Higher National Unit Specification

General information for centres

Unit title: Systems Development: Object Oriented Design

Unit code: DM3H 35

Unit purpose: This Unit is designed to enable candidates to develop a knowledge of the theoretical concepts, underlying principles, scope and role of systems analysis and design undertaken within an object oriented environment. The Unit develops candidates' practical systems development skills and introduces candidates to a variety of requirements gathering and modelling techniques used in object oriented systems analysis and design, using UML or similar modelling notation. The study of this Unit will provide a strong foundation for a candidate who will be developing object oriented, or event-driven software, and systems in an object oriented or object/component based environment.

On completion of this Unit the candidate should be able to:

1. Describe the object oriented approach to systems development.
2. Use object oriented techniques to gather requirements.
3. Produce a model of system objects.
4. Produce a model of system behaviour.
5. Specify physical design of the system.

Credit points and level: 2 HN credits at SCQF level 8: (16 SCQF credit points at SCQF level 8*)

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.

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the Centre, however it would be beneficial if the candidate already possessed good data gathering and processing techniques, written communication, critical thinking and analytical skills, either through workplace experience or training at an appropriate level. It would also be beneficial if the candidate had prior experience of systems analysis and design.

This may be evidenced by the possession of relevant HN units in systems analysis and design, *DH3F 34 Systems Development: Introduction* and *DH3G 34 Systems Development: Object Oriented Design (Introduction)*. Experience of object oriented software development and/or software development using an event driven language would also be beneficial. This may be evidenced by possession of relevant HN Units such as *DH3C 35 Software Development: Object Oriented Programming* and/or *DH34 35 Software Development: Event Driven Programming*.

General information for centres (cont)

Core skills: There may be opportunities to gather evidence towards core skills in this Unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: If this Unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes. The most appropriate approach to delivery is to integrate this Unit with a Unit that requires the candidate to carry out development of a computer system that utilises object-oriented, component-based or event-driven technologies. Suitable HN Units include *DH3C 35 Software Development: Object Oriented Programming* and/or *DH34 35 Software Development: Event Driven Programming*.

Assessment: The assessment for Outcome 1 will be a representative range of multiple choice questions.

Outcomes 2, 3, 4 and 5 are practical in nature and open book. A holistic approach could be taken to the assessment of these outcomes where the output of one will become the input to others. If a holistic approach is taken the assessor will have ensure the accuracy of the output from an outcome by a candidate is accurate to allow a project approach.

A stand-alone approach to each assessment can be taken by a centre, however, this is not recommended as this does not necessarily demonstrate the iterative nature of development.

During the assessment cycle of Outcomes 2, 3, 4 and 5 changes to design documents should result in an updated model to reflect the iterative nature to systems development.

Some of the evidence requirements may be produced using e-assessment. This may take the form of e-testing (for knowledge and understanding) and/or e-portfolios (for practical abilities). There is no requirement for you to seek prior approval if you wish to use e-assessment for either of these purposes so long as the normal standards for validity and reliability are observed. Please see the following SQA publications for further information on e-assessment: (i) *SQA Guidelines on Online Assessment for Further Education* (March 2003) and (ii) *Assessment and Quality Assurance in Open and Distance Learning* (Feb. 2001).

If a centre is presenting Outcome 1 of these assessments on-line the following assessment methods, where appropriate, may be selected:

- Multiple choice
- Drag and drop
- Multiple response
- Mix and match
- A combination of the above

It is expected that the questions will be of the multi-choice variety. Centres may consider the use of alternative questions types, particularly if using Computer Assisted Assessment approaches. However, care should be taken that the questions are valid and at an appropriate level. The use of simple true/false question responses is unlikely to achieve this.

Higher National Unit specification: statement of standards

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Unit code: DM3H 35

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe the object oriented approach to systems development

Knowledge and/or skills

♦ Object oriented concepts
♦ Object oriented design models and techniques
♦ Object oriented system life cycle

Evidence requirements

Evidence will be produced in response to a representative range of multiple choice questions to assess the candidate's knowledge and understanding of all the knowledge/skills items above.

