| **Topic** | **National 4** | **National 5** | **Higher** |
| --- | --- | --- | --- |
| **Languages and environments** |  |  | Description of the key characteristics of the following language types: * low-level
* high-level
* procedural
* declarative
* object-oriented
 |
| **Computational constructs** | Exemplification and implementation of the following constructs:* expressions to assign values to variables
* expressions to return values using arithmetic operations (+, -, \*, /, ^)
* execution of lines of code in sequence demonstrating input – process – output
* use of selection constructs including simple conditional statements
* iteration and repetition using fixed and conditional loops
 | Exemplification and implementation of the following constructs: * expressions to assign values to variables
* expressions to return values using arithmetic operations (+, -, \*, /, ^, mod)
* expressions to concatenate strings and arrays using the & operator
* use of selection constructs including simple and complex conditional statements and logical operators
* iteration and repetition using fixed and conditional loops
* pre-defined functions (with parameters)
 | * parameter passing (value and reference, formal and actual)
* scope, local and global variables
* sub-programs/routines, defined by their name and arguments (inputs and outputs), including
	+ functions
	+ procedures
	+ methods
 |
| **Data types and structures**  | * String
* numeric (integer) variables
* graphical objects
 | * String, character
* numeric (integer and real) variables
* Boolean variables
* 1-D arrays
 | * string
* numeric (integer and real) variables
* Boolean variables
* 1-D arrays and records (including arrays of records)
* sequential files (open, create, read, write, close)
 |
| **Testing and documenting solutions**  | * normal, extreme and exceptional test data
* readability of code
	+ internal commentary
	+ meaningful variable names
 | * normal, extreme and exceptional test data
* syntax, execution and logic errors
* readability of code
	+ internal commentary
	+ meaningful identifiers
	+ indentation
 | * constructing a test plan
* comprehensive testing
* syntax, execution and logic errors
* dry runs
* trace tables /tools
* breakpoints
 |
| **Algorithm specification**  |  | Exemplification and implementation of algorithms, including * input validation
 | Analysis, exemplification and implementation of algorithms including: * input validation
* linear search
* find minimum and maximum
* count occurrences

 Analysis of other algorithms of similar complexity  |
| **Low-level operations and computer architecture**  | Use of binary to represent and store:* positive integers
* characters
* instructions (machine code)

Units of storage * bit
* Byte
* KB
* MB
* GB
* TB
* PB
 | Translation of high-level program code to binary (machine code): interpreters and compilers Use of binary to represent and store:* integers and real numbers
* characters
* instructions (machine code)
* graphics (bit-mapped and vector)

Basic computer architecture: * processor (registers, ALU, control unit),
* memory,
* buses (data and address),
* interfaces
 | virtual machinesemulatorsmobile devices Use of binary to represent and store: * integers and real numbers
* characters
* instructions (machine code)
* graphics (bit-mapped and vector)
* sound
* video

 Computer architecture (trends and implications): * processor (registers, ALU, control unit)
* cache
* memory
* buses (data and address)
* interfaces
 |
| **Design notations**  | * graphical to illustrate selection and iteration
* other contemporary design notations
 | * pseudocode to exemplify programming constructs

other contemporary design notations | * structure diagram
* entity relationship diagram
* data dictionary
* pseudocode
* wire-framing
* other contemporary design notations
 |
| **Development methodologies**  |  |  | Iterative phases of development process: AnalysisDesignImplementationTestingDocumentationEvaluationMaintenance.  Development methodologies: * rapid application development
* top-down/step-wise refinement
* Agile methodologies
 |
| **Contemporary developments**  |  |  | Exemplification of trends in the development of: * software development languages
* software development environments
* intelligent systems
* online systems
 |
| **User interface**  |  | User requirements * visual layout
* navigation
* selection
* consistency
* interactivity
* readability
 | * usability
* accessibility
 |
| **Structures and links (database)**  | * database structure: field, record, file
* field types
	+ text
	+ number
	+ date/time
	+ graphic
	+ calculated
* database operations (search, sort)
 | * database structure:
	+ flat file
	+ linked tables
	+ primary keys
	+ foreign keys
* field types
	+ text
	+ number
	+ date/time
	+ graphic
	+ object
	+ calculated
	+ link
	+ Boolean
* validation including:
	+ presence check
	+ restricted choice
	+ field length
	+ range
* database operations search, sort (on multiple fields)
* good design to avoid data duplication and modification errors (insert, delete, update)
 | * database structures: relational
* primary keys, including compound keys
* relationships
	+ one-to-one
	+ one-to-many
	+ many-to-many
* complex database operations
	+ queries
	+ forms
	+ reports
	+ calculating
 |
| **Structures and links (web-based)**  | * website, page, URL
* hyperlink
 | * website, page, URL
* hyperlinks (internal, external), relative and absolute addressing
* navigation
* web browsers and search engines
* good design to aid navigation, usability and accessibility
 | * site structure: multi-level
* page structure
* head
* title
* body
* cascading style sheets
* meta tags
* dynamic web pages
* database-driven website
* interactive web page
 |
| **Media types**  | Sound, graphics, video, text | Standard file formats: * text: txt, rtf
* audio: wav, mp3
* graphics: jpeg, bmp, gif, png
* video: mp4, avi
* pdf

Factors affecting file size and quality, including * resolution
* colour depth
* sampling rate
* Calculation of file size for colour bitmap.

