KS4 Curriculum Content

GCSE Computer Science

Year 10	Half Term 1 September - October	Half Term 2 October - December	Half Term 3 January - February
	Topic 1.1 Systems Architecture Knowledge Students study the architecture of a CPU and the processes that CPUs follow when carrying out tasks. 1.1.1 Architecture of the CPU The purpose of the CPU: • The fetch-execute cycle Common CPU components and their function: • ALU (Arithmetic Logic Unit) • CU (Control Unit) • Cache • Registers. Von Neumann architecture: • MAR (Memory Address Register) • MDR (Memory Data Register) • Program Counter • Accumulator 1.1.2 CPU performance How common characteristics of CPUs affect their performance: • Clock speed • Cache size • Number of cores 1.1.3 Embedded systems The purpose and characteristics of embedded systems. Examples of embedded systems.	1.2.3 Units The units of data storage: • Bit • Nibble (4 bits) • Byte (8 bits) • Kilobyte (1,000 bytes or 1 KB) • Megabyte (1,000 KB) • Gigabyte (1,000 MB) • Terabyte (1,000 GB) • Petabyte (1,000 TB) How data needs to be converted into a binary format to be processed by a computer. Data capacity and calculation of data capacity requirements. 1.2.4 Data storage Numbers • How to convert positive denary whole numbers to binary numbers (up to and including 8 bits) and vice versa • How to add two binary integers together (up to and including 8 bits) and explain overflow errors which may occur • How to convert positive denary whole numbers into 2-digit hexadecimal numbers and vice versa • How to convert binary integers to their hexadecimal equivalents and vice versa • Binary shifts Characters	Topic 1.3 – Computer networks, connections and protocols Knowledge This topic focuses on how computers are connected to form networks and the technology and protocols that are used to allow this to happen. 1.3.1 Networks and topologies Types of network: • LAN (Local Area Network) • WAN (Wide Area Network) Factors that affect the performance of networks. The different roles of computers in a client-server and a peer-to peer network. The hardware needed to connect stand-alone computers into a Local Area Network: • Wireless access points • Routers • Switches • NIC (Network Interface Controller/Card) • Transmission media The Internet as a worldwide collection of computer networks: • DNS (Domain Name Server) • Hosting • The Cloud • Web servers and clients

	Topic 1.2 Memory and Storage Knowledge Students will learn about how data is stored in memory and secondary storage. Students also learn how data is stored as binary numbers and how to convert between different number systems. 1.2.1 Primary storage (Memory) The need for primary storage. The difference between RAM and ROM The purpose of ROM in a computer system The purpose of RAM in a computer system Virtual memory 1.2.2 Secondary storage The need for secondary storage. Common types of storage: • Optical • Magnetic • Solid state Suitable storage devices and storage media for a given application. The advantages and disadvantages of different storage devices and storage media relating to these characteristics: • Capacity • Speed • Portability	• The use of binary codes to represent characters • The term 'character set' • The relationship between the number of bits per character in a character set, and the number of characters which can be represented, e.g.: ASCII; Unicode Images • How an image is represented as a series of pixels, represented in binary • Metadata • The effect of colour depth and resolution on: The quality of the image; The size of an image file Sound • How sound can be sampled and stored in digital form • The effect of sample rate, duration and bit depth on: The playback quality; The size of a sound file 1.2.5 Compression The need for compression Types of compression: • Lossy • Lossless Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.	Star and Mesh network topologies 1.3.2 Wired and wireless networks, protocols and layers Modes of connection: • Wired - Ethernet • Wireless - Wi-Fi; Bluetooth Encryption IP addressing and MAC addressing Standards Common protocols including: • TCP/IP (Transmission Control Protocol/Internet Protocol) • HTTP (Hyper Text Transfer Protocol) • HTTPS (Hyper Text Transfer Protocol Secure) • FTP (File Transfer Protocol) • POP (Post Office Protocol) • IMAP (Internet Message Access Protocol) • SMTP (Simple Mail Transfer Protocol) The concept of layers Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.

