

GCE



CCEA GCE Specification in Digital Technology

Updated: September 2019

For first teaching from September 2016
For first award of AS level in Summer 2017
For first award of A level in Summer 2018
Subject Code: 2650



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1 Introduction

This specification sets out the content and assessment details for our Advanced Subsidiary (AS) and Advanced GCE courses in Digital Technology. First teaching is from September 2016.

Students can take:

- the AS course as a final qualification; or
- the AS units plus the A2 units for a full GCE A level qualification.

We assess the AS units at a standard appropriate for students who have completed the first part of the full course. A2 units have an element of synoptic assessment (to assess students' understanding of the subject as a whole), as well as more emphasis on assessment objectives that reflect higher order thinking skills.

The full Advanced GCE award is based on students' marks from the AS (40 percent) and the A2 (60 percent). The guided learning hours for this specification, as for all GCEs, are:

- 180 hours for the Advanced Subsidiary level award; and
- 360 hours for the Advanced level award.

We will make the first AS awards for the specification in 2017 and the first A level awards in 2018. The specification builds on the broad objectives of the Northern Ireland Curriculum.

If there are any major changes to this specification, we will notify centres in writing. The online version of the specification will always be the most up to date; to view and download this please go to www.ccea.org.uk

1.1 Aims

This specification aims to encourage students to:

- develop a genuine interest in digital technology;
- gain an understanding of the systems development process;
- gain an awareness of a range of technologies and an appreciation of the potential impact these may have on individuals, organisations and society;
- participate in developing an application while adhering to the systems development process;
- develop an understanding of the consequences of using digital technology on individuals, organisations and society, and of social, legal, ethical and other considerations of using digital technology;
- apply their skills to relevant work-related scenarios;
- carry out research and development, and present their findings in different formats;
- develop advanced study skills that help them prepare for third level education; and
- demonstrate that they understand and can apply key concepts through internal and external assessments.

1.2 Key features

The following are important features of this specification.

- It includes four assessment units: three are externally assessed and one is internally assessed.
- It gives students opportunities to progress to career paths leading to professional IT management.
- It offers advanced study of modern technology-based systems.
- It provides stretch and challenge for A2 students.
- It allows students to develop advanced skills in a range of development environments using a mixture of examination formats and question types.
- A range of support is available, including specimen assessment materials, schemes of work and teacher guidance on particular aspects of the specification and the internally assessed unit.

1.3 Prior attainment

There is no specific requirement for prior learning. However, it is expected that many students will have already gained skills, knowledge and understanding of digital technology following the successful completion of an IT-related GCSE course, or a level two equivalent.

1.4 Classification codes and subject combinations

Every specification has a national classification code that indicates its subject area. The classification code for this qualification is 2650.

Please note that if a student takes two qualifications with the same classification code, universities and colleges that they apply to may take the view that they have achieved only one of the two GCEs. The same may occur with any two GCE qualifications that have a significant overlap in content, even if the classification codes are different. Because of this, students who have any doubts about their subject combinations should check with the universities and colleges that they would like to attend before beginning their studies.

2 Specification at a Glance

The table below summarises the structure of the AS and A level courses:

Content	Assessment	Weightings
AS 1: Approaches to Systems Development	External written examination 1 hour 30 mins Students answer short and extended questions based on Approaches to Systems Development.	50% of AS 20% of A level
AS 2: Fundamentals of Digital Technology	External written examination 1 hour 30 mins Students answer short and extended questions based on the Fundamentals of Digital Technology.	50% of AS 20% of A level
A2 1: Information Systems	External written examination 2 hours 30 mins Students answer short and extended questions based on Information Systems.	40% of A level
A2 2: Application Development (Case Study)	Internal assessment Students compile a portfolio showing evidence of the analysis, design, development, testing and evaluation of an application for a specified end user.	20% of A level

3 Subject Content

We have divided this course into four units: two units at AS level and two units at A2. This section sets out the content and learning outcomes for each unit.

3.1 Unit AS 1: Approaches to Systems Development

In this unit, students develop knowledge and understanding of the various approaches to the development of complex systems, the key stages in the development process and the outputs produced at each stage. The content of this unit underpins the learning that will take place in each of the three subsequent units. This unit is assessed through a 1 hour 30 minute written examination that includes both short and extended questions. For more details, see Section 6.

Content	Learning Outcomes
<p>Approaches to systems development Reasons for systems development</p> <p>Analysis</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • explain the impact of the ‘software crisis’; • explain the need for software systems that meet the needs of organisations and/or individuals; • explain the main factors affecting systems development: the user needs, time and cost; • understand that a computer system consists of a user interface, processes and data; • describe the roles of the following during systems development: <ul style="list-style-type: none"> – the systems analyst; – the project manager; and – the programmer; • describe the purpose of analysis; • evaluate different fact-finding techniques: interviews, questionnaires, observation and document sampling; • distinguish between functional and non-functional user requirements in systems, such as stock control, reservation, payroll and billing; • explain the purpose of a data flow diagram (DFD); and • produce context and level 1 DFDs for simple scenarios.

