Topic 1 – Fundamentals of Computer Systems

Students need to know about:

Computer Systems:

Candidates should be able to:

- define a computer system
- describe the importance of computer systems in the modern world
- explain the need for reliability in computer systems
- explain the need for adherence to suitable professional standards in the development, use and maintenance of computer systems
- explain the importance of ethical, environmental and legal considerations when creating computer systems.

Topic 2 – Computing Hardware

Students need to know about:

The CPU:

- state the purpose of the CPU
- describe the function of the CPU as fetching and executing instructions stored in memory
- explain how common characteristics of CPUs such as clock speed, cache size and number of cores affect their performance.

Binary Logic

- explain why data is represented in computer systems in binary form
- understand and produce simple logic diagrams using the operations NOT, AND and OR
- produce a truth table from a given logic diagram.

Memory

- describe the difference between RAM and ROM
- explain the need for ROM in a computer system
- describe the purpose of RAM in a computer system
- explain how the amount of RAM in a personal computer affects the performance of the computer
- explain the need for virtual memory
- describe cache memory
- describe flash memory
- discuss how changes in memory technologies are leading to innovative computer designs.

Input and Output Devices

- understand the need for input and output devices
- describe suitable input devices for a wide range of computer controlled situations
- describe suitable output devices for a wide range of computer controlled situations
- discuss input and output devices for users with specific needs.

Secondary Storage

- explain the need for secondary storage
- describe common storage technologies such as optical, magnetic and solid state
- select suitable storage devices and storage media for a given application and justify their choice using characteristics such as capacity, speed, portability, durability and reliability.

Topic 3 – Software

Students need to know about:
• explain the need for the following functions of an operating system: user interface, memory management, peripheral management, multi-tasking and security • describe the purpose and use of common utility programs for computer security (antivirus, spyware protection and firewalls), disk organisation formatting, file transfer, and defragmentation), and system maintenance (system information and diagnosis, system cleanup tools, automatic updating) • discuss the relative merits of custom written, off the shelf, open source and proprietary software.

Topic 4 – Representation of Data

Students need to learn about:
Units • define the terms bit, nibble, byte, kilobyte, megabyte, gigabyte, terabyte • understand that data needs to be converted into a binary format to be processed by a computer.
Number • convert positive denary whole numbers (0-255) into 8-bit binary numbers and vice versa • add two 8-bit binary integers and explain overflow errors which may occur • convert positive denary whole numbers (0-255) into 2-digit hexadecimal numbers and vice versa • convert between binary and hexadecimal equivalents of the same number • explain the use of hexadecimal numbers to represent binary numbers.
Character • explain the use of binary codes to represent characters • explain the term character set • describe with examples (for example ASCII and Unicode) the relationship between the number of bits per character in a character set and the number of characters which can be represented.
Images • explain the representation of an image as a series of pixels represented in binary • explain the need for metadata to be included in the file such as height, width and colour depth • discuss the effect of colour depth and resolution on the size of an image file.
Sound • explain how sound can be sampled and stored in digital form • explain how sampling intervals and other considerations affect the size of a sound file and quality of its playback.
Instructions • explain how instructions are coded as bit patterns • explain how the computer distinguishes between instructions and data.

Topic 5 – Databases

Students need to learn about:
The database concept • describe a database as a persistent organised store of data • explain the use of data handling software to create, maintain and interrogate a database.
The DBMS • describe how a DBMS allows the separation of data from applications and why this is desirable • describe the principal features of a DBMS and how they can be used to create customised • data handling applications.
Relational Databases • understand the relationship between entities and tables • understand the components of a relational database, such as tables, forms, queries, reports and modules • understand the use of logical operators in framing database queries • explain the use of key fields to connect tables and avoid data redundancy • describe methods of validating data as it is input.

Topic 6 – computer communications and networking

Students need to learn about:

Networks

- explain the advantages of networking stand-alone computers into a local area network
- describe the hardware needed to connect stand-alone computers into a local area network,
- including hub/switches, wireless access points
- explain the different roles of computers in a client-server and a peer-to-peer network
- describe, using diagrams or otherwise, the ring, bus and star network topologies
- describe the differences between a local area network and a