CAMBRIDGE
International Examinations

Cambridge
IGCSE

SYLLABUS

Cambridge IGCSE®
Computer Science
0478

For examination in June and November 2016

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate (QN: 601/3120/2).

Cambridge Secondary 2

Changes to syllabus for 2016

- Section 7 gives details of changes to the availability of the pre-release material for Paper 2 Problem-Solving and Programming.
- There are some editorial changes for clarification.
- Section 6 explains the annual technical update process which will take account of emerging technologies, relevant to the syllabus content for examinations from 2017.

For examination in 2016, there are some amendments to Section 6 Syllabus Content; these are indicated by black vertical lines either side of the text.

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1. Introduction

1.1 Why choose Cambridge?

Recognition

Cambridge International Examinations is the world's largest provider of international education programmes and qualifications for learners aged 5 to 19. We are part of Cambridge Assessment, a department of the University of Cambridge, trusted for excellence in education. Our qualifications are recognised by the world's universities and employers.

Cambridge IGCSE® (International General Certificate of Secondary Education) is internationally recognised by schools, universities and employers as equivalent in demand to UK GCSEs. Learn more at **www.cie.org.uk/recognition**

Excellence in education

Our mission is to deliver world-class international education through the provision of high-quality curricula, assessment and services.

More than 9000 schools are part of our Cambridge learning community. We support teachers in over 160 countries who offer their learners an international education based on our curricula and leading to our qualifications. Every year, thousands of learners use Cambridge qualifications to gain places at universities around the world.

Our syllabuses are reviewed and updated regularly so that they reflect the latest thinking of international experts and practitioners and take account of the different national contexts in which they are taught.

Cambridge programmes and qualifications are designed to support learners in becoming:

- **confident** in working with information and ideas – their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **reflective** as learners, developing their ability to learn
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Support for teachers

A wide range of materials and resources is available to support teachers and learners in Cambridge schools. Resources suit a variety of teaching methods in different international contexts. Through subject discussion forums and training, teachers can access the expert advice they need for teaching our qualifications. More details can be found in Section 2 of this syllabus and at **www.cie.org.uk/teachers**

Support for exams officers

Exams officers can trust in reliable, efficient administration of exams entries and excellent personal support from our customer services. Learn more at **www.cie.org.uk/examsofficers**

Not-for-profit, part of the University of Cambridge

We are a not-for-profit organisation where the needs of the teachers and learners are at the core of what we do. We continually invest in educational research and respond to feedback from our customers in order to improve our qualifications, products and services.

Our systems for managing the provision of international qualifications and education programmes for learners aged 5 to 19 are certified as meeting the internationally recognised standard for quality management, ISO 9001:2008. Learn more at **www.cie.org.uk/ISO9001**

1.2 Why choose Cambridge IGCSE?

Cambridge IGCSEs are international in outlook, but retain a local relevance. The syllabuses provide opportunities for contextualised learning and the content has been created to suit a wide variety of schools, avoid cultural bias and develop essential lifelong skills, including creative thinking and problem-solving.

Our aim is to balance knowledge, understanding and skills in our programmes and qualifications to enable candidates to become effective learners and to provide a solid foundation for their continuing educational journey.

Through our professional development courses and our support materials for Cambridge IGCSEs, we provide the tools to enable teachers to prepare learners to the best of their ability and work with us in the pursuit of excellence in education.

Cambridge IGCSEs are considered to be an excellent preparation for Cambridge International AS and A Levels, the Cambridge AICE (Advanced International Certificate of Education) Group Award, Cambridge Pre-U, and other education programmes, such as the US Advanced Placement program and the International Baccalaureate Diploma programme. Learn more about Cambridge IGCSEs at **www.cie.org.uk/cambridgesecondary2**

Guided learning hours

Cambridge IGCSE syllabuses are designed on the assumption that learners have about 130 guided learning hours per subject over the duration of the course, but this is for guidance only. The number of hours required to gain the qualification may vary according to local curricular practice and the learners' prior experience of the subject.

1.3 Why choose Cambridge IGCSE Computer Science?

Computer science is the study of the foundational principles and practices of computation and computational thinking and their application in the design and development of computer systems. Learning computational thinking involves learning to program, that is to write computer code, because this is the means by which computational thinking is expressed.

