

National Unit Specification: general information

UNIT	Expert Systems (Intermediate 2)
NUMBER	DM4H 11
COURSE	Information Systems (Intermediate 2)

SUMMARY

This Unit is designed to develop knowledge and understanding of the principles of expert systems and practical skills related to expert systems through the use of contemporary hardware and software. This knowledge and understanding, and these practical skills, may then be applied by the candidate to solve practical problems related to expert systems. It is designed for candidates undertaking the Intermediate 2 Information Systems Course, but is also suitable for anyone wishing to develop a basic understanding of expert systems. It is also appropriate as an extension for those who have studied Artificial Intelligence at Intermediate 2.

OUTCOMES

1. Demonstrate knowledge and understanding of the basic principles, techniques and applications of expert systems.
2. Demonstrate practical skills by applying knowledge and understanding of the basic principles, techniques and applications of expert systems using contemporary hardware and software.

RECOMMENDED ENTRY

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

- ◆ Intermediate 1 Computing Studies
- ◆ Standard Grade Computing Studies at General level

Administrative Information

Superclass:	CB
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National Unit Specification: general information (cont)

CREDIT VALUE

1 credit at Intermediate 2 (6 SCQF credit points at SCQF level 5).

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

CORE SKILLS

This Unit gives automatic certification of the following:

Core Skill components for the Unit	Critical Thinking	Int 2
	Planning and Organising	Int 2

National Unit Specification: statement of standards

UNIT Expert Systems (Intermediate 2)

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

OUTCOME 1

Demonstrate knowledge and understanding of the basic principles, techniques and applications of expert systems.

Performance Criteria

- a) Basic principles and techniques of expert systems are explained using appropriate terminology.
- b) Descriptions of applications are technically accurate and concise.
- c) Simple conclusions, predictions and generalisations are made from knowledge and understanding.

Evidence Requirements

Written or oral evidence that the candidate can describe, explain and apply the principles, techniques and applications of expert systems. Evidence could be obtained using questions in a closed book test, under supervision, lasting no more than 45 minutes. The test must sample the content (see Information Systems (Intermediate 2) Course Content) in each of the following areas:

- ◆ expert systems in context
- ◆ characteristics of expert systems
- ◆ development, use and evaluation of expert system
- ◆ construction of a working expert system

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

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

National Unit Specification: statement of standards (cont)

UNIT Expert Systems (Intermediate 2)

OUTCOME 2

Demonstrate practical skills by applying knowledge and understanding of the basic principles, techniques and applications of expert systems using contemporary hardware and software.

Performance criteria

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

Evidence Requirements

Observation checklist showing that the candidate has demonstrated practical skills in the following contexts:

- ◆ finding solutions to given problems by consultation of expert systems for advice, classification, diagnosis or planning
- ◆ testing and evaluation of an expert system
- ◆ representation of a limited domain of knowledge in a structured form
- ◆ construction of a working expert system given a limited domain of knowledge

Hard copy evidence should be provided of the expert system constructed.

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

The practical skills should be demonstrated in the context defined in the content statements (see Information Systems (Intermediate 2) Course Content).

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

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

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

National Unit Specification: support notes

UNIT Expert Systems (Intermediate 2)

This part of the Unit Specification is offered as guidance.

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

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

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

Content Statements: Expert systems in context
Description of the purpose of an expert system: to represent the knowledge of one or more domain experts; to provide advice to a user via a consultation; to provide explanations of why certain questions are being asked and how conclusions have been reached. Definition of an 'expert system shell'. Identification of applications for expert systems, including medical, legal and financial advice.
Distinction between knowledge (created by the application of inference rules to known facts), data and information.
Identification of the components of an expert system: knowledge base, inference engine, user interface.
Identification of the categories of expert system: planning, advice, classification, diagnosis. Classification of example expert systems into these categories.

Content Statements: Characteristics of expert systems
Description of the main features of the knowledge base: contains facts and rules.
Representation of knowledge as rules and factor tables.
Description of the main features of the inference engine: to determine the order in which rules are applied, and hence questions are asked. Identification of inferencing methods: forward and backward chaining. Description of advantages and disadvantages of forward and backward chaining.
Description of the main functions of the user interface: to ask questions and obtain answers from the user; to display advice; to justify questions and answers.