Content	Learning Outcomes
<p>Approaches to systems development (cont.) Design, development and testing</p> <p>Implementation</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • describe the purpose of systems design, development and testing; • describe the use of storyboarding in developing the user interface; • describe the use of prototyping in the design of the user interface and the data model; • understand the importance of testing throughout the development of a system in ensuring system quality; • distinguish between different types of testing: system, acceptance, alpha and beta; • understand the purpose of a test plan; • describe the main components of a test plan; • distinguish between different types of test data; • describe the purpose of system implementation; • evaluate different changeover methods: parallel, direct, pilot and phased; • describe the different types of documentation: user documentation and technical documentation, and explain how they are used; • explain what is meant by data conversion; • describe the purpose of system maintenance; and • evaluate different forms of maintenance: corrective, adaptive and perfective.

Content	Learning Outcomes
<p>Approaches to systems development (cont.)</p> <p>Alternative development approaches</p> <p>Software projects</p> <p>Security issues</p> <p>Programming</p> <p>Programming environment</p> <p>Program structure</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • describe the main features of different approaches to systems development: the waterfall model, Rapid Application Development (RAD) and Agile; • evaluate different approaches to systems development: the waterfall model, RAD and Agile; • describe the main elements in the organisation of a software project: resources, constraints and risks; • explain the main features of project management for a software project; • evaluate the use of project management tools: Gantt charts and critical path analysis; • describe the importance of version management during systems development; • explain why data is archived; • explain the need for backup and recovery; • evaluate methods of backup: full backup, differential backup and incremental backup; • explain the purpose of a disaster recovery plan; • describe the contents of a typical disaster recovery plan; • describe the purpose of a computer program; • describe the main features of an integrated development environment (IDE); • explain the process of translation; • explain the terms algorithm, syntax, data type and variable; and • describe the fundamental programming concepts of sequence, selection and iteration, including count-controlled and condition-controlled loops.

Content	Learning Outcomes
Programming Program structure (cont.)	Students should be able to: <ul style="list-style-type: none">• describe how algorithms can be represented using flowcharts;• explain object-oriented programming terminology: objects, classes, methods and inheritance; and• evaluate the use of the object-oriented approach.

3.2 Unit AS 2: Fundamentals of Digital Technology

In this unit, students develop knowledge and understanding of the fundamentals of any system, such as data representation, computer architecture, software and the user interface. Along with Unit AS 1, the content of this unit will provide a foundation for progression to A2. This unit is assessed through a 1 hour 30 minute written examination that includes both short and extended questions.

For more details, see Section 6.

Content	Learning Outcomes
<p>Data representation Bits and bytes</p> <p>Binary and decimal</p> <p>Data and information Data, information and knowledge</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • explain the terms bit, byte, kilobyte, megabyte, gigabyte and terabyte; • demonstrate that 2^n different values can be represented with n bits (maximum n = 8); • perform conversions from decimal to binary and from binary to decimal for a maximum of 8 bits; • demonstrate how the two's complement system can represent positive and negative numbers in binary using 8 bits; • demonstrate how American Standard Code for Information Interchange (ASCII) and Unicode are used to represent characters; • distinguish between data, information and knowledge by using examples; • describe how the quality of the information produced can be affected by the following factors: <ul style="list-style-type: none"> – accuracy; – relevance; – up to date/currency; – completeness; – presentation; and – reliability.

Content	Learning Outcomes
<p>Data and information (cont.) Data validation and verification</p> <p>Hardware and software Architecture</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • describe and apply the following data validation methods: <ul style="list-style-type: none"> – range; – type; – length; – format; – presence; – Modulus 11 check digit; and – lookup; • understand the purpose of the following data validation methods: <ul style="list-style-type: none"> – check digits; and – batch totals (hash and controls); • understand the purpose of data verification methods: double entry and proofreading; • explain the limitations of data validation and data verification; • describe the internal components of a computer system: processor, clock, main memory, cache memory, buses (address, data and control), input/output (I/O) controllers, registers and ports; • describe the fetch-execute cycle; • evaluate the factors that can influence the speed of processing: processor type and clock speed; • explain the need for secondary storage; • describe secondary storage media: magnetic, optical and flash; and • evaluate the use of secondary storage media for common applications.

Content	Learning Outcomes
<p>Hardware and software (cont.) The user interface</p> <p>Data compression</p> <p>System software</p> <p>Application software</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • describe the main features of different types of user interface: windows, icons, menu, pointer (WIMP), command line and forms dialogue; • evaluate different types of user interface: WIMP, command line and forms dialogue; • describe how text, sound and video can be input using a range of devices, such as personal computers, laptops, tablets or smartphones; • explain the need for data compression; • describe how zipping is used to compress data; • evaluate common data file formats: txt, wav, bitmap, Joint Photographic Experts Group (JPEG), Motion Picture Experts Group (MPEG) and Graphics Interchange Format (GIF); • describe the purpose of an operating system; • describe different types of operating system: single user, multi-user, multiprocessing, multitasking and multithreading; • explain the need for utility programs; • describe some common utility programs: data compression, file backup, archive software and disk defragmenters; • explain what is meant by application software; • explain the difference between generic software and special purpose software; • compare the use of custom-built software with off-the-shelf software; • explain how application software can be delivered on different platforms, for example downloaded to a device or accessed using the web; and • evaluate different methods of obtaining software: proprietary and open source.