Cambridge IGCSE Computer Science enables learners to develop an interest in computing and to gain confidence in computational thinking and programming. They develop their understanding of the main principles of problem-solving using computers.

Learners apply their understanding to develop computer-based solutions to problems using algorithms and a high-level programming language. They also develop a range of technical skills, as well as the ability to test effectively and to evaluate computing solutions.

This qualification will help learners appreciate current and emerging computing technologies and the benefits of their use. They learn to recognise the ethical issues and potential risks when using computers.

Cambridge IGCSE Computer Science is an ideal foundation for further study in Computer Science. Understanding the principles of Computer Science provides learners with the underpinning knowledge required for many other subjects in science and engineering, and the skills learnt can also be used in everyday life.

Prior learning

Learners in England who are beginning this course should have followed the Key Stage 3 programme of study within the National Curriculum for England.

Other learners beginning this course should have achieved an equivalent level of general education.

Progression

Cambridge IGCSE Certificates are general qualifications that enable learners to progress either directly to employment, or to proceed to further qualifications.

Candidates who are awarded grades A* to C are well prepared to follow courses leading to Level 3 AS and A Level GCE Computer Science/Computing, Cambridge International AS and A Level Computer Science, or the equivalent.

1.4 Cambridge ICE (International Certificate of Education)

Cambridge ICE is a group award for Cambridge IGCSE. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising the achievements of learners who pass examinations in at least seven subjects. To qualify for the Cambridge ICE award, learners are required to have studied subjects from five groups: two languages from Group 1, and one subject from each of the remaining four groups. The seventh subject can be taken from any of the five subject groups.

Computer Science (0478) is in Group 5, Creative, Technical and Vocational Subjects.

Learn more about Cambridge ICE at **www.cie.org.uk/cambridgesecondary2**

The Cambridge ICE is awarded from examinations administered in the June and November series each year.

1.5 How can I find out more?

If you are already a Cambridge school

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at **info@cie.org.uk**

If you are not yet a Cambridge school

Learn about the benefits of becoming a Cambridge school at **www.cie.org.uk/startcambridge**. Email us at **info@cie.org.uk** to find out how your organisation can register to become a Cambridge school.

2. Teacher support

2.1 Support materials

Cambridge syllabuses, past question papers and examiner reports to cover the last examination series are on the *Syllabus and Support Materials* DVD, which we send to all Cambridge schools.

You can also go to our public website at **www.cie.org.uk/igcse** to download current and future syllabuses together with specimen papers or past question papers and examiner reports from one series.

For teachers at registered Cambridge schools a range of additional support materials for specific syllabuses is available from Teacher Support, our secure online support for Cambridge teachers. Go to **http://teachers.cie.org.uk** (username and password required).

2.2 Resource lists

We work with publishers providing a range of resources for our syllabuses including textbooks, websites, CDs, etc. Any endorsed, recommended and suggested resources are listed on both our public website and on Teacher Support.

The resource lists can be filtered to show all resources or just those which are endorsed or recommended by Cambridge. Resources endorsed by Cambridge go through a detailed quality assurance process and are written to align closely with the Cambridge syllabus they support.

2.3 Training

We offer a range of support activities for teachers to ensure they have the relevant knowledge and skills to deliver our qualifications. See **www.cie.org.uk/events** for further information.

3. Syllabus content at a glance

Sections	Topics
Section 1 **Theory of Computer Science**	1.1 Data representation 1.1.1 Binary systems 1.1.2 Hexadecimal 1.1.3 Data storage 1.2 Communication and Internet technologies 1.2.1 Data transmission 1.2.2 Security aspects 1.2.3 Internet principles of operation 1.3 Hardware and software 1.3.1 Logic gates 1.3.2 Computer architecture and the fetch-execute cycle 1.3.3 Input devices 1.3.4 Output devices 1.3.5 Memory, storage devices and media 1.3.6 Operating systems 1.3.7 High- and low-level languages and their translators 1.4 Security 1.5 Ethics
Section 2 **Practical Problem-solving and Programming**	2.1 Algorithm design and problem-solving 2.1.1 Problem-solving and design 2.1.2 Pseudocode and flowcharts 2.2 Programming 2.2.1 Programming concepts 2.2.2 Data structures; arrays 2.3 Databases

4. Assessment at a glance

For Cambridge IGCSE Computer Science, candidates take two components: Paper 1 and Paper 2.

