6 Unit 6: Software Development – Design
[AS level, double award, optional, internally assessed]

6.1 ABOUT THIS UNIT

This AS level unit is an optional part of the double award only and is internally assessed.

This unit helps you to:

- understand and apply strategies to investigate computer solutions;
- analyse a system prior to designing a solution;
- design a solution.

Before a computer solution can be designed, it is important to understand why, how and where the solution will be used and by whom. In order for a computerised solution to fully meet the needs of the end-user, it is important to follow a plan and to investigate the current system fully.

The main strategy used when investigating, analysing and designing computer solutions is systems analysis. It is important to understand the system life-cycle which is followed when developing a complete solution to a problem.

The system life-cycle has various stages which need to be completed in order. The stages which make up the system's life-cycle are:

- feasibility;
- investigation;
- analysis;
- design;
- implementation;
- maintenance.

This unit will help you to have an understanding of the tools and techniques which are used in the first **four** stages, to understand why they are used and the benefits of each one.

This unit has links with Unit 15: *Software development.* In order to make a judgement or a solution, candidates should have completed Unit 3: *ICT solutions for individuals and society* and Unit 4: *System specification and configuration*.

This unit is assessed through your portfolio work. The mark on that assessment will be your mark for the unit. You will produce a design for a solution to a given problem, in a familiar context, which includes:

- the identification and explanation of the tools and techniques used in the analysis stage;
- the identification and explanation of the tools and techniques used in the design stage;
- the investigation methods used when designing solutions;
- a report documenting feasibility and design;
- data-flow modelling and associated documentation;
- entity-relationship diagrams and associated documentation;
- a conclusion and evaluation of the proposed solution and your performance in solving the problem.

6.2 WHAT YOU NEED TO LEARN

You need to learn about:

- feasibility studies;
- the investigation stage;
- structured analysis;
- design of forms and layouts;
- producing a conclusion.

6.2.1 Feasibility Studies

The initial stages of investigation, analysis and design are very important, as it is at these stages that the needs and requirements of the end-user are identified. If the requirements and needs of the end-user are not identified correctly, then a solution may be designed which does not fulfill their needs and requirements. If this is the case then the solution may not be used.

Before a system can be analysed and designed, a feasibility stage needs to be undertaken. The feasibility stage determines if the required solution is possible. The main questions which need to be answered at this stage are:

- Will the solution fulfill all the needs and requirements of the end-users?
- Will the solution have a positive impact on the end-users?
- Can the solution be designed and implemented within the time-scale allocated and within the budget?

If the system life-cycle is to progress to the next stage then all the answers to these questions need to be ‘yes’.

6.2.2 Investigation Stage

The investigation stage is very important as this is where all the initial information required to design the solution is gathered. The investigation needs to be collected and recorded and the information also needs to be saved as you may need to refer to it at a later stage.

There are various techniques which can be used when investigating the requirements of a solution. These techniques include:

- interviews;
- questionnaires;
- meetings;
- observations;
- document analysis.

You need to research these techniques and identify when it would be appropriate to use each one. There are benefits and disadvantages to each method used for investigation and you need to explain these.

6.2.3 Structured Analysis

The next stage is to analyse the current system and to suggest a number of options for the solution. There are a number of tools and techniques which could be used when analysing a system. These include data-flow modelling and ERDs (entity-relationship diagrams).

Data-flow modelling includes techniques and tools such as:

- simple data-flow diagrams (DFDs);
- informal diagrams such as 'rich picture'.

You need to develop **two** levels of DFDs for the system for which you are designing a solution.

A Level 0 DFD (context diagram) shows the general overview of the system and its relationship with external entities which are outside the system boundary. The context diagram will show the flows of data between the system for which you are designing a solution and the external entities with which it needs to interact.

A Level 1 DFD then shows an overview of what is happening within the system for which you are designing a solution. This includes:

- the type of information being passed within the system;
- the documents used;
- how the information is stored;
- the processes which occur within the system.

Standard symbols are used for data-flow diagrams. There are many different sets of symbols which can be used and you need to research, identify and select a set of symbols to use. Once you have selected the set of symbols which you are going to use then they need to be used *consistently*.

You also need to develop the documentation which accompanies the diagrams. Documentation which could be used in data-flow modelling includes:

- external-entity descriptions;
- input/output descriptions.

This documentation is used to clarify the diagrams you have produced and to stop any confusion occurring. Each process you have used in your Level 1 DFD needs to have an associated process description to identify the activities or operations which take place within that process.

Input/output descriptions provide textual descriptions of the data flows which connect the internal processes and entities to the external entities of the system.