Content	Learning Outcomes
<p>Hardware and software (cont.) Processing systems</p> <p>Web technology and multimedia Web applications</p> <p>Website development</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • describe batch processing and real-time processing; • evaluate the use of batch processing and real-time processing for common applications; • describe the input, output and processing involved in a range of common devices: automatic teller machines (ATMs), point of sale (POS) terminals and smartphones; • explain the following terms: the World Wide Web (WWW), the internet, Uniform Resource Locator (URL), Hypertext Transfer Protocol (HTTP), Internet Protocol (IP) address, web browser, web server, web hosting, File Transfer Protocol (FTP), internet service provider (ISP), search engine, cache, cookies, portal, website and web page; • explain how domain names are organised; • describe the role of the International Telecommunications Union (ITU) and World Wide Web Consortium (W3C) in agreeing web standards; • evaluate the use of an intranet by an organisation; • explain how web pages are created using Hypertext Markup Language (HTML); • understand the purpose of a range of HTML tags: paragraph, image, anchor, ordered list, unordered list and hyperlinks; • explain how cascading style sheet (CSS) is used in web development; • distinguish between client-side and server-side processing; and • evaluate methods of ensuring security over the internet: encryption (including public and private keys), hypertext transfer protocol secure (https), Secure Sockets Layer (SSL), digital signature or digital certificate.

3.3 Unit A2 1: Information Systems

In this unit, students develop knowledge and understanding of information systems. It acts as an extension to Unit AS 2: Fundamentals of Digital Technology, for students progressing from AS level. This unit is assessed through a 2 hour 30 minute written examination that includes both short and extended questions.

For more details, see Section 6.

Content	Learning Outcomes
<p>Networks Network resources</p> <p>Protocols</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • describe networks by their scope: local area network (LAN), metropolitan area network (MAN) and wide area network (WAN); • describe the purpose of the network resources: network card, server, switched hub, repeater, wireless access point, media converter, IP address and media access control (MAC) address; • define the purpose of an IP address and a MAC address; • describe the features of a peer-to-peer (P2P) and server-based networks; • evaluate the bus, star and ring network topologies; • explain the need for communication protocols; • describe the Open Systems Interconnection (OSI) network organisation model and each of its component layers; and • describe communication protocols: <ul style="list-style-type: none"> – Transmission Control Protocol/Internet Protocol (TCP/IP); – Ethernet; – Carrier Sense Multiple Access with Collision Detection (CSMA/CD); – token passing; – Wi-Fi; – Bluetooth; – voice over internet protocol (VoIP); and – radio-frequency identification (RFID).

Content	Learning Outcomes
<p>Networks (cont.) Transmission media</p> <p>Error detection and correction</p> <p>Databases</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • define the terms bandwidth and broadband; • describe transmission media: metal cable, fibre optic and wireless; • evaluate these transmission media in terms of volume of data transfer, bandwidth and security; • describe and evaluate methods of detecting and correcting data transmission errors: parity bits, checksums, echo checking and cyclic redundancy check (CRC); • describe the main features of a relational database; • describe the difference between a logical data model and a physical data model; • define the terms attribute, entity, primary key, composite key, foreign key, relationships, referential integrity, data duplication and data inconsistency; • produce an entity-relationship (ER) model from the given data requirements for a scenario; • describe the characteristics of data in un-normalised form, first normal form (1NF), second normal form (2NF) and third normal form (3NF); • describe the advantages and disadvantages of normalisation; • normalise data requirements for a scenario to 3NF; • describe the components of a data dictionary; • use Structured Query Language (SQL) to create tables and to retrieve, update, insert and delete data in a relational database; and • evaluate Query By Example (QBE) as an alternative to SQL.
Content	Learning Outcomes

Content	Learning Outcomes
<p>Applications of digital technology</p> <p>Artificial intelligence</p> <p>Expert systems</p> <p>Natural language and voice recognition</p> <p>Robotics</p> <p>Mobile technologies</p> <p>Data mining</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • explain what is meant by artificial intelligence (AI); • explain the significance of the Turing test in defining what is meant by AI; • describe the main features of neural network modelling; • describe the structure of an expert system; • describe the purpose of the knowledge base and inference engine in an expert system; • explain the following terms in relation to expert systems: <ul style="list-style-type: none"> – shell; – heuristics; – fuzzy logic; and – knowledge engineer; • evaluate the use of expert systems in medicine, car engine fault diagnosis and life insurance; • describe the technology required for natural language and voice recognition systems; • evaluate the use of natural language and voice recognition systems; • describe the technology involved in the use of robotics; • evaluate the use of robotics in a range of commercial situations; • describe how technology supports mobile phone communication: mobile phone masts, cells, handoffs, base station controller, mobile switching centre and public switched telephone network (PSTN) telephone system; • explain what is meant by data mining; and • describe how digital technology can be used in data mining to gather, store, process and analyse large volumes of data.