The questions should cover the following areas:

♦ The principles behind object oriented concepts, modelling and techniques:
  • Objects and classes
  • Attributes and operations
  • Abstraction, encapsulation and information hiding
  • Inheritance
  • Polymorphism
  • Association
  • Aggregation
  • Collaboration
  • Coupling
  • Cohesion
  • Components
  • Patterns
  • Persistence (storage and associations)

♦ The system life cycle for an object oriented systems development method

Evidence for all the knowledge and/or skills in this Outcome will be assessed using a representative sample of 20 multiple choice questions.   All knowledge and skills must be covered.

Higher National Unit specification: statement of standards

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Assessment must be undertaken in supervised conditions and is closed book. Candidates may not bring to the assessment event any notes, textbooks, handouts or other material (calculators are not allowed). The questions presented must change on **each** assessment occasion.

Candidates must answer at least 60% of the questions correctly.

If a centre is presenting this assessment on-line the following assessment methods, where appropriate, may be selected:

♦ Multiple choice
♦ Drag and drop
♦ Multiple response
♦ Mix and match
♦ A combination of the above

Assessment guidelines

There is an opportunity for a candidate to be assessed on-line subject to meeting the prescribed assessment conditions.

A candidate should complete this assessment within one hour.

Outcome 2

Use object oriented techniques to gather requirements

Knowledge and/or skills

♦ Domain modelling
♦ User interface prototyping
♦ Requirements validation

Evidence requirements

The candidate will need evidence to demonstrate their knowledge and/or skills by showing that s/he can:
♦ Domain Modelling
  o Construct an initial use case diagram
  o Document the flow of events of use cases using an activity diagram
  o Model the domain using Class, Responsibility, Collaboration (CRC) cards
  o Use CRC cards to create an analysis class (conceptual) diagram
♦ Construct a low fidelity user interface prototype
♦ Validate requirements using use case scenarios and user interface walkthroughs

Current UML standards should be used to construct the models.

This assessment is open book. Assessors should assure themselves of the authenticity of each candidate's submission.

Higher National Unit specification: statement of standards (cont)

Unit title: Systems Development: Object Oriented Design

Assessment Guidelines

Outcome 2 can be assessed as a separate activity, however, it is recommended that the evidence requirements produced are further developed by the candidate in Outcome 3 and Outcome 4. The candidate's evidence should be endorsed by the assessor.

The conceptual model should comprise of at least eight concepts.

Outcome 3

Produce a model of system objects

Knowledge and/or skills

♦ Construction of an analysis class diagram
♦ Identification of attributes
♦ Identification of operations
♦ Visibility of attributes and operations (private, public, protected)
♦ Specification of appropriate association, aggregation and inheritance relationships between classes

Evidence requirements

If a holistic approach is taken to assessment then this assessment should be based on the candidate evidence produced in Outcome 2 and should be an analysis class diagram comprising of a minimum of four classes, including subclasses, abstract classes and aggregations of classes. However, if the outcome is being assessed as standalone then the candidate must be supplied with suitable source material.

Current UML standards should be used to construct the models.

This assessment is open book. Assessors should assure themselves of the authenticity of each candidate's submission.

Assessment guidelines

The evidence produced for this Outcome can be assessed in conjunction with Outcome 4.

Outcome 4

Produce a model of system behaviour

Knowledge and/or skills

♦ Construction of a detailed Use Case Diagram and Use Case Descriptions
♦ Construction of Interaction Diagrams
♦ Construction of Statechart Diagrams

Higher National Unit specification: statement of standards (cont)

Unit title: Systems Development: Object Oriented Design

Evidence requirements

To achieve this Outcome the candidate will need to demonstrate his/her knowledge and/or skill by producing a model of the behaviour of the system –

♦ Construction of a detailed Use Case Diagram and Use Case Descriptions

The use case should indicate actors, the use cases and the associations between actors and use cases using the UML use case diagram. The use of <<include>> and <<extend>> stereotypes should be taught. Candidates must be supplied with a use case description template as an organisational standard. The template must contain pre and post conditions, a trigger and a main flow of events as a minimum. At least one use case must exhibit, alternative and exceptional behaviour.