Components	Weighting
Paper 1 Theory 1 hour 45 minutes This written paper contains short-answer and structured questions. All questions are compulsory. No calculators are permitted in this paper. 75 marks Externally assessed.	60%
Paper 2 Problem-solving and Programming 1 hour 45 minutes This written paper contains short-answer and structured questions. All questions are compulsory. 20 of the marks for this paper are from questions set on the pre-release material.[1] No calculators are permitted in this paper. 50 marks Externally assessed.	40%

Availability

This syllabus is examined in the June and November examination series.

This syllabus is available to private candidates.

Detailed timetables are available from **www.cie.org.uk/examsofficers**

Centres in the UK that receive government funding are advised to consult the Cambridge website **www.cie.org.uk** for the latest information before beginning to teach this syllabus.

Combining this with other syllabuses

Candidates can combine this syllabus in an examination series with any other Cambridge syllabus, except:

- syllabuses with the same title at the same level
- 2210 Cambridge O Level Computer Science

Please note that Cambridge IGCSE, Cambridge International Level 1/Level 2 Certificate and Cambridge O Level syllabuses are at the same level.

1 The pre-release material for Paper 2 will be made available to Centres the January before the June examination, and the July before the November examination. It will also be reproduced in the question paper. Candidates are not permitted to bring any prepared material into the examination.

5. Syllabus aims and assessment objectives

5.1 Syllabus aims

Cambridge IGCSE Computer Science syllabus aims are to develop:

- computational thinking that is thinking about what can be computed and how, and includes consideration of the data required
- understanding of the main principles of solving problems by using computers
- understanding that every computer system is made up of sub-systems, which in turn consist of further sub-systems
- understanding of the component parts of computer systems and how they interrelate, including software, data, hardware, communications and people
- skills necessary to apply understanding to solve computer-based problems using a high-level programming language.

5.2 Assessment objectives

AO1 Recall, select and communicate knowledge and understanding of computer technology.

AO2 Apply knowledge, understanding and skills to solve computing or programming problems.

AO3 Analyse, evaluate, make reasoned judgements and present conclusions.

5.3 Relationship between assessment objectives and components

The approximate weightings allocated to each of the assessment objectives are summarised below.

Assessment objective	Paper 1	Paper 2	Weighting for qualification
AO1	32%	8%	40%
AO2	16%	24%	40%
AO3	12%	8%	20%
Total	60%	40%	100%

5.4 Grade descriptions

Grade A

- Candidates communicate a thorough knowledge and understanding of the characteristics and methods of operation of a broad range of computer hardware, software and communications.
- They systematically analyse problems and identify efficient methods to solve them. They apply knowledge, understanding and skills to design and write effective computer programs which solve these problems. In their solutions, they effectively validate input data, sequence instructions, manipulate, store and process data and represent the results of the processing in an appropriate format. They plan thorough systematic testing of programmed solutions. They amend their own programs as well as those written by others when requirements change.
- They work systematically, and critically evaluate the way they and others produce and use computer solutions.
- They understand and adopt safe, secure and responsible practices.

Grade C

- Candidates communicate a good knowledge and understanding of the characteristics and methods of operation of a broad range of computer hardware, software and communications.
- They analyse problems and identify methods to solve them. They apply knowledge, understanding and skills to design and write computer programs which solve these problems. In their solutions, they select input data, sequence instructions, manipulate, store and process data and represent the results of the processing in a mostly appropriate format. They plan testing of programmed solutions. They amend programs when requirements change.
- They evaluate the way they and others produce and use computer solutions.
- They work using safe, secure and responsible practices.

Grade F

- Candidates communicate a basic knowledge and understanding of the characteristics and methods of operation of a limited range of computer hardware, software and communications.
- They apply limited knowledge, understanding and skills to design and write basic computer programs which solve simple problems. In their solutions, they input some data, use simple instructions to process data and represent the results. They plan simple tests to programmed solutions and make simple modifications to programs when requirements change.
- They provide comments on the way they and others produce and use computer solutions.
- They demonstrate some awareness of the need for safe, secure and responsible practices.

