| **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 machinesemulators  mobile 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:  Analysis  Design  Implementation  Testing  Documentation  Evaluation  Maintenance.    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 |