You need to learn about, and create, entity-relationship diagrams (ERDs). You need to understand and identify different types of relationships, including:

- one-to-one;
- many-to-one;
- one-to-many;
- many-to-many.

ERDs provide a detailed graphical representation of the information used within the system and identify the relationships that exist between data items. As with data-flow modelling, there is a set of tools and techniques which you need to use.

You also need to develop the documentation which accompanies the diagrams. Documentation includes:

- entity descriptions;
- attribute lists.

Every entity which you have used needs to have an entity description which details the:

- name of the entity and a description;
- the entity attributes;
- the relationships and links.

You also need to learn about, and develop for your solution:

- decision tables;
- flowcharts;
- structured English/pseudo-code.

Decision tables provide a very simple way of showing actions which take place under certain rules. The advantage of a decision table is that all combinations of the rules have to be considered and it is easy to see if all the rules have been identified. There is a standard layout for decision tables which means that all the information included in the table can be understood by the end-users.

Flowcharts are a method of representing the processes of a system in a pictorial form using different shaped boxes to represent different types of actions. Flowcharts help break down a complex process into small steps and are easy to understand. However, flowcharts do not convert into program code very easily and can, in some cases, become very complex, making them hard to follow. Flowcharts are, therefore, best used to give an overview of the functions of a process with decision tables or structured English used to describe the detail.

Structured English is the mid-step between program code and normal English. It is used to describe the steps in a process without being concerned about the programming syntax. Structured English is also known as pseudo-code. When using structured English to define a process you need to use constructs such as:

- IF…THEN…ELSE;
- WHILE…DO;
- SELECT CASE…END CASE;
- REPEAT…UNTIL.

6.2.4 Design of Forms and Layouts

The next stage is to design:

- the data-input forms;
- screen layouts;
- screen-report layouts;
- printed-report layouts.

For each screen or printed report required for the new system, it is necessary to produce the following information:

- type:
  – screen display;
  – printing;
  – screen display with an option to print displayed data;
- purpose:
  – for whom;
  – for what it is to be used;
- data required:
  – the attributes to be shown;
  – any calculated data items to be displayed;
  – any processes required, e.g. sorting or grouping of data (and which attributes need to be used for these processes).

6.2.5 Production of a Conclusion

In producing a conclusion, you need to have an understanding of the resources needed for the new system and the impact the new system will have. This needs to include a discussion of:

- alternative solutions available in terms of hardware and software;
- the benefits of developing a new system.

6.3 ASSESSMENT EVIDENCE GRID

Please see over.

Unit 6: Software development – design

What you need to do:

You need to produce a design for a solution to a given problem, in a familiar context.

Your evidence needs to include:

a [AO2] the identification and explanation of the tools and techniques used in the analysis stage [**4**];
b [AO2] the identification and explanation of the tools and techniques used in the design stage [**4**];
c [AO2] the investigation methods used when designing solutions [**4**];
d [AO1] a report documenting feasibility and design [**15**];
e [AO3] data-flow modelling and associated documentation [**8**];
f [AO3] entity-relationship diagrams and associated documentation [**8**];
g [AO4] a conclusion and evaluation of the proposed solution and your performance in solving the problem [**7**].

How you will be assessed:

Task	Assessment Objective	Mark Band 1	Mark Band 2	Mark Band 3	Mark Awarded
a	**AO2**	You identify the tools and techniques which are used during the analysis stage; **[0 1 2]**	you give a simple explanation of the tools and techniques which are used during the analysis stage; **[3]**	you give a detailed explanation of the tools and techniques which are used during the analysis stage. **[4]**	**/4**
b	**AO2**	You identify the tools and techniques which are used during the design stage; **[0 1 2]**	you give a simple explanation of the tools and techniques which are used during the design stage; **[3]**	you give a detailed explanation of the tools and techniques which are used during the design stage. **[4]**	**/4**
c	**AO2**	You identify investigation methods; **[0 1 2]**	you give a simple explanation of investigation methods; **[3]**	you give a detailed explanation of investigation methods. **[4]**	**/4**
d	**AO1**	You produce a simple report showing a single solution to the given problem; your report may contain errors in spelling, punctuation and grammar; **[0 1 2 3 4 5]**	you produce a detailed report showing alternate solutions to the given problem; your report contains few spelling, punctuation and grammar errors; **[6 7 8 9 10]**	you produce a detailed report showing alternate solutions to the given problem, justifying the chosen solution; your report is consistently well-structured and there are few, if any, spelling, punctuation and grammar errors. **[11 12 13 14 15]**	**/15**
e	**AO3**	You produce an incomplete data-flow model for the current solution with incomplete documentation; **[0 1 2]**	you produce a data-flow model of the current solution using simple graphical representation with complete documentation; **[3 4 5]**	you produce a complete data-flow model of the current solution, making effective use of formal graphical representation with complete and detailed documentation. **[6 7 8]**	**/8**
f	**AO3**	You produce an incomplete ERD for the proposed solution with incomplete documentation; **[0 1 2]**	you produce a simple ERD of the solution, with complete documentation; **[3 4 5]**	you produce a complete ERD of the solution, with complete and detailed documentation. **[6 7 8]**	**/8**
g	**AO4**	You produce a simple evaluation of the system; you comment on your actions and role in solving the problem; **[0 1 2]**	you evaluate the solution discussing either benefits or disadvantages of the solution; you include an analysis on your experiences in order to improve your own performance; **[3 4]**	you evaluate the solution discussing both benefits and disadvantages of the solution; you include an analysis on your experiences, suggesting how you might approach a similar task in the future. **[5 6 7]**	**/7**
				Total mark awarded:	**/50**