6. Syllabus content

Annual technical updates

Technical updates will be published each year to take account of emerging technologies relevant to the Syllabus content. Please refer to the updates page for this syllabus on the Cambridge website **http//www.cie.org.uk/0478** for the relevant year of examination.

For Cambridge IGCSE Computer Science, the assessment is by written examination but the learning should happen in a mainly practical way: problem-solving and programming.

Section 1 Theory of Computer Science

1.1 Data representation

Candidates should be able to:

1.1.1 Binary systems

- recognise the use of binary numbers in computer systems
- convert positive denary integers into binary and positive binary integers into denary
- show understanding of the concept of a byte and how the byte is used to measure memory size
- use binary in computer registers for a given application (such as in robotics, digital instruments and counting systems)

1.1.2 Hexadecimal

- represent integers as hexadecimal numbers
- show understanding of the reasons for choosing hexadecimal to represent numbers
- convert positive hexadecimal integers to and from denary
- convert positive hexadecimal integers to and from binary
- represent numbers stored in registers and main memory as hexadecimal
- identify current uses of hexadecimal numbers in computing, such as defining colours in Hypertext Markup Language (HTML), Media Access Control (MAC) addresses, assembly languages and machine code, debugging

1.1.3 Data storage

- show understanding that sound (music), pictures, video, text and numbers are stored in different formats
- identify and describe methods of error detection and correction, such as parity checks, check digits, checksums and Automatic Repeat reQuests (ARQ)
- show understanding of the concept of Musical Instrument Digital Interface (MIDI) files, JPEG files, MP3 and MP4 files
- show understanding of the principles of data compression (lossless and lossy compression algorithms) applied to music/video, photos and text files

1.2 Communication and Internet technologies

Candidates should be able to:

1.2.1 Data transmission

- show understanding of what is meant by transmission of data
- distinguish between serial and parallel data transmission
- distinguish between simplex, duplex and half-duplex data transmission
- show understanding of the reasons for choosing serial or parallel data transmission
- show understanding of the need to check for errors
- explain how parity bits are used for error detection
- show understanding of the use of serial and parallel data transmission, in Universal Serial Bus (USB) and Integrated Circuit (IC)

1.2.2 Security aspects

- show understanding of the security aspects of using the Internet and understand what methods are available to help minimise the risks
- show understanding of the Internet risks associated with malware, including viruses, spyware and hacking
- explain how anti-virus and other protection software helps to protect the user from security risks (this also links into section 1.4 of the syllabus)

1.2.3 Internet principles of operation

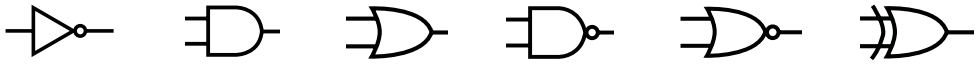
- show understanding of the role of the browser and Internet server
- show understanding of what is meant by hypertext transfer protocol (http and https) and HTML
- distinguish between HTML structure and presentation
- show understanding of the concepts of MAC address, Internet Protocol (IP) address, Uniform Resource Locator (URL) and cookies

1.3 Hardware and software

Candidates should be able to:

1.3.1 Logic gates

- use logic gates to create electronic circuits
- understand and define the functions of NOT, AND, OR, NAND, NOR and XOR (EOR) gates, including the binary output produced from all the possible binary inputs (all gates, except the NOT gate, will have 2 inputs only)
- draw truth tables and recognise a logic gate from its truth table
- recognise and use the following standard symbols used to represent logic gates:



NOT AND OR NAND NOR XOR

- produce truth tables for given logic circuits, for example:

A	B	C	Out
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

- produce a logic circuit to solve a given problem or to implement a given written logic statement, such as IF (switch A is NOT on) OR (switch B is on AND switch C is NOT on) then alarm, X, sounds

1.3.2 Computer architecture and the fetch-execute cycle

- show understanding of the basic Von Neumann model for a computer system and the stored program concept (program instructions and data are stored in main memory and instructions are fetched and executed one after another)
- describe the stages of the fetch-execute cycle, including the use of registers