Content	Learning Outcomes
<p>Applications of digital technology Data mining (cont.)</p> <p>Cloud computing</p> <p>Individual, social and legal considerations Legislation</p> <p>Ethical considerations</p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> • explain the importance of big data to the operation and competitiveness of organisations in the health, finance and retail sectors; • describe the threats to the privacy of the individual from the use of data mining; • explain what is meant by cloud computing; • explain the terms virtualisation, hosted instances, hosted solutions and clustering; • describe how cloud computing provides services, such as: <ul style="list-style-type: none"> – data storage; – email; – virtualised software; – backup; and – remotely hosted applications; • evaluate the use of cloud computing in terms of business benefits and security issues; • describe the main features of the following legislation: <ul style="list-style-type: none"> – the Data Protection Act; – the Copyright, Designs and Patents Act; and – the Computer Misuse Act; • understand and apply how each piece of legislation may impact on organisations, their employees and members of the public; and • explain the ethical considerations around: <ul style="list-style-type: none"> – automated decision making; – online censorship; – monitoring of personal behaviour; – artificial intelligence; and – the capture, storage and analysis of personal information.

3.4 Unit A2 2: Application Development (Case Study)

In this unit, students have the opportunity to become involved in a real-world situation detailed in a case study. They apply their skills, knowledge and understanding of digital technology to solve a problem for a specified client. We provide a new case study each year.

Students apply their practical skills to produce a solution and associated detailed documentation for the client. They can adopt a range of approaches, but the teacher should guide them in selecting an approach suitable to their particular knowledge and skills.

This unit may be taught alongside Unit A2 1: Information Systems, allowing students to work over an extended period.

The case study encourages students to demonstrate their skills in:

- analysing the problem;
- designing an appropriate solution to the real-world problem;
- developing the solution;
- testing the solution;
- evaluating the solution; and
- developing user support documentation.

Content	Learning Outcomes
Analysis	<p>Students should be able to:</p> <ul style="list-style-type: none"> • produce a Gantt chart to schedule the project; • identify internal and external constraints that may impact on the solution; • detail the user requirements in terms of inputs, processes and outputs; • prioritise and justify user requirements into essential and non-essential; • use analysis tools such as DFDs (level 0 and level 1) to illustrate the flow of data through the information system and the processes required; and • specify the hardware and software requirements to produce the new system.

4 Scheme of Assessment

4.1 Assessment opportunities

Each unit is available for assessment in summer each year. It is possible to resit individual AS and A2 assessment units once and count the better result for each unit towards an AS or A level qualification. Candidates' results for individual assessment units can count towards a qualification until we withdraw the specification.

4.2 Assessment objectives

There are three assessment objectives for this specification. Candidates must:

- demonstrate knowledge and understanding of the concepts, characteristics, components and functions of digital technology (AO1);
- apply knowledge and understanding of digital technology to investigate and analyse problems and propose solutions (AO2); and
- design, develop and evaluate digital technology solutions to solve problems, making reasoned judgements and presenting conclusions (AO3).

4.3 Assessment objective weightings

The table below sets out the assessment objective weightings for each assessment unit and the overall A level qualification:

Percentage Assessment Objective Weightings					
	AO1	AO2	AO3	AS	A Level
AS 1	9	6	5	20	20
AS 2	9	6	5	20	20
A2 1	16	12	12		40
A2 2	2	9	9		20
Totals	36	33	31	40	100

4.4 Quality of written communication

In AS and A level Digital Technology, candidates must demonstrate their quality of written communication. They need to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- select and use a form and style of writing that suit their purpose and complex subject matter; and
- organise information clearly and coherently, using specialist vocabulary where appropriate.

Quality of written communication is assessed in responses to questions and tasks that require extended writing.

4.5 Synoptic assessment at A2

The A2 assessment units include some synoptic assessment, which encourages candidates to develop their understanding of the subject as a whole. In our GCE Digital Technology, synoptic assessment involves:

- building on material from the AS units;
- bringing together and making connections between areas of knowledge and skills that they have explored throughout the course;
- following their own lines of enquiry, and recording and observing from primary sources; and
- responding to one or more of the following:
 - a stimulus or scenario;
 - a design brief or problem; and/or
 - a task that requires them to produce a specific image, object or other outcome.

4.6 Higher order thinking skills

The A2 assessment units provide opportunities to demonstrate higher order thinking skills by incorporating:

- a wider range of question types to address different skills, for example case studies and open-ended questions;
- more demanding evaluative tasks;
- questions that require candidates to make more connections between sections of the specification; and
- extended writing.

4.7 Reporting and grading

We report the results of individual assessment units on a uniform mark scale that reflects the assessment weighting of each unit.

We award AS qualifications on a five grade scale from A to E, with A being the highest. We award A level qualifications on a six grade scale from A* to E, with A* being the highest. To determine candidates' grades, we add the uniform marks obtained in individual assessment units.

