KS4 Curriculum Map – Computer Science:

Topic	Substantive Knowledge This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	Disciplinary Knowledge (Skills) This is the action taken within a particular topic in order to gain substantive knowledge.	Assessment Opportunities What assessments will be used to measure student progress?
Algorithms	• Computational thinking ○ Abstraction ○ Decomposition ○ Algorithmic Thinking. • Designing, creating and refining algorithms ○ Pseudocode ○ Flowcharts ○ Reference language/high-level programming language ○ Trace tables • Searching and sorting algorithms ○ Binary search ○ Linear search ○ Bubble sort ○ Merge sort Insertion sort	Understand and use different types of search • Linear search Understand arithmetic operators and variables Define the data types integer, real, Boolean, character, string Understand the principles of • computational thinking including • Abstraction • Decomposition • Algorithmic thinking Understand and use different types of search • Binary search • Understand the standard sort algorithms: • Bubble sort • Insertion sort Merge sort	• Worksheets/homeworks • End of unit test Mid-year assessment
Programming fundamentals	• Programming fundamentals ○ The use of variables, constants, operators, inputs, outputs and assignments ○ Sequence, Selection, Iteration (count- and condition- controlled loops) ○ The common arithmetic operators	• Understand and use data types: integer, real, Boolean, character and string • Declare and use constants and variables • Use random number generation • Use arithmetic operators including MOD and DIV • Use string handling and conversion functions	• Programming project • Worksheets/homeworks • End of unit test • Mid-year assessment

	- o The common Boolean operators AND, OR, NOT - Data types - o Integer, Real, Boolean, Character and string - Additional programming techniques - o The use of basic string manipulation - o The use of basic file handling - o The use of records to store data - o The use of SQL to search for data - o Arrays - Sub programs	- Use selection and nested selection statements with NOT, AND and OR when creating Boolean expressions - Understand and use iteration in an algorithm - Write algorithms in pseudocode involving sequence, selection and iteration - Use one- and two-dimensional arrays in the design of solutions to simple problems - Understand the concept of subroutines - Understand and use basic file handling operations Use SQL (Structured Query Language) statements to search for data	
Data Representation	- The units of data storage - How data is converted to binary format - Data capacity and requirements - Denary, binary and hexadecimal conversions - Binary shifts - Binary addition - Compression	- Define the terms bit, byte, kilobyte, megabyte, gigabyte, - Convert positive denary whole numbers (0-255) into 8-bit binary numbers and vice versa - Convert between binary, denary and hexadecimal equivalents of the same number - Add two 8-bit binary integers and explain overflow errors which may occur - Understand the use of binary shifts - Understand the use of binary codes to represent characters - Understand the term 'character set' - Explain how sampling intervals and resolution affect the size of a sound file using the terms: - o Sample rate - o Bit depth	- Worksheets/homeworks - End of unit test - Mid-year assessment

Systems architecture	• The purpose of the CPU
	  o The fetch-execute cycle
	• Common CPU components and their function:
	  o ALU (Arithmetic Logic Unit)
	  o CU (Control Unit)
	  o Cache
	  o Registers
	• Von Neumann architecture:
	  o MAR (Memory Address Register)
	  o MDR (Memory Data Register)
	  o Program Counter
	  o Accumulator
	• How common characteristics of CPUs affect their performance:
	  o Clock speed
	  o Cache size
	  o Number of Cores
	• The purpose and characteristics of embedded systems
	Examples of embedded systems
	• Primary and secondary storage
	• RAM and ROM
	• Common types of storage
	• Suitable secondary storage devices
	• Characteristics of storage media
		• Understand the purpose of the CPU
		• Identify actions occur at each stage of the fetch-execute cycle
		• The role/purpose of each component and what it manages, stores, or controls during the fetch-execute cycle Common CPU components and their function
		• The purpose of each register, what it stores (data or address)
		• LMC to demonstrate the FDE cycle
		• Explain the function of the ALU and CU function
		• Understand how cache, clock speed and number of cores affects the performance of the CPU
		• Identify examples and characteristics of an embedded system
		• The need for primary storage and key characteristics of RAM and ROM
		• Understand how virtual memory works
		• Identify the different types of storage
		• Understand how optical, magnetic and solid-state function
		• Name the key characteristics of each storage media: capacity, speed, portability, durability, reliability and cost
			• Worksheets/homeworks
			• Exam style questions
			• Little man computer activities
			• End of unit test
			• Mid-year assessment

Networks and topologies	• Types of networks:
	    • 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
		• Define a Wide Area Network
		• Describe the difference between a Local Area Network and a Wide Area Network
		• Describe star and mesh network topologies
		• Understand wireless modes of connection, including:
		– Wi-Fi
		– Bluetooth
		• Explain the need for Wireless Access Points to create wireless hotspots
		• Describe what is meant by:
		- Hosting
			• Worksheets/homeworks
			• Exam style questions
			• Network workbook
			• End of unit test
			• Mid-year assessment