6.4 GUIDANCE FOR TEACHERS

6.4.1 Guidance on Delivery

This unit has links with Unit 15: *Software development*, but to ensure that each unit is meaningful in its own right there is a small overlap in content. The overlap is appropriate because the approach in each case is different. This unit introduces analysis methods that are used to investigate existing or potentially-new systems.

Candidates need to learn about the system's life-cycle and need to understand each stage and how it impacts on the next stage. They need to identify the tools and techniques that are used in the first **three** stages in particular. Each of these stages needs to be identified and the techniques and methods used at each point need to be covered. Candidates need to learn a variety of techniques so that they are able to select the appropriate ones to use for their coursework.

You need to cover analysis tools and methods such as:

- formal data-flow diagrams (DFDs) at **two** levels;
- informal diagrams such as 'rich picture';
- entity-relationship diagrams (ERDs);
- decision tables;
- flowcharts;
- structured English/pseudo-code.

Design of the system also needs to be covered. The importance of layout, both on screen and printed reports needs to be stressed as well as the ease of data input.

6.4.2 Guidance on Assessment

It needs to be stressed that you determine only the *mark* for a candidate's portfolio evidence and not the *grade* which will be determined by OCR.

Regular, early and constructive feedback to candidates on their performance is essential and crucial. Help with planning and structuring their portfolio work in a logical manner throughout the course will lead to better understanding of their work and is likely to achieve higher marks.

Giving candidates deadlines for the completion of various sections of their work, and encouraging them to adhere to them, is also essential if candidates are not going to rush to complete and possibly finish up with marks below their potential.

You need to mark each portfolio according to the assessment objectives and content requirements in the *Assessment Evidence Grid* (Section 6.3).

The information on this *grid* will eventually be transferred onto a *Unit Recording Sheet* to be attached to the front of each candidate's piece of work at the point when the work is submitted for moderation. A *Coursework Administration Pack* will be supplied, containing all relevant *Unit Recording Sheets*. Where marking for this unit has been carried out by more than **one** teacher in a centre, there must be a process of internal standardisation carried out to ensure that there is a consistent application of the criteria as laid down in the *Assessment Evidence Grids*.

Each row in the *grid* comprises a *strand* in the banner, which may be a task or sub-task, showing the development of an assessment objective.

The maximum mark for each strand is shown in the far right-hand column of the *grid* and this maximum mark is further broken down into a number of mark bands across each row with a range of descriptors.

You use your professional judgement to determine which descriptor in a strand best suits the candidate's work and from the range of marks available within that particular mark band, you circle the mark that best fits the work. You then record this mark in the column headed *Mark*.

You should use the full range of marks available. You must award *full* marks in any strand for work which *fully* meets the criteria. This is work which is the best one could expect from candidates working at AS level.

Only **one** mark per strand/row will be entered. The final mark for the candidate is out of a total of **50** and is found by totalling the marks for each strand.

The further guidance below clarifies the criteria in the *Assessment Evidence Grid* and will help you to determine the appropriate mark to be awarded for each strand.

Amplification of Criteria			
Task	**AO**	**Mark Band**	**Characteristics of the work one may expect to see at this mark band can be summarised as follows:**
a	**AO2**	**1**	Candidates provide an identification of the tools and techniques which could be used during the analysis stage; the tools and techniques identified will be limited;
		2	candidates identify and provide a simple explanation of the tools and techniques which could be used during the analysis stage; there is a range of tools and techniques identified and explained; candidates provide either the advantages or limitations of each tool and technique identified;
		3	candidates identify and provide a detailed explanation of the tools and techniques which could be used during the analysis stage; there is a wide range of tools and techniques explained; candidates provide the advantages and limitations of each tool and technique identified with appropriate situations of use.