To be awarded an A*, candidates need to achieve a grade A on their full A level qualification and at least 90 percent of the maximum uniform marks available for the A2 units. If candidates fail to attain a grade E, we report their results as unclassified (U).

The grades we award match the grade descriptions in Section 5 of this specification.

5 Grade Descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded depends in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performances in others.

The requirement for all AS and A level specifications to assess candidates' quality of written communication will be met through assessment objectives AO2 and AO3.

AS Grade Descriptions

Grade	Description
AS Grade A	<p>For AO1, candidates characteristically:</p> <ul style="list-style-type: none"> • demonstrate thorough knowledge and understanding of the concepts and key features of the systems development process; • demonstrate thorough knowledge and understanding of a range of alternative approaches to systems development; • demonstrate thorough knowledge and understanding of the characteristics of data and information and key considerations when assessing its quality; and • demonstrate thorough knowledge and understanding of key components and characteristics of hardware, software and web technology. <p>For AO2, candidates characteristically:</p> <ul style="list-style-type: none"> • effectively apply knowledge and understanding of the concepts and key features of systems development to investigate complex problems; • effectively apply a range of approaches to analyse the problem and propose solutions; and • articulate solutions to problems using technical language appropriately and accurately. <p>For AO3, candidates characteristically:</p> <ul style="list-style-type: none"> • appreciate the value of adopting a formal approach to systems development; • evaluate the key concepts associated with the systems development process; and • comprehensively articulate and evaluate solutions to problems and justify the approach taken.

Grade	Description
AS Grade E	<p>For AO1, candidates characteristically:</p> <ul style="list-style-type: none"> • demonstrate basic knowledge and understanding of the concepts and key features of the systems development process; • demonstrate basic knowledge and understanding of a range of alternative approaches to systems development; • demonstrate basic knowledge and understanding of the characteristics of data and information, and a limited understanding of considerations when assessing its quality; and • demonstrate basic knowledge and understanding of key components and characteristics of hardware, software and web technology. <p>For AO2, candidates characteristically:</p> <ul style="list-style-type: none"> • apply limited knowledge and understanding of the concepts and key features of systems development to investigate complex problems; • apply a range of approaches in a limited way to analyse the problem and propose solutions; and • suggest solutions to problems using basic technical language. <p>For AO3, candidates characteristically:</p> <ul style="list-style-type: none"> • demonstrate a basic understanding of the value of adopting a formal approach to systems development; • provide limited discussion of the key concepts associated with the systems development process; and • provide a basic solution to problems and a limited justification of the approach taken.

A2 Grade Descriptions

Grade	Description
A2 Grade A	<p>For AO1, candidates characteristically:</p> <ul style="list-style-type: none"> • demonstrate advanced knowledge and understanding of the concepts, components, characteristics and functions of computer networks and database systems; • demonstrate an in-depth knowledge and understanding of applications of digital technology in a variety of contexts; and • demonstrate a detailed understanding of individual, social and legal considerations that affect the use of digital technology. <p>For AO2, candidates characteristically:</p> <ul style="list-style-type: none"> • apply advanced knowledge and understanding of the systems development process and analytical approaches to problem solving; • carry out thorough investigation and analysis of IT-related problems; and • provide detailed documentation of user requirements and propose solutions using accurate and appropriate technical language. <p>For AO3, candidates characteristically:</p> <ul style="list-style-type: none"> • design comprehensive solutions to solve complex problems; • develop and test solutions to complex problems, analyse and present valid conclusions; and • critically evaluate the solution and make informed judgements about recommendations for improvement.

Grade	Description
<p>A2</p> <p>Grade E</p>	<p>For AO1, candidates characteristically:</p> <ul style="list-style-type: none"> • demonstrate a limited knowledge and understanding of the concepts, components, characteristics and functions of computer networks and database systems; • demonstrate a basic knowledge and understanding of applications of digital technology in a variety of contexts; and • demonstrate a limited understanding of individual, social and legal considerations that affect the use of digital technology. <p>For AO2, candidates characteristically:</p> <ul style="list-style-type: none"> • apply basic knowledge and understanding of the systems development process and analytical approaches to problem solving; • carry out limited investigation and analysis of IT-related problems; and • provide basic documentation of user requirements and propose solutions using technical language. <p>For AO3, candidates characteristically:</p> <ul style="list-style-type: none"> • design solutions of limited scope to solve a given problem; • develop and test solutions to problems and present basic conclusions; and • provide a limited evaluation of the solution and make some recommendations for improvement.

6 Guidance on External Assessment

There are three external assessment units in this specification, two at AS level and one at A2:

- Unit AS 1: Approaches to Systems Development;
- Unit AS 2: Fundamentals of Digital Technology; and
- Unit A2 1: Information Systems.

The external assessment focuses on candidates' knowledge, understanding and analysis of the content of each unit.

6.1 Unit AS 1: Approaches to Systems Development

This unit is assessed through an external written examination lasting 1 hour 30 minutes. The examination includes both short and extended writing questions and is worth 100 marks.