♦ Construction of Interaction Diagrams

The interaction diagrams must be based on the evidence generated in Outcome 2 and Outcome 3.   If a holistic approach is taken to assessment then this assessment must be based on the candidate evidence produced in Outcome 2.   However, if the outcome is being assessed as standalone then the candidate must be supplied with suitable source material.

The candidate evidence produced must include at least one sequence diagram and one collaboration diagram.

♦ Construction of Statechart Diagrams

The candidate evidence produced should include at least one statechart diagram based on a class which exhibits state dependent behaviour.

Current UML standards must be used to construct the models.

This assessment is open book.   Assessors should assure themselves of the authenticity of each candidate's submission.

Assessment guidelines

The evidence produced for this Outcome can be assessed in conjunction with Outcome 3.

Outcome 5

Specify physical design of the system

Knowledge and/or skills

♦ Creation of a design class diagram
♦ Specification of a user interface to facilitate the interaction between users and the system.

Higher National Unit specification: statement of standards (cont)

Unit title: Systems Development: Object Oriented Design

Evidence requirements

To achieve this Outcome the candidate will need to demonstrate his/her knowledge and/or skill by producing a model of the behaviour of the system –

♦ Creation of a design class diagram

The evidence produced must cover the following –
♦ Specification of data types to represent unstructured data held by attributes
♦ Specification of collections to represent groupings of data or objects
♦ Identification of persistent and transient objects

Note – The design class diagram should not necessarily cover all classes, however, this should be sampled (at the discretion of the assessor).   If this unit is being delivered in conjunction with *DH3C 35 Software Development: Object Oriented Programming* or a similar HN Unit then all classes will have to be included.

♦ Specification of a user interface to facilitate the interaction between users and the system.

The evidence produced by a candidate must include an annotated graphical representation of the interface design indicating how the interface components map to the design class diagram.

The interface design must meet agreed design principles supplied by the candidate as an organisational standard.

Current UML standards must be used to construct the models.

This assessment is open book.   Assessors should assure themselves of the authenticity of each candidate's submission.

Evidence guidelines

The evidence produced for this Outcome can be assessed in conjunction with Outcomes 3 and 4.

Administrative Information

Unit code: DM3H 35

Unit title: System Development: Object Oriented Design

Superclass category: CB

Date of publication: August 2004

Version: 01

Source: SQA

Higher National Unit specification: support notes

Unit title: Systems Development: Object Oriented Design

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

While the exact time allocated to this Unit is at the discretion of the Centre, the notional design length is 80 hours.

Guidance on the content and context for this Unit

The aim of the Unit is to introduce candidates to the principles and practices of object-oriented analysis and design. The Unit provides candidates with the skills necessary to use a variety of object-oriented tools, techniques and methods to analyse a problem and model and design a system.

The Unit will also provide candidates with an understanding of the defining features of object-oriented analysis and design and how an object-oriented analysis and design lifecycle fits into the general subject area of systems development. To this end, UML diagrams are used to specify a system from three perspectives – domain modelling (Outcome 2), specification modelling (outcomes 3 and 4) and implementation modelling (Outcome 5) encouraging an iterative and incremental lifecycle approach to software development.

The aim of domain modelling is to represent the main concepts (and their interactions) of the real world problem irrespective of whether a software solution will be used to deal with it.
In specification modelling, a software solution is assumed and an abstract model of the services to be provided by the system is modelled.

Implementation modelling specifies physical design of the system.

This Unit has been developed with the intention of taking the candidates through all phases of analysis and design from requirements gathering through to specifying the physical design of the system under consideration. Although it is envisaged that UML or a similar modelling notation is used to model and document analysis and design, the Outcomes of the Unit are generally specified to allow the Unit to be delivered using selected techniques from combinations of object oriented analysis and design methods. The choice of techniques and modelling notation may be matched to the requirements of the stakeholders, the type of system under consideration and development environment.

Outcome 1 introduces candidates to the general principles of the object-oriented approach to systems analysis and design. The candidates should be introduced to the fundamental object-oriented concepts of classes, objects, persistence, encapsulation, inheritance and polymorphism, etc. The candidates should be able to identify the processes that take place in the lifecycle and identify the major inputs and deliverables that result from each process.