	• NIC (Network Interface Controller/Card)
	• Transmission media
	• The Internet as a worldwide collection of computer networks:
	    • DNS (Domain Name Server)
	    • Hosting
	    • The Cloud
	    • Webservers and Clients
	• Star and Mesh network topologies
	• Modes of connection:
	    • Wired
	    • Wireless
	• Encryption
	• IP addressing and MAC addressing
	• Common protocols including:
	    • TCP/IP, HTTP, HTTPS, FTP, POP, IMAP, SMTP
	• The concept of layers
		- The Cloud
		• Describe the factors that affect network performance
		• Describe the uses of communications protocols including
		• Explain the need for IP addressing of resources on the Internet and how this can be facilitated by the role of DNS services
		• Understand the need for Network Interface Cards and the uses of MAC addressing
		• Explain packet switching
		• Describe routers and switches needed to connect stand-alone computers into a Local Area Network
		• Explain the use of Ethernet standards to transmit data over a wired network
		• Understand how encryption is used to secure data across network connections
		• Explain the role of computers in client-server and peer-to-peer networks
		• Describe the uses of communications protocols
		• Explain the concept of layers in the TCP/IP protocol stack	

Threats to computer systems and networks	• Forms of attack
	• Malware
	• Social engineering, e.g. phishing, people as the 'weak point'
	    o Brute-force attacks
	    o Denial of service attacks
	    o Data interception and theft
	    o The concept of SQL injection
	
	• Common prevention methods:
	    o Penetration Testing
	    o Anti-malware software
	    o Firewalls
	    o User access levels
		• Understand a variety forms of attach and threats the pose at a basic level
		• Identify and understand the prevention of vulnerabilities including the use of:
		    – anti-malware software
		    – passwords
		    – physical security
		
		• Explain the need for the following functions of an operating system:
		    – User interface
		
		• Understand forms of attack and threats posed to a network including:
			• Worksheets/homeworks
			• Exam style questions
			• Presentation on network threats
			• End of unit test
			• End of year assessment

	o Passwords o Encryption o o Physical Security	– Malware – Phishing – Social engineering – Brute force attacks – Data interception and theft • Identify and understand the prevention of vulnerabilities including the use of: – penetration testing – user access levels – encryption	
Logic and Languages	• Defensive design considerations: o Anticipating misuse o Authentication • Input validation • Maintainability: o Use of sub programs o Naming conventions o Indentation o Commenting • The purpose of testing • Types of testing: o Iterative o Final/terminal • Identify syntax and logic errors • Selecting and using suitable test data • Simple logic diagrams using the operations AND, OR and NOT • Truth tables • Characteristics and purpose of different levels of programming language: o High-level languages o Low-level languages • The purpose of translators • The characteristics of a compiler and an interpreter • Common tools and facilities available in an integrated development environment (IDE):	• Construct truth tables for the following logic gates: – NOT, AND, OR • Understand how to make maintainable programs including: – Naming conventions, Indentation • Create, modify and interpret simple logic circuit diagrams • Describe defensive design considerations: – Input validation – Anticipating misuse – Authentication • Understand how to make maintainable programs including: – Commenting • Understand the purpose of testing including: – Iterative testing – Final/terminal testing • Identify syntax and logic errors • Select and use suitable test data • Describe the characteristics of a compiler and interpreter • Describe the characteristics and purpose of different levels of programming language	• Worksheets/homeworks • Exam style questions • End of unit test • Mid-year test • Programming questions • Trace table questions • Testing activities •

	o Editors o Error diagnostics o Run-time environment		

Systems Software	• The purpose and functionality of operating systems:
	  o User interface
	  o Memory management and multitasking
	  o Peripheral management and drivers
	  o User management
	  o File management
	• The purpose and functionality of utility software
	• Utility system software:
	  o Encryption software
	  o Defragmentation
	o Data Compression
		• Explain the need for the following functions of an operating system:
		– User interface
		– Memory management and multitasking
		– Peripheral management and drivers
		– User management
		– File management
		• Describe the purpose and functionality of common utility software including:
		– Encryption software
		– Defragmentation software
		– Data compression software
		• Explain the need for the following functions of an operating systems including memory management and multitasking
			• Worksheets/homeworks
			• Exam style questions
			• End of unit test
			• Mid-year test

Ethical, legal, cultural and environmental impacts of digital technology	• Impacts of digital technology on wider society including:
	  o Ethical issues
	  o Legal issues
	  o Cultural issues
	  o Environmental issues
	  o Privacy issues
	• Legislation relevant to Computer Science:
	  o The Data Protection Act 2018
	  o Computer Misuse Act 1990
	  o Copyright Designs and Patents Act 1988
	o Software licences (i.e. open source and proprietary)
		• List ethical issues, cultural issues and environmental issues in relation to a given scenario
		• List items of legislation that relate to digital technology
		• Discuss the impacts of digital technology on the wider society including ethical issues, cultural issues and environmental issues
		• Discuss the impact of manufacture, disposal, upgrading and replacing digital technology
		• Discuss the impact of e-waste
		• Discuss the impact of digital technology regarding legal issues and privacy issues
		• Describe legislation relevant to Computer Science including
		o The Data Protection Act 2018
		o Computer Misuse Act 1990
		o Copyright Designs and Patents Act 1988
			• Worksheets/homeworks
			• Exam style questions
			• End of unit test
			• Mid-year test

| | | • Describe the features of open source and proprietary software licences
• List the clauses of the Data Protection Act and Computer Misuse Act and give examples of situations in which they are relevant
Evaluate the impact of and issues related to the use of computers in society | |