National Unit Specification: support notes (cont)

UNIT Expert Systems (Intermediate 2)

Content Statements: Development, use and evaluation of expert systems
Identification of the principal personnel in the development of an expert system: <ul style="list-style-type: none"> ◆ domain expert ◆ knowledge engineer ◆ programmer ◆ user Identification of the stages of development of an expert system: <ul style="list-style-type: none"> ◆ knowledge acquisition/elicitation ◆ knowledge representation ◆ system validation
Querying of the expert system to answer simple structured questions.
Testing of an expert system using a set of structured test cases.
Use of How and Why justification facilities.
Evaluation of an expert system, in terms of: purpose (type of expert system, domain of expertise); range and coverage of rules; quality of user interface (structure/syntax/order of questions asked, presentation of conclusion; quality of explanation facilities).

Content Statements: Construction of a working expert system
Description and demonstration of techniques of analysis, design, implementation, testing and evaluation of an expert system.
Derivation of suitable attribute-value pairs, from a short piece of structured text, not involving multi-valued attributes.
Representation of attribute-value pairs as a factor table and as a decision tree.
Derivation of structured rules involving multiple (up to three) conditions to represent knowledge. Construction of forward or backward chaining rules (in pseudocode or appropriate KRL). Construction of a rule base of 5—10 rules, leading to direct conclusions without rule chaining.
Production of structured questions, including some multi-response.
Entry of rules into an expert system shell. Debugging of rules to produce a working system. Testing of expert system using a given set of structured test cases.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will require individual access to appropriate computer hardware and software throughout this Unit. In particular, candidates will require access to an expert system shell which will enable them to construct and test a working expert system. In addition to commercial software, there are a wide variety of free expert system shells available. However, centres should note that these are very often research vehicles and are provided ‘as is’, without support, and may be aimed at a university level audience. Nevertheless, some shells have active user groups which can provide useful backup.

Candidates will also benefit from the opportunity to consult and evaluate a range of expert systems.

Possible sources of software are easily available by searching on the World Wide Web.

The two Outcomes should be delivered in an integrated way. Appropriate practical activities, both computer and non-computer based, should be taught and used to illustrate and exemplify the knowledge and understanding required for Outcome 1.

National Unit Specification: support notes (cont)

UNIT Expert Systems (Intermediate 2)

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

Expert systems in context	4 hours
Characteristics of expert systems	9 hours
Development, use and evaluation of expert systems	8 hours
Construction of a working expert system	15 hours

1½ hours should be set aside to:

- a) administer the Outcome 1 test
- b) gather evidence for Outcome 2

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

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

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

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

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

To gain success in this Outcome, the candidate must demonstrate practical skills in the following contexts and at an appropriate level as context defined by the content statements (see Information Systems (Intermediate 2) Course Content):

- ◆ finding solutions to given problems by consultation of expert systems for advice, classification, diagnosis or planning
- ◆ testing and evaluation of an expert system
- ◆ representation of a limited domain of knowledge in a structured form
- ◆ construction of a working expert system given a limited domain of knowledge

Note: this expert system should involve 5—10 rules, some involving multiple conditions, but not requiring chaining).

Hard copy evidence should be provided of the expert system constructed; note that this need not be formal documentation — hard copy of the rule base is sufficient.

National Unit Specification: support notes (cont)

UNIT Expert Systems (Intermediate 2)

An observation checklist for Outcome 2 is provided in the National Assessment Bank materials.

All evidence for Outcome 2 should be gathered under 'open book' conditions and must be retained by the Centre. The assessment of this Unit is subject to moderation by SQA.

The assessment of this Unit will require candidates to be familiar with, and able to correctly use in context, the following technical terms:

◆ advice	◆ inference engine, inferencing	◆ knowledge representation language (KRL)
◆ classification	◆ justification	◆ query
◆ conclusion	◆ knowledge	◆ question
◆ consultation	◆ knowledge acquisition/elicitation	◆ rule
◆ domain	◆ knowledge base/rule base	◆ type of expert system: advice; classification; diagnosis; planning
◆ domain expert	◆ knowledge engineer	◆ user
◆ expert system	◆ knowledge representation	◆ user interface
◆ expert system shell		◆ validation
◆ explanation: how, why		
◆ factor table		
◆ forward/backward chaining		

SPECIAL NEEDS

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