining these until all are combined into a single structure.

Candidates should also be able to specify strategies for deciding which part of the text to work on first, for example:

i move systematically through the input (left to right)
ii systematically take chunks of increasing size.

They should be able to choose between depth-first search and breadth-first search.

c) Software such as a parser and generator (for example, written in Prolog incorporating Definite Clause Grammars) should be used to demonstrate and test the grammars defined.

d) Sufficient examples should be used to indicate the range, flexibility and limitations of the grammar. Examples should be generated of successful and unsuccessful parses, and correct and incorrect sentences generated. Further rules or techniques may be suggested by candidates to correct inappropriate outcomes.

e) Candidates should define a set of test sentences for testing their grammars, and clearly document the performance on these sentences. The test set should include sentences likely to be parsed, and those likely to fail also.

Outcome 4

a) Examples of other natural language techniques include key phrase matching (as in ELIZA); transition networks; templates for generating and matching text; the use of logic to represent semantics.

b) One example of a technique applied to an application area should be given: for example, using logic in question answering from a database; key phrase matching in text retrieval; using templates for explanation generation in intelligent tutoring (AI and Education) systems.

c) The demonstration of a technique will depend on the software available. It does not have to refer to the same technique as examined in PC (b).

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

A candidate-centred, resource-based learning approach is recommended. Candidates will require software tools to support Outcomes 3 and 4.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres may use the instruments of assessment which are considered to be most appropriate. Examples of instruments of assessment which could be used are as follows:

Outcome 1	A report detailing the nature and role of natural language, the goals of natural language processing and its relation to other fields, and an outline of potential application areas.
Outcome 2	Written summary of levels with language-related examples of level. Analysis of 15 to 20 example sentences or pairs of sentences, with commentary on type of ambiguity (if any); level of processing and statement of other knowledge needed for processing.

National Unit Specification: support notes (cont)

UNIT Natural Language Processing (Advanced Higher)

Outcome 3 Specification of grammar rules, and lexical items to be used. Specification of a set of test sentences. Report documenting the performance of the program (incorporating the grammar and lexicon) in relation to the test sentences, evaluating the coverage of the grammar and discussion of those test items which fail. Analysis of example sentences to demonstrate each parsing strategy.

Outcome 4 A report outlining each technique, with examples, and with reference to the literature where appropriate. A more detailed account of one technique applied to one application area, illustrated with examples. A short report documenting and evaluating the performance of a program illustrating one or more example techniques.

During the work of the unit, candidates should have several opportunities to develop their practical skills, and should be assessed at appropriate points. Terminology should be presented in context throughout the module. Where the candidate is unsuccessful in achieving an outcome, provision should be made for remediation and re-assessment.

Written evidence may take various forms, including handwriting and word processed text; or other forms of written communication that are more suited to candidates with physical disabilities.

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 alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Systems Analysis and Design (Advanced Higher)

NUMBER D308 13

COURSE Information Systems (Advanced Higher)

SUMMARY

This unit is designed to introduce candidates to the theory and practice of systems analysis and design.

OUTCOMES

1 Describe the stages of the systems analysis and design cycle.
2 Analyse and document a simple manual information system.
3 Design a simple computerised information system.

RECOMMENDED ENTRY

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

- Database Systems (H) unit
- Information Systems course at Higher level
- equivalent

Administrative Information

Superclass: CB

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

UNIT Systems Analysis and Design (Advanced Higher)

CREDIT VALUE

1 credit at Advanced Higher.

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Systems Analysis and Design (Advanced 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

Describe the stages of the systems analysis and design cycle.

Performance criteria

(a) Description of each stage is clear, concise and correct.
(b) Relationships between stages are correctly identified.
(c) Iterative nature of the cycle is clearly described.

Note on range for the outcome

Stages: analysis; design; implementation; testing; maintenance.

Evidence requirements

Written or oral evidence that the candidate can describe the systems analysis and design cycle as detailed in PCs (a) to (c) for all classes in the range.

OUTCOME 2

Analyse and document a simple manual information system.

Performance criteria

(a) Major components are accurately identified.
(b) Information flows between major sub-systems are accurately identified.
(c) Information is assembled and recorded correctly.
(d) User requirements are accurately identified.

Note on range for the outcome

Components: sources; destinations; stores; processes; sub-systems; data flows.

Evidence requirements

Written or oral evidence that the candidate can analyse and document a simple manual information system as detailed in PCs (a) to (c) for all classes in the range.

National Unit Specification: statement of standards (cont)

UNIT Systems Analysis and Design (Advanced Higher)

OUTCOME 3

Design a simple computerised information system.

Performance criteria

(a) System specification meets user requirements.
(b) File structures are accurately defined.
(c) Data flows are efficient and effective.

Note on range for the outcome

System specification: system outline, data flow diagrams, data dictionary.
File structures: file size, fields, field size, field type, keys.

Evidence requirements

Written or oral evidence that the candidate can design a simple computerised information system as detailed in PCs (a) to (c) for all classes in the range.

National Unit Specification: support notes

UNIT Systems Analysis and Design (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

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

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

This unit may be delivered as a stand-alone unit or in combination with other units as part of the Information Systems course at Advanced Higher level. The details of content given earlier provide information on the delivery and assessment of this unit within the context of a coherent course.

This unit is intended to introduce the candidate to the theory and practice of systems analysis and design. Whilst it is anticipated that the majority of systems investigated will be in the business area, thought should be given to extending the range of systems to other vocational areas.