6.2 Unit AS 2: Fundamentals of Digital Technology

This unit is assessed through an external written examination lasting 1 hour 30 minutes. The examination includes both short and extended writing questions and is worth 100 marks.

6.3 Unit A2 1: Information Systems

This unit is assessed through an external written examination lasting 2 hours 30 minutes. The examination includes both short and extended writing questions and is worth 150 marks.

7 Guidance on Internal Assessment

There is one internal assessment unit, Unit A2 2: Application Development (Case Study), in this specification. The internal assessment focuses on candidates' ability to apply their knowledge and skills.

7.1 Skills assessed by internal assessment

Teachers must assess the following skills through internal assessment:

- investigating and analysing problems;
- designing effective solutions;
- developing solutions;
- testing and implementing solutions;
- documenting solutions for the end user; and
- evaluating solutions and their own performance.

There may also be external assessment of elements of all these skills.

7.2 Setting the tasks

We will provide centres with details of a scenario-based assessment task along with guidance on how to complete and submit it. Teachers must ensure that the completed task conforms to the unit requirements. We will produce a new scenario each year that continues to set an appropriate challenge and remains valid, reliable and stimulating. We will publish a new scenario-based task for Unit A2 2 in June each year, to be used the following academic year.

7.3 Taking the tasks

Internal assessment is likely to involve both work in the classroom and independent study. It is essential to manage the assessment conditions in a way that ensures the assessment remains reliable and fair. Please note the requirements below.

Area	Assessment Conditions
Supervision	Teachers should supervise candidates' work to: <ul style="list-style-type: none"> • monitor their progress; • prevent plagiarism and check that the work which candidates submit is their own; • comply with health and safety requirements; • provide advice and guidance if there are any problems; and • ensure that the work aligns with the specification requirements and can be marked using the criteria set out for each unit.

Area	Assessment Conditions
Authenticity	<p>Teachers must be aware of any third party copyright or intellectual property issues in candidates' work.</p> <p>They must sign a declaration to certify that, to the best of their knowledge, all the work which candidates have submitted for assessment is their own.</p>
Time Limit/ Word Limit	Candidates should be assigned 60 hours to complete the task.
Collaboration	Candidates should work independently when completing their internal assessment tasks.
Resources	Candidates must appropriately reference all the materials they use in their work, including any online resources.

7.4 Marking the tasks

Teachers should use their professional judgement to apply the criteria in the mark bands appropriately and fairly to candidates' work. They should take a 'best fit' approach to award the appropriate mark within a range, balancing strengths and weaknesses in each response.

For up-to-date advice on plagiarism, or any kind of candidate malpractice, see *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* on the Joint Council for Qualifications website at www.jcq.org.uk

7.5 Internal standardisation

Centres with more than one teaching group must carry out internal standardisation of their internal assessment tasks before submitting their marks to us. This is to ensure, as far as possible, that each teacher has applied the assessment criteria consistently. It may be necessary to adjust an individual teacher's marking:

- to bring it into line with that of other teachers in the centre; and
- to match the standards established at the agreement trial.

If marks do change, centres must amend the total/final marks on their Candidate Record Sheets.

7.6 Moderation

Centres must submit their marks and samples to us by May in any year. We may adjust centres' marking to bring the assessment of candidates' work into line with our agreed standards.

We issue full instructions each year on:

- our moderation procedures;
- which samples we require; and
- the deadlines for submitting marks and samples to us.

Teachers and centre staff may contact us at any stage for advice or support relating to internal assessment.

7.7 Internal assessment review

We will review our internal assessment tasks every year to ensure that they continue to set an appropriate challenge and remain valid, reliable and stimulating.

8 Links and Support

8.1 Support

The following resources are available to support this specification:

- our Digital Technology microsite at www.ccea.org.uk
- specimen assessment materials; and
- guidance notes for teachers.

We also intend to provide:

- past papers and mark schemes;
- Chief Examiner's reports;
- Principal Moderator's reports;
- schemes of work;
- centre support visits;
- support days for teachers;
- portfolio clinics;
- agreement trials;
- a resource list;
- exemplification of standards; and
- fact files.

8.2 Curriculum objectives

This specification supports centres to build on the broader Northern Ireland Curriculum objectives to develop the young person:

- as an individual;
- as a contributor to society; and
- as a contributor to the economy and environment.

It can contribute to meeting the requirements of the Northern Ireland Entitlement Framework at post-16 and the provision of a broad and balanced curriculum.

Curriculum Progression from Key Stage 4

This specification builds on learning from Key Stage 4 and gives students opportunities to develop their subject knowledge and understanding further.

Students will also have opportunities to continue to develop the **Cross-Curricular Skills** and the **Thinking Skills and Personal Capabilities** shown on the next page. The extent of this development depends on the teaching and learning methodology the teacher uses.

Cross-Curricular Skills

- Communication:
 - Talking and Listening
 - Reading
 - Writing
- Using Mathematics
- Using ICT

Thinking Skills and Personal Capabilities

- Problem Solving
- Working with Others
- Self-Management

For further guidance on the skills and capabilities in this subject, please refer to the supporting schemes of work.