	• Durability • Reliability • Cost Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams.		
Vocabulary Links	**Architecture, Processor, Component, Fetch-Decode-Execute Cycle, Control Unit, Memory Address Register (MAR), Memory Data Register (MDR), Cache, Hertz, Gigahertz, Cycles, Memory, RAM, Bit, Nibble, Byte, Kilobyte, Megabyte, Gigabyte, Terabyte, Petabyte.**	**Secondary Storage, Hard Disk Drive (HDD), Solid State Drive (SSD), Read Only Memory (ROM), BIOS, Binary, Hexadecimal, Denary, Base 2, Base 10, Base 16, ASCII, Extended ASCII, Unicode, Lossy, Lossless, Metadata, Pixel, Bitmap, Colour Depth, Resolution, Dots per Inch (DPI), Sample Rate, Bit Depth, Bit Rate.**	**Switch, Router, Network Interface Controller (NIC), CAT5e/6 Cable, Coaxial Cable, Fibre Optic Cable, Local Area Network (LAN), Ethernet, Wide Area Network (WAN), Bandwidth, Wired, Wireless, Network Topology, Star Topology, Mesh Topology, Transmit, Latency, Client-Server Network, Peer-to-Peer Network, Client, Server, Web Server, URLs, Domain Name System (DNS), IP Address, MAC Address, Hosting, The Cloud, Wi-Fi, Encryption, SSID, Cipher Text, Master key, Network Standards, Network Protocols, Network Layers, TCP/IP, HTTP, HTTPS, FTP, POP3, IMAP, SMTP, Application Layer, Transport Layer, Internet Layer, Network Access Layer.**
Assessment Objectives	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science.	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science.	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science.
Year 10	Half Term 4 February – March	Half Term 5 April - May	Half Term 6 June - July
	Topic 1.4 Network Security Knowledge	Topic 1.5 Systems Software Knowledge	Topic 1.6 Ethical, Legal, Cultural and Environmental Impacts of Digital Technology Knowledge

	Students will study the potential weaknesses in networks, the threats posed by hackers, and potential solutions to these issues. 1.4.1 Threats to computer systems and networks: Forms of attack: • Malware • Social engineering, e.g. phishing, people as the 'weak point' • Brute-force attacks • Denial of service attacks • Data interception and theft • The concept of SQL injection 1.4.2 Identifying and preventing vulnerabilities Common prevention methods: • Penetration testing • Anti-malware software • Firewalls • User access levels • Passwords • Encryption • Physical security Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.	Students learn about the different types of systems software and how this software runs and maintains a computer. 1.5.1 Operating systems: The purpose and functionality of operating systems: • User interface • Memory management and multitasking • Peripheral management and drivers • User management • File management 1.5.2 Utility software The purpose and functionality of utility software. Utility system software: • Encryption software • Defragmentation • Data compression Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.	Students are required to see how digital technology impacts the world. Students look at issues such as e-safety, cyberbullying, e-waste, the digital divide, and the legislation that is used to manage these issues. 1.6.1 Ethical, legal, cultural and environmental impact Impacts of digital technology on wider society including: • Ethical issues • Legal issues • Cultural issues • Environmental issues • Privacy issues Legislation relevant to Computer Science: • The Data Protection Act 2018 • Computer Misuse Act 1990 • Copyright Designs and Patents Act 1988 • Software licences (i.e. open source and proprietary) Assessment - students will be assessed with an end of topic test with a range of past questions from previous exams.
Vocabulary Links	**Passive Attack, Brute Force Attack, Active Attack, Insider Attack, Denial-of-Service Attack (DoS), Encryption, Hacker, Malicious Software (Malware), Firewall, Intrusion Prevention**	**Application Software, Systems Software, Operating System, Utility Software, User Interface, Memory Management, Buffering, Multitasking, Peripheral Management, Device Drivers, User Management, Access**	**Ethical Issues, Legal issues, Cultural Issues, Environmental Issues, Open Source, Proprietary, Legislation, Stakeholders, Natural Resources, Virtual Servers, Hibernation, E-Waste, Internet**