Need for compression | Compression: lossy and lossless compression techniques applied to: * sound
* graphic
* video
 |
| **Coding**  |  | Exemplification and implementation of coding to create and modify information systems, including the use of: * scripting languages (including JavaScript)
* mark-up languages (including HTML)
 | Exemplification and implementation of coding to create and modify information systems including the use of: * scripting (database/web pages)
* client-side scripting
* server-side scripting
* optimisation (web search (crawlers) and efficiency of coding)
 |
| **Testing**  |  | * Links and navigation
* Matches user interface design
 | * Beta testing
* Usability
* Compatibility issues
	+ memory
	+ storage requirements
	+ OS compatibility
 |
| **Purpose, functionality, users**  | Simple descriptions of main features and functionality | * Description of purpose

Users: expert, novice, age-range | * detailed descriptions of purpose
* Interaction of information systems with:
	+ human users: expert, novice, age-range
	+ other software: search engines
 |
| **Technical** **Implementation (hardware requirements)**  | * input and output devices
* processor clock speed (Hz)
* memory (RAM, ROM)
 | * input and output devices
* processor type and speed (Hz)
* memory (RAM, ROM)
* device type including:
	+ supercomputer
	+ desktop
	+ portable devicesincluding:
		- laptop
		- tablet
		- smartphone
 | * input and output devices
* processor type, number and speed (Hz)
* memory
	+ RAM
	+ ROM
	+ cache
* device type
	+ Desktop
	+ Laptop
	+ Tablet
	+ Smartphone
 |
| **Technical** **Implementation (software requirements)**  | * operating system platform required
 | * operating systems
* web browsers

specific applications and/or utilities | * operating systems
* licensing
* proprietary v open source
* portability

 Description and exemplification of current trends in operating system design  |
| **Technical implementation** **(storage)**  | Storage devices* built-in, external, portable
* magnetic, optical
* capacity, speed
* rewritable, read-only
 | * local, web, cloud
* capacity (in appropriate units)
* rewritable, read-only
* interface type
* data transfer speed

storage devices: * built-in, external, portable
* magnetic, optical
* solid state
 | * distributed and off-line storage
* backup systems and strategy
* capacity (in appropriate units)
* rewritable, read-only
* interface type
* data transfer speed

 Storage devices: * built-in, external
* magnetic, optical
* solid state

 Description and exemplification of current trends in storage systems.  |
| **Technical implementation (networking/ connectivity)**  | * stand-alone or networked
* LAN/internet
* wired/wireless
 | * peer-to-peer, client/server
* wired, optical, wireless
 | Cloud systems and server provision: * public, private, hybrid
* cloud-based services
* web hosting

 Description and exemplification of current trends in networking and connectivity.  |
| **Security risks**  | * viruses, worms, Trojans
* hacking
 | * spyware, phishing, keylogging
* online fraud, identity theft
* DOS (Denial of Service) attacks
 | * spyware, phishing, keylogging
* online fraud, identity theft
* DOS (Denial of Service) attacks
 |
| **Security precautions**  |  | * anti-virus software
* passwords/encryption
* biometrics
* security protocols and firewalls
* use of security suites
 | * encryption
* digital certificates and signatures
* server-side validation of online form data
* Biometrics in industry
 |
| **Legal implications**  |  | Basic descriptions and implications of: * Computer Misuse Act
* Data Protection Act
* Copyright, Designs and Patents Act (plagiarism)
* Health and Safety regulations
* Communications Act
 | Detailed descriptions and implications of : * Computer Misuse Act
* Data Protection Act
* Copyright Designs and Patents Act (plagiarism)
* Communication Acts
* Regulation of Investigatory Powers Act
 |
| **Environmental implications**  |  | * Energy use
* Disposal of IT equipment
* Carbon footprint
 | * lifetime carbon footprint (manufacture, use, disposal)
* environmental benefits
 |
| **Economic and social impact**  |  |  | * economic:
	+ competitive advantage
	+ global marketplace
	+ business costs
	+ maintainability
	+ scalability
* social:
	+ censorship and freedom of speech
	+ privacy and encryption
	+ global citizenship
	+ online communities
 |