8.3 Examination entries

Entry codes for this subject and details on how to make entries are available on our Qualifications Administration Handbook microsite, which you can access at www.ccea.org.uk

Alternatively, you can telephone our Examination Entries, Results and Certification team using the contact details provided.

8.4 Equality and inclusion

We have considered the requirements of equality legislation in developing this specification and designed it to be as free as possible from ethnic, gender, religious, political and other forms of bias.

GCE qualifications often require the assessment of a broad range of competences. This is because they are general qualifications that prepare students for a wide range of occupations and higher level courses.

During the development process, an external equality panel reviewed the specification to identify any potential barriers to equality and inclusion. Where appropriate, we have considered measures to support access and mitigate barriers.

We can make reasonable adjustments for students with disabilities to reduce barriers to accessing assessments. For this reason, very few students will have a complete barrier to any part of the assessment.

It is important to note that where access arrangements are permitted, they must not be used in any way that undermines the integrity of the assessment. You can find information on reasonable adjustments in the Joint Council for Qualifications document *Access Arrangements and Reasonable Adjustments: General and Vocational Qualifications*, available at www.jcq.org.uk

8.5 Contact details

If you have any queries about this specification, please contact the relevant CCEA staff member or department:

- Specification Support Officer: Nuala Tierney
(telephone: (028) 9026 1200, extension 2292, email: ntierney@ccea.org.uk)
- Subject Officer: Andrew Douglas
(telephone: (028) 9026 1200, extension 2713, email: adouglas@ccea.org.uk)
- Examination Entries, Results and Certification
(telephone: (028) 9026 1262, email: entriesandresults@ccea.org.uk)
- Examiner Recruitment
(telephone: (028) 9026 1243, email: appointments@ccea.org.uk)
- Distribution
(telephone: (028) 9026 1242, email: cceadistribution@ccea.org.uk)
- Support Events Administration
(telephone: (028) 9026 1401, email: events@ccea.org.uk)
- Information Section (including Freedom of Information requests)
(telephone: (028) 9026 1200, email: info@ccea.org.uk)
- Moderation
(telephone: (028) 9026 1200, extension 2236, email: moderationteam@ccea.org.uk)
- Business Assurance (Complaints and Appeals)
(telephone: (028) 9026 1244, email: complaints@ccea.org.uk or appealsmanager@ccea.org.uk).

Appendix 1

Unit A2 2 Assessment Criteria (Total Marks 120)

Analysis (30 marks)

Indicator	Mark Range
<p>At band 4 the candidate has:</p> <ul style="list-style-type: none"> • carried out comprehensive and coherent analysis on the specified problem; • produced a highly detailed project plan, demonstrating effective use of project management tools; • given full consideration to both internal and external constraints on the solution; • set out detailed user requirements in terms of inputs, process and outputs, and further categorised them into essential and non-essential requirements appropriate to the nature of the approach to be taken; • produced high quality data flow diagrams at both level 0 and level 1 to illustrate the flow of information through the current system; • considered hardware and software requirements in detail; and • demonstrated excellent: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	24–30
<p>At band 3 the candidate has:</p> <ul style="list-style-type: none"> • carried out detailed analysis on the specified problem; • produced a detailed project plan, demonstrating appropriate use of project management tools; • given consideration to both internal and external constraints on the solution; • set out user requirements in terms of inputs, process and outputs, and further categorised them into essential and non-essential requirements appropriate to the nature of the approach to be taken; • produced data flow diagrams at both level 0 and level 1 to illustrate the flow of information through the current system; • considered hardware and software requirements; and • demonstrated good: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	16–23

Indicator	Mark Range
<p>At band 2 the candidate has:</p> <ul style="list-style-type: none"> • carried out an analysis on the specified problem; • produced a project plan, demonstrating use of project management tools; • given consideration to some constraints on the solution; • set out user requirements in terms of inputs, process and outputs; • produced data flow diagrams at level 0 or level 1 to illustrate the flow of information through the current system; • considered some hardware and software requirements; and • demonstrated satisfactory: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	8–15
<p>At band 1 the candidate has:</p> <ul style="list-style-type: none"> • carried out some analysis on the specified problem; • produced a simple project plan; • set out some user requirements; • set out a consideration of data flow to illustrate the flow of information through the current system; and • demonstrated basic: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	1–7
Not worthy of credit	0

Design (30 marks)