	Systems, Rate-Limit Router, Cracking Passwords, Data Loss Prevention, Virus, Worm, Trojan, Scareware, Ransomware, Spyware, Rootkits, Social Engineering, Phishing, SQL Injection, Data Interception, Lawful Interception, Penetration Testing (Pentesting), Physical Security.	**Rights, File Management, File Permissions, Graphical User Interfaces (GUI), Command-Line Interfaces (CLI), Encryption, Defragmentation, Compression.**	**Censorship, Computer Surveillance, Peer Pressure, Cyber Bullying, Trolling, E-Safety, Repetitive Strain Injury (RSI), Digital Divide, Global Divide, Data Protection Act 1998, Copyright, Computer Misuse Act 1990, Copyright Designs and Patents Act 1988, Software Licences.**
Assessment Objectives	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science.	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science.	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science.
Year 11	Half Term 1 September - October	Half Term 2 October - December	Half Term 3 January - February
	Topic 2.1 Algorithms Knowledge Students will explore complex problems are broken down using abstraction and decomposition and then represented using algorithms, such as flow charts and pseudocode. 2.1.1 Computational thinking: Principles of computational thinking: • Abstraction • Decomposition • Algorithmic thinking 2.1.2 Designing, creating and refining algorithms Identify the inputs, processes, and outputs for a problem. Structure diagrams.	Topic 2.2 Programming fundamentals Knowledge In this topic, students learn the basics of programming and how to execute code. The fundamental concepts, such as sequence, selection, and iteration are discussed. Students will also learn basic Python programming commands, such as print, input, if statements, and loops. 2.2.1 Programming fundamentals The use of variables, constants, operators, inputs, outputs and assignments. The use of the three basic programming constructs used to control the flow of a program: • Sequence • Selection • Iteration (count- and condition-controlled loops)	Topic 2.3 – Producing robust programs Knowledge This topic expands on the last topic by looking at more complex programming concepts and thus allows students to build on their existing knowledge. 2.3.1 Defensive design Defensive design considerations: • Anticipating misuse • Authentication Input validation. Maintainability: • Use of sub programs • Naming conventions • Indentation • Commenting 2.3.2 Testing The purpose of testing

	Create, interpret, correct, complete, and refine algorithms using: • Pseudocode • Flowcharts • Reference language/high-level programming language Identify common errors. Trace tables. 2.1.3 Searching and sorting algorithms Standard searching algorithms: • Binary search • Linear search Standard sorting algorithms: • Bubble sort • Merge sort • Insertion sort Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.	The common arithmetic operators. The common Boolean operators AND, OR and NOT. 2.2.2 Data types The use of data types: • Integer • Real • Boolean • Character and string • Casting 2.2.3 Additional programming techniques The use of basic string manipulation The use of basic file handling operations: • Open • Read • Write • Close The use of records to store data. The use of SQL to search for data. The use of arrays (or equivalent) when solving problems, including both one-dimensional (1D) and two-dimensional arrays (2D). How to use sub programs (functions and procedures) to produce structured code. Random number generation Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions	Types of testing: • Iterative • Final/terminal Identify syntax and logic errors. Selecting and using suitable test data: • Normal • Boundary • Invalid/Erroneous Refining algorithms Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.