1.3.3 Input devices

- describe the principles of operation (how each device works) of these input devices: 2D and 3D scanners, barcode readers, Quick Response (QR) code readers, digital cameras, keyboards, mice, touch screens, interactive whiteboard, microphones
- describe how these principles are applied to real-life scenarios, for example: scanning of passports at airports, barcode readers at supermarket checkouts, and touch screens on mobile devices
- describe how a range of sensors can be used to input data into a computer system, including light, temperature, magnetic field, gas, pressure, moisture, humidity, pH and motion
- describe how these sensors are used in real-life scenarios, for example: street lights, security devices, pollution control, games, and household and industrial applications

1.3.4 Output devices

- describe the principles of operation of the following output devices: inkjet, laser and 3D printers; 2D and 3D cutters; speakers and headphones; actuators; flat-panel display screens, including Liquid Crystal Display (LCD) and Light-Emitting Diodes (LED) display; LCD projectors and Digital Light Projectors (DLP)
- describe how these principles are applied to real-life scenarios, for example: printing single items on demand or in large volumes; use of small screens on mobile devices

1.3.5 Memory, storage devices and media

- show understanding of the difference between: primary, secondary and off-line storage and provide examples of each, such as:

  primary: Read Only Memory (ROM), and Random Access Memory (RAM)

  secondary: hard disk drive (HDD) and Solid State Drive (SSD); off-line: Digital Versatile Disc (DVD), Compact Disc (CD), Blu-ray disc, USB flash memory and removable HDD
- describe the principles of operation of a range of types of storage device and media including magnetic, optical and solid state
- describe how these principles are applied to currently available storage solutions, such as SSDs, HDDs, USB flash memory, DVDs, CDs and Blu-ray discs
- calculate the storage requirement of a file

1.3.6 Operating systems

- describe the purpose of an operating system
- show understanding of the need for interrupts

1.3.7 High- and low-level languages and their translators

- show understanding of the need for both high-level and low-level languages
- show understanding of the need for compilers when translating programs written in a high-level language
- show understanding of the use of interpreters with high-level language programs
- show understanding of the need for assemblers when translating programs written in assembly language

1.4 Security

Candidates should be able to:

1.4.1 • show understanding of the need to keep data safe from accidental damage, including corruption and human errors • show understanding of the need to keep data safe from malicious actions, including unauthorised viewing, deleting, copying and corruption
1.4.2 • show understanding of how data are kept safe when stored and transmitted, including: – use of passwords, both entered at a keyboard and biometric – use of firewalls, both software and hardware, including proxy servers – use of security protocols such as Secure Socket Layer (SSL) and Transport Layer Security (TLS) – use of symmetric encryption (plain text, cypher text and use of a key) showing understanding that increasing the length of a key increases the strength of the encryption
1.4.3 • show understanding of the need to keep online systems safe from attacks including denial of service attacks, phishing, pharming
1.4.4 • describe how the knowledge from 1.4.1, 1.4.2 and 1.4.3 can be applied to real-life scenarios including, for example, online banking, shopping

1.5 Ethics

Candidates should be able to:

• show understanding of computer ethics, including copyright issues and plagiarism • distinguish between free software, freeware and shareware • show understanding of the ethical issues raised by the spread of electronic communication and computer systems, including hacking, cracking and production of malware

Section 2 Practical Problem-solving and Programming

2.1 Algorithm design and problem-solving

Candidates should be able to:

2.1.1 Problem-solving and design

- show understanding that every computer system is made up of sub-systems, which in turn are made up of further sub-systems
- use top-down design, structure diagrams, flowcharts, pseudocode, library routines and sub-routines
- work out the purpose of a given algorithm
- explain standard methods of solution
- suggest and apply suitable test data
- understand the need for validation and verification checks to be made on input data (validation could include range checks, length checks, type checks and check digits)
- use trace tables to find the value of variables at each step in an algorithm
- identify errors in given algorithms and suggest ways of removing these errors
- produce an algorithm for a given problem (either in the form of pseudocode or flowchart)
- comment on the effectiveness of a given solution

2.1.2 Pseudocode and flowcharts

- understand and use pseudocode for assignment, using ←
- understand and use pseudocode, using the following conditional statements:

  `IF … THEN … ELSE … ENDIF`

  `CASE … OF … OTHERWISE … ENDCASE`
- understand and use pseudocode, using the following loop structures:

  `FOR … TO … NEXT`

  `REPEAT … UNTIL`

  `WHILE … DO … ENDWHILE`
- understand and use pseudocode, using the following commands and statements:

  `INPUT` and `OUTPUT` (e.g. `READ` and `PRINT`)

  totalling (e.g. `Sum ← Sum + Number`)

  counting (e.g. `Count ← Count + 1`)
- understand and use standard flowchart symbols to represent the above statements, commands and structures

(Candidates are advised to try out solutions to a variety of different problems on a computer using a language of their choice; no particular programming language will be assumed in this syllabus.)