Task	AO	Mark Band	Characteristics of the work one may expect to see at this mark band can be summarised as follows:
b	AO2	1	Candidates provide an identification of the tools and techniques which could be used during the design stage; the tools and techniques identified will be limited;
		2	candidates identify and provide a simple explanation of the tools and techniques which could be used during the design stage; there is a range of tools and techniques identified and explained; candidates provide either the advantages or limitations of each tool and technique identified;
		3	candidates identify and provide a detailed explanation of the tools and techniques which could be used during the design stage; there is a wide range of tools and techniques explained; candidates provide the advantages and limitations of each tool and technique identified, with appropriate situations of use.
c	AO2	1	Candidates identify investigation methods which could be used; the range of investigation methods identified will be limited;
		2	candidates identify and provide a simple explanation of the investigation methods which could be used; candidates provide either the advantages or limitations of each investigation method they have identified;
		3	candidates identify and provide a simple explanation of the investigation methods which could be used; candidates provide the advantages and limitations of each investigation method they have identified, with appropriate situations of use.
d	AO1	1	Candidates provide a simple report including the feasibility of the proposed system, a proposed solution to the given problem and simple or incomplete design of input/output requirements; candidates only provide **one** proposed solution with no alternate solutions indicated; the proposed solution is incomplete or does not meet the needs of the end-user;
		2	candidates provide a detailed report including the feasibility of the proposed system, solutions to the given problem and design of data input/output requirements; candidates provide alternate solutions to the problem; proposed solutions and designs meet the needs of the end-user;
		3	candidates provide a detailed report including the feasibility of the proposed system, solutions to the given problem and design of data input/output requirements and calculations needed; candidates provide alternate solutions to the problem; candidates provide a preferred solution for the end-user and are able to justify the choice; the proposed solutions and designs meet the needs of the end-user.

Task	AO	Mark Band	Characteristics of the work one may expect to see at this mark band can be summarised as follows:
e	AO3	1	Candidates produce an incomplete data flow model with incomplete documentation;
		2	candidates produce a data flow model using a simple graphical representation method; the documentation is complete, appropriate and relates to the data flow model;
		3	candidates produce a full and complete data flow model using a formal modelling technique; the detailed documentation is complete, to an appropriate level of detail, and relates to the data flow model produced.
f	AO3	1	Candidates produce an incomplete ERD with incomplete documentation;
		2	candidates produce an ERD with complete documentation that is, appropriate and relates to the ERD;
		3	candidates produce a full and complete ERD with detailed documentation that is complete, to an appropriate level of detail, and relates to the ERD produced.
g	AO4	1	Candidates provide a simple conclusion for the proposed solution; candidates make brief comments on how they tackled and solved the problem and suggest simple improvements;
		2	candidates provide an evaluation leading to a conclusion; the benefits or disadvantages of the new system are considered; an alternative solution is identified; candidates' evaluations consider both good and not so good features of the way they tackled and solved the problem; candidates provide sensible suggestions as to how each method could be improved;
		3	candidates provide an evaluation leading to a justified conclusion; the benefits and disadvantages of the new system are fully discussed; alternative solutions are identified; candidates show evidence of evaluation through the refinement of their work as it progresses; candidates identify the strengths and weaknesses in their strategies to solve the problem and explain how these were refined to meet the purpose more closely; final evaluations include consideration of how a more efficient approach might be adopted for a similar task in future.

6.4.3 Resources

Textbooks	Avison DE & Shah H	*The Information Systems Development Life-Cycle: A first course in information systems*	McGraw-Hill 1997
	Curtis G & Cobnam D	*Business Information Systems – Analysis, Design and Practice* (4th Edition)	Prentice Hall 2002
	Deeks D & Lejk M	*Introduction to Systems Analysis Techniques*	Prentice Hall
	Kendall JE & Kendall KE	*Systems Analysis and Design*	Irwin
	Pressman RS	*Software Engineering: A practitioners approach (European adaptation)*	McGraw-Hill
	Robertson J & Robertson S	*Complete Systems Analysis: The work book, the text book and the answers*	Dorset House
	Shelly GB, Cashman TJ & Rosenblatt HJ	*Systems Analysis and Design*	Course Technolgy
	Skidmore S	*Introducing Systems Analysis*	Macmillan
	Sommerville I	*Software Engineering* (6th Edition)	Addison Wesley 2001
	Whitten & Bentley	*Systems Analysis and Design Methods*	McGraw-Hill
Websites	http://www.bcs.org.uk – The home page for the British Computer Society http://www.computer.org – The home page for the IEEE Computer Society		