The overall approach should take account of the techniques used in structured methodologies, eg Structured Systems Analysis and Design Methodology (SSADM) or Yourdon Structured Design (YSD), but complete description of any specific methodology is outwith the scope of the unit. In general, the techniques taught should be applicable within any structured methodology, but some aspects (eg diagramming conventions) may be specific to a particular methodology. The principal technique covered is data flow diagrams. In the interests of simplicity the term 'file' is used to cover both 'table' and 'relation'. The terminology used by different methodologies may vary.

Corresponding to Outcomes 1 to 3

Outcome 1

This outcome relates to the stages in the systems analysis and design cycle. The outcome is essentially descriptive, and candidates will not be expected to carry out the tasks referred to at all stages. (Some of the tasks in the analysis and design stages will be carried out during Outcomes 2 and 3.) Candidates should be aware of the principal stages in the analysis and design cycle (analysis, design, implementation, testing, maintenance). Analysis should cover the investigation and recording of the existing (manual) system. Some mention may also be made of the pre-analysis stages, eg terms of reference and feasibility study. Design should include both the logical and physical design of the new (computerised) system. Implementation should cover software development and the changeover to the new system. Testing should cover program testing, system (integration) testing and acceptance testing. Maintenance should include both ad-hoc amendments to deal with undiscovered bugs as well as planned maintenance to cope with changing circumstances within the organisation (eg addition of new product ranges) or the environment (eg changes in tax structure).

Candidates should be able to define the terms *data* (the raw 'facts' gathered); *information* (data with some structure imposed upon it, eg by grouping items together into records and/or by sorting in some order); *system* (a group of procedures which operate together as a coherent whole to carry out a specified task. Systems may be either manual or computerised. A computerised system may incorporate manual elements and will certainly have hardware and software components.); *sub-system* (a constituent part of a system which carries out some clearly defined subtask); *systems analysis* (the process of investigating and recording the operation of an existing system); *system*

specification (a detailed description of the tasks required of a new system); *systems design* (a breakdown of the system specification into logical and physical components); *systems boundary* (the limits of the system); *interface* (the connections between the system and its environment or other related systems, eg the link between an order acceptance system and an invoicing system); *environment* (the area outwith the system boundary); *information flow* (the routes by which information passes between systems or between the system and its environment).

Outcome 2

This outcome relates to the analysis and documentation of a simple manual system. The system to be investigated should be kept as simple as possible and should be familiar to the candidate, eg systems for use in a video rental shop or a record store. Candidates should be aware of a variety of data gathering and recording techniques, eg interviewing, questionnaires, discussion reports. However, it is likely that only one technique will be used to any great extent. Candidates should also be aware of the techniques used to formalise procedure descriptions (eg narrative, structured English, structure diagrams, etc) and be able to use at least one of these.

Outcome 3

This outcome relates to the design of a simple computerised information system. Once again, the system should be kept as simple as possible and should be familiar to the candidate. The candidate should be able to produce a system specification consisting of a system outline (inputs, files, processes and outputs), data flow diagrams, a data dictionary and file structures (showing field size and type). Only first-level data flow diagrams are required. Candidates are not required to normalise files. Where normalised files are required to produce a meaningful system, details of these should be supplied by the teacher/lecturer. These details should consist of a list of the data items to be included in each file. It should be left to the candidate to determine the size and type of each data item.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

A candidate-centred, resource-based learning approach is recommended. To enliven learning, the use of case studies, role-playing, group working, and video, audio and multimedia learning aids is recommended. The approach should encourage integration of theory and practice at all stages.

Candidates may investigate problems in groups. Case studies are particularly useful. These should be based on simple and familiar situations, such as a video library, a record store or a shopping catalogue. Candidates should gather information about the system by interviewing the teacher/lecturer, who acts the role of the user. Wherever relevant, additional information about the system may be supplied to the candidates in written form.

In order to complete the unit within the allocated timescale, simplicity is essential. Wherever possible problems should be sufficiently simple that no normalisation is required. If this is not possible, then details of the normalised files should be supplied to the candidates.

Ideally, teachers/lecturers should have access to two case studies, one for teaching and one for assessment purposes. Materials provided to candidates as part of the teaching case study may be used as exemplars to show the standard expected in assessment.

National Unit Specification: support notes (cont)

UNIT Systems Analysis and Design (Advanced Higher)

While the distribution of time between the outcomes will vary, candidates might be expected to complete each outcome within the following timescale:

Outcome 1 ..... 10 hours
Outcome 2 ..... 15 hours
Outcome 3 ..... 15 hours

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres may use the instruments of assessment which are considered to be most appropriate. Examples of instruments of assessment which could be used are as follows:

Outcome 1	Restricted response questions: the candidate will be presented with a series of restricted response questions relating to the function of each stage and the relationship between the stages.
Outcome 2	Assignment/Case study: the candidate will be asked to investigate and document an existing system.
Outcome 3	Assignment/Case study: the candidate will be asked to produce a design for a new system.

It is recommended that the same case study should be used for assessing Outcomes 2 and 3.

During the work of the unit, candidates should have several opportunities to develop their practical skills and should be assessed at appropriate points. Terminology should be presented in context throughout the module. Where the candidate is unsuccessful in achieving an outcome, provision should be made for additional support and re-assessment. There are opportunities to integrate assessment within this unit.

Written evidence may take various forms including handwriting and word processed text or other forms of written communication that are more suited to candidates with physical disabilities.

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 alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).