2.2 Programming

Candidates should be able to:

2.2.1 Programming concepts

- declare and use variables and constants
- understand and use basic data types: Integer, Real, Char, String and Boolean
- understand and use the concepts of sequence, selection, repetition, totalling and counting
- use predefined procedures/functions

2.2.2 Data structures; arrays

- declare and use one-dimensional arrays, for example: `A[1:n]`
- show understanding of the use of one-dimensional arrays, including the use of a variable as an index in an array
- read or write values in an array using a `FOR … TO … NEXT` loop

2.3 Databases

Candidates should be able to:

- define a single-table database from given data storage requirements
- choose and specify suitable data types
- choose a suitable primary key for a database table
- perform a query-by-example from given search criteria

7. Description of components

Scheme of assessment

Paper 1 Theory

This is a compulsory question paper, consisting of short-answer and structured questions set on Section 1 of the syllabus content. All questions are compulsory. Candidates will answer on the question paper.

Paper 2 Problem-solving and Programming

This is a compulsory question paper, consisting of short-answer and structured questions set on Section 2 of the syllabus content. All questions are compulsory. Candidates will answer on the question paper. 20 of the marks in this paper are from questions set on tasks provided in the Paper 2 Problem-solving and Programming pre-release material.

Centres need to be aware that in order to prepare best their candidates for this paper, they should plan for sufficient practical sessions within their lesson timetable and teach the contents of the section in a largely practical way. Candidates will be expected to be able to program in a high-level programming language to be chosen by the Centre. The programming language should be procedural.

There will be some examining of knowledge with understanding, but most of the credit will be for using techniques and skills to solve problems. The examination questions will require candidates to have practical programming experience, including writing their own programs, executing (running), testing and debugging them. Knowledge of programming language syntax will not be examined; in all cases the logic will be more important than the syntax.

Paper 2 Problem-solving and Programming pre-release material

The Paper 2 Problem-solving and Programming pre-release material will be made available to Centres the January before the June examination, and the July before the November examination. It will also be reproduced in the question paper. Candidates are not permitted to bring any prepared material into the examination.

Centres are advised to encourage their candidates to develop solutions to tasks using a high-level programming language, such as Visual Basic, Pascal/Delphi or Python. The purpose of the pre-release material tasks is to direct candidates to some of the topics which will be examined in Paper 2. Teachers are expected to incorporate these tasks into their lessons and give support in finding methods and reaching solutions. 20 of the marks in this paper will be from questions testing candidates' understanding gained from developing programmed solutions to these tasks.

8. Notes for the guidance of teachers

Introduction

The purpose of these notes is to provide assistance for teachers preparing learners for the Cambridge IGCSE Computer Science examination. They contain notes on equipment, facilities and resources and sources of further information.

Equipment and facilities

Computer science is a practical subject and the Cambridge IGCSE Computer Science syllabus places emphasis on the use of procedural high-level programming languages. Centres must ensure that their equipment and facilities are adequate for learners to be able to satisfy the requirements of the syllabus. The hardware facilities needed will depend on the number of learners, but should be sufficient for all candidates to have enough time to practise their programming skills.

Hardware

Learners need to have access to a system with direct-access file capability on backing store and hardcopy facilities.

Software

Learners should have experience of using a high-level programming language, such as Visual Basic, Pascal/Delphi or Python, chosen by the Centre.

Books

Provision of textbooks is difficult as new titles are available all the time. The British Computer Society (BCS) book list for schools and colleges lists books which are suitable for use as reference books. Teachers will need to consult several books to cover the whole syllabus adequately. There is a suggested book list on our website. Many schools prefer to have a wide range of reference books rather than a class textbook.