Outcome 2 addresses requirements gathering. The high level specification of the client's requirements should indicate all the users/actors that interact with each case of usage, and the relationship between cases of usage. This may be done using a diagram such as UML Use Case Diagram and Activity Diagram. Identification of the classes that represent the concepts in the problem domain should be achieved using Class, Responsibility, Collaboration (CRC) Cards. These should then be used to create the analysis class (conceptual) diagram.

Unit title: Systems Development: Object Oriented Design

Candidates should produce a low fidelity user interface prototype that will serve as the starting point for modelling user interface requirements. Finally, the models produced should be validated using use case scenarios and a user interface walkthrough.

Outcome 3 will involve refining the deliverables from Outcome 2 or supplied requirements documentation and specifying the classes required to model the system. The candidates should produce a class diagram which indicates all appropriate classes and their relationships in terms of association, aggregation and inheritance. The model system objects should also describe the attributes and operations needed to support defined cases of usage.

Outcome 4 involves refining the use case deliverables from Outcome 2 to produce use case descriptions. The candidates should construct a sequence and collaboration diagram showing how classes interact and collaborate to accomplish a task defined in a use case. A class which exhibits state dependent behaviour should be modelled using a Statechart Diagram.

Outcome 5 covers activities that specify the physical aspects of the system. The attributes and operations described in the model of system objects should be specified in detail, indicating the format of unstructured data attributes in terms of primitive data types. Groupings of data or objects should be specified by appropriate collections that efficiently model their requirements and properties. Data that requires external or permanent storage should be identified as persistent data. The interface to the system should be specified by a diagram or graphical representation of the layout, annotated to indicate how the interface components and controls enable the input/output of data and display the required information about objects in the system. The candidates should use agreed (or in-house) design principles and heuristics to specify an interface design that meets an agreed in-house standard or set of design guidelines.

Guidance on the delivery and assessment of this Unit

The timing of Outcome 1 should be assessed at the discretion of the centre assessor. It is recommended that this is assessed last, since it is intended that the candidate should have practical experience of an approach to object-oriented systems development and the techniques involved. The main focus in Outcome 1 should be on the object oriented systems approach and its defining features, boundaries and general concepts. Outcome 1 will be assessed by a set of multiple choice questions

Outcome 2 involves analysis of the problem domain to elicit requirements. It is recommended that a holistic approach is taken with Outcomes 3, 4 and 5 as this demonstrates the iterative nature of systems development.
The evidence produced must follow a centre agreed organisational standard.

Bibliography

♦ Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design – Craig Larman (Prentice Hall)
♦ The Unified Modelling Language User Guide – Booch Rumbaugh Jacobson (Addison Wesley)
♦ The Object Primer (2nd Edition) – Scott W Ambler

Higher National Unit specification: support notes (cont)

Unit title: Systems Development: Object Oriented Design

Open learning

If this Unit is delivered by open or distance learning methods, additional planning and resources may be required for candidate support, assessment and quality assurance. A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes. For further information and advice, please see *Assessment and Quality Assurance for Open and Distance Learning* (SQA, February 2001 — publication code A1030).

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements for Candidates with Additional Support Needs* (www.sqa.org.uk).

General information for candidates

Unit title: Systems Development: Object Oriented Design

This Unit is designed to enable you to develop a knowledge of the theoretical concepts, underlying principles, scope and role of systems analysis and design undertaken within an object oriented environment. The Unit develops your practical systems development skills and will introduce you to a variety of requirements, engineering techniques and the main modelling and diagramming techniques used in object oriented systems analysis and design, using UML or similar modelling notation. The Unit will also develop your appreciation of the boundaries, strengths and limitations of object oriented systems analysis and design so that you can select the most appropriate tools and techniques for undertaking analysis and design given a specific project context. The study of this Unit will provide a strong foundation for anyone who will be developing object oriented, or event-driven software, and systems in an object oriented based environment. On completion of this Unit you should be able to:

1. Describe the object oriented approach to systems development

2. Use object oriented techniques to gather requirements

3. Produce a model of system objects

4. Produce a model of system behaviour

5. Specify physical design of the system