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Vocabulary Links	**Algorithm, Pseudocode, Flow Chart, Abstraction, Decomposition, Linear Search Algorithm, Binary Search Algorithm, Bubble Sort Algorithm, Merge Sort Algorithm, Insertion Sort Algorithm, Binary Search Tree, Trace Table.**	**Sequence, Selection, Iteration, Variables, Constants, Operators, Inputs, Outputs, Assignments, Count Controlled Loops, Conditional Loops, Arithmetic Operators, Boolean Operators, Modulus, Quotient, Exponentiation, Integer, Real Number, Boolean, Character, String, Casting, One-Dimensional Array, Two-Dimensional Array, Sub Program, Function, Procedure, SQL, File Operations - Open/Read/Write/Close, String Manipulation, Concatenation, Slicing, Fields, Records, SQL Commands – SELECT/FROM/WHERE.**	**Defensive Design, Authentication, Input Validation, Maintainability, Indentation, Commenting, Iterative Testing, Final/Terminal Testing, Syntax, Test Data – Normal/Boundary/Invalid/Erroneous.**
Assessment Objectives	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science. AO3 – Analyse problems in computational terms: to make reasoned judgements; to design, program, evaluate and refine solutions.	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science. AO3 – Analyse problems in computational terms: to make reasoned judgements; to design, program, evaluate and refine solutions.	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science. AO3 – Analyse problems in computational terms: to make reasoned judgements; to design, program, evaluate and refine solutions.
Year 11	Half Term 4 February – March	Half Term 5 April - May	
	Topic 2.5 2.4 – Boolean logic Knowledge Students learn about Boolean logic and how logic gates form the basis of computer systems. The logical operators AND, OR, and NOT are taught and students create truth tables based on these concepts. 2.4.1 Boolean logic	Topic revision and exam preparation Knowledge This half term will be spent revisiting areas of weakness specific to the class and preparing for the examination. Students will learn how the examiners mark the exams using exemplar answers and mark schemes to be able to accurately grade work. They will then use this in their practice exam answers to be able to refine their answers to attract as many marks as possible.	

	Simple logic diagrams using the operators AND, OR and NOT. Truth tables. Combining Boolean operators using AND, OR and NOT. Applying logical operators in truth tables to solve problems. 2.5 – Programming languages and Integrated Development Environments Knowledge This topic expands on the topics 2.2 and 2.3 by looking at more further complex programming concepts and again allowing students to build on their existing knowledge. 2.5.1 Languages Characteristics and purpose of different levels of programming language: • High-level languages • Low-level languages The purpose of translators. The characteristics of a compiler and an interpreter. 2.5.2 The Integrated Development Environment (IDE) Common tools and facilities available in an Integrated. Development Environment (IDE):	Where possible topics will be linked together from theme one and two allowing questions to cover both areas Assessment Full papers and bespoke papers will be used to cover areas of weakness along with exam techniques which need honing, such as answers in context or longer answer questions.	

	• Editors • Error diagnostics • Run-time environment • Translators Assessment - students will be assessed with an end of topic test with a range of past exam questions from previous exams, questions from previous topics will also be included to make the assessment holistic.		
Vocabulary Links	**Boolean, Operators, AND/OR/NOT, Truth Table, Logical Operator, Logic Gate, High-Level Languages, Low-Level Languages, Translators, Compiler, Interpreter, Integrated Development Environment (IDE), Editors, Error Diagnostics, Run-Time Environment.**		
Assessment Objectives	AO1 – Demonstrate knowledge and understanding of the key concepts and principles of Computer Science. AO2 – Apply knowledge and understanding of key concepts and principles of Computer Science. AO3 – Analyse problems in computational terms: to make reasoned judgements; to design, program, evaluate and refine solutions.		

The exam papers:

Exam 1 - J277/01: Computer systems

This is a compulsory component. It is worth 80 marks, representing 50% of the total marks for the GCSE (9–1). This component is an externally assessed written examination testing AO1 and AO2. The examination lasts 1 hour 30 minutes. All the questions are mandatory. Students are not permitted to use a calculator in the examination. The question paper will consist of short and medium answer questions. There will also be one 8-mark extended response question. This question will enable students to demonstrate the ability to construct and develop a sustained line of reasoning.

Exam 2 - J277/02: Computational thinking, algorithms and programming

This is a compulsory component. It is worth 80 marks, representing 50% of the total marks for the GCSE (9–1). This component is an externally assessed written examination testing AO1, AO2 and AO3. The examination lasts 1 hour 30 minutes and is formed of two sections. All the questions are mandatory. Section A is worth 50 marks, and assesses students' knowledge and understanding of concepts of Computer Science. Students then apply these to problems in computational terms, where they may use an algorithmic approach. Section B is worth 30 marks, and assesses students' Practical Programming skills and their ability to design, write, test and refine programs. Students are not permitted to use a calculator in the examination. The question paper will consist of short and medium answer questions.