Practical skills

Computer science is a practical subject and a range of practical exercises should be integral to the teaching of this qualification.

It is important that teachers encourage learners, as early as possible in the course, to develop a systematic approach to practical problem-solving using appropriate resources.

9. Other information

Equality and inclusion

Cambridge International Examinations has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind. To comply with the UK Equality Act (2010), Cambridge has designed this qualification with the aim of avoiding direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with disabilities or learning difficulties. Arrangements can be put in place for these candidates to enable them to access the assessments and receive recognition of their attainment. Access arrangements will not be agreed if they give candidates an unfair advantage over others or if they compromise the standards being assessed.

Candidates who are unable to access the assessment of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Information on access arrangements is found in the *Cambridge Handbook* which can be downloaded from the website **www.cie.org.uk/examsofficer**

Language

This syllabus and the associated assessment materials are available in English only.

Grading and reporting

Cambridge IGCSE results are shown by one of the grades A*, A, B, C, D, E, F or G indicating the standard achieved, A* being the highest and G the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade G. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results) and Y (to be issued) may also appear on the statement of results but not on the certificate.

Entry codes

To maintain the security of our examinations, we produce question papers for different areas of the world, known as 'administrative zones'. Where the component entry code has two digits, the first digit is the component number given in the syllabus. The second digit is the location code, specific to an administrative zone. Information about entry codes can be found in the *Cambridge Guide to Making Entries*.

10. Additional information for England, Wales and Northern Ireland

This syllabus appears on the Register of Regulated Qualifications (**http://register.ofqual.gov.uk**) as a Cambridge International Level 1/Level 2 Certificate. In other contexts it is known as a Cambridge IGCSE.

Cambridge International Level 1/Level 2 Certificates are approved for regulation in England, Wales and Northern Ireland and are eligible for inclusion in school and college performance tables.

For up-to-date information on the performance tables, including the list of qualifications which count towards the English Baccalaureate, please go to the Department for Education website and search on 'performance tables'.

Candidates who are awarded grades D to G will have achieved an award at Level 1 of the National Qualifications Framework. Candidates who are awarded grades A* to C will have achieved an award at Level 2 of the National Qualifications Framework.

Prior learning

Learners in England who are beginning this course should have followed the Key Stage 3 programme of study within the National Curriculum for England.

Other learners beginning this course should have achieved an equivalent level of general education.

Progression

Cambridge IGCSE Certificates are general qualifications that enable learners to progress either directly to employment, or to proceed to further qualifications.

Candidates who are awarded grades A* to C are well prepared to follow courses leading to Level 3 AS and A Level GCE Computer Science/Computing, Cambridge International AS and A Level Computer Science, or the equivalent.

Grading and reporting

Cambridge International Level 1/Level 2 Certificate results are shown by one of the grades A*, A, B, C, D, E, F or G indicating the standard achieved, A* being the highest and G the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade G. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results) and Y (to be issued) may also appear on the statement of results but not on the certificate.

Overlapping qualifications

Every qualification is assigned to a national classification code indicating the subject area to which it belongs. Candidates who enter for more than one qualification with the same classification code will only have one grade (the highest) counted for the purpose of the school and college performance tables. Centres may wish to advise candidates that, if they take two qualifications with the same classification code, colleges are very likely to take the view that they have achieved only one of the two qualifications. Candidates who have any doubts about their subject combinations should seek advice, either from their centre or the institution to which they wish to progress.

Spiritual, moral, ethical, social, legislative, economic and cultural issues

This syllabus encourages candidates to explore the spiritual, moral, ethical, social, legislative, and cultural aspects of the introduction of computer-based solutions through a study of their effects on society.

Through candidates' study of Section 1 Theory of Computer Science, they have an opportunity to develop their understanding of spiritual, moral, ethical, social, legislative and cultural issues. These topics consider issues such as changing leisure patterns and work practices, privacy and confidentiality of data held in systems, opportunities for access to information and environmental issues.

Sustainable development, health and safety considerations and international developments

This syllaubs offers opportunities to develop their ideas on sustainable development and environmental issues, health and safety considerations, and the international dimension. Through their own practical work in problem-solving and programming activities, they should consider sustainability, health and safety issues.

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