Indicator	Mark Range
<p>At band 4 the candidate has:</p> <ul style="list-style-type: none"> • presented a detailed and thorough design of the solution, evidenced by including a highly detailed structured diagram or storyboard; • clearly and accurately set out a suitably documented normalisation to 3NF, along with an appropriate entity-relationship (ER) model; • designed appropriate algorithms in detail, giving full consideration to data structures, data validation, the user interface, queries and reports; • produced a comprehensive and well-structured test plan for the design, including a wide range of test data and expected results; and • demonstrated excellent: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	24–30
<p>At band 3 the candidate has:</p> <ul style="list-style-type: none"> • presented a suitable design of the solution, evidenced by including a suitable structured diagram or storyboard; • included a suitably documented normalisation to 3NF along with an appropriate ER model; • designed algorithms, giving full consideration to data structures, data validation, the user interface, queries and reports; • produced a well-structured test plan for the design, including a wide range of test data and expected results; and • demonstrated good: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	16–23
<p>At band 2 the candidate has:</p> <ul style="list-style-type: none"> • presented an incomplete design of the solution, evidenced by including an incomplete structured diagram or storyboard; • included a suitably documented normalisation to at least 2NF, along with an ER model; • given some consideration to data structures, data validation, the user interface, queries and reports; • included a test plan for the design; and • demonstrated satisfactory: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	8–15

Indicator	Mark Range
At band 1 the candidate has: <ul style="list-style-type: none"> • given limited consideration to the design of the solution; • given some consideration to data structures, the user interface, queries and reports; • identified some tests and associated test data; and • demonstrated basic: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	1–7
Not worthy of credit	0

Application Development (30 marks)

Indicator	Mark Range
<p>At band 4 the candidate has:</p> <ul style="list-style-type: none"> • produced a comprehensive and effective software solution to the specified problem, in line with the nature of the approach they have taken; • presented high quality evidence of full and effective implementing of the test plan with third party involvement; • fully documented the results of testing, with outputs cross-referenced to the original plan; • included a highly detailed strategy for system implementation; and • demonstrated excellent: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	24–30
<p>At band 3 the candidate has:</p> <ul style="list-style-type: none"> • produced an effective software solution to the specified problem, in line with the nature of the approach they have taken; • presented good quality evidence of an effective test plan with user involvement; • documented the results of testing; • included a good strategy for system implementation; and • demonstrated good: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	16–23
<p>At band 2 the candidate has:</p> <ul style="list-style-type: none"> • produced a software solution to the specified problem using an appropriate approach; • presented evidence of a test plan with some user involvement; • documented most results of testing; • included a strategy for system implementation; and • demonstrated satisfactory: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	8–15

Indicator	Mark Range
<p>At band 1 the candidate has:</p> <ul style="list-style-type: none"> • produced an inadequate or incomplete software solution to the problem; • devised an inadequate test plan; • presented limited evidence of the results of testing; • included an incomplete strategy for system implementation; and • demonstrated basic: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	1–7
Not worthy of credit	0

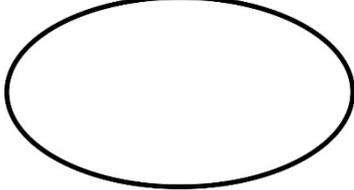
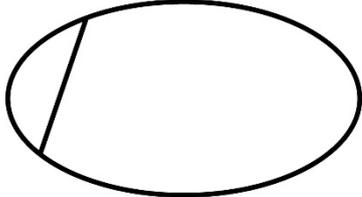
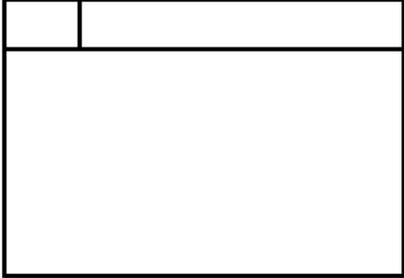
Evaluation and Documentation (30 marks)

Indicator	Mark Range
<p>At band 4 the candidate has:</p> <ul style="list-style-type: none"> • comprehensively evaluated the effectiveness of the solution against the user requirements; • demonstrated realistic awareness of limitations; • set out extensions to the application in detail; • developed a detailed electronic user guide, accessible from the user interface; • included a highly detailed troubleshooting and FAQs section; and • demonstrated excellent: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	24–30
<p>At band 3 the candidate has:</p> <ul style="list-style-type: none"> • evaluated the effectiveness of the solution against the user requirements; • demonstrated awareness of limitations; • set out possible extensions to the application; • developed a detailed electronic user guide, accessible from the user interface; • included a troubleshooting and FAQs section; and • demonstrated good: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	16–23
<p>At band 2 the candidate has:</p> <ul style="list-style-type: none"> • evaluated the effectiveness of the solution against some of the user requirements; • demonstrated some awareness of limitations; • set out possible extensions to the application; • developed an electronic user guide, accessible from the user interface; and • demonstrated satisfactory: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	8–15
<p>At band 1 the candidate has:</p> <ul style="list-style-type: none"> • carried out a limited evaluation of the solution; • developed a basic electronic user guide; and • demonstrated basic: <ul style="list-style-type: none"> – use of specialist vocabulary; and – levels of spelling, punctuation and grammar. 	1–7
Not worthy of credit	0

Appendix 2

Diagrammatic Notations

Dataflow diagram notations

Data source or destination	
Duplicated data source or destination	
Process	
Data store	
Data flow	

Entity-relationship diagram notations

<p>One to one (1:1) relationship</p>	
<p>One to many (1:M) relationship</p>	
<p>Many to many (M:N) relationship</p>	

Critical path analysis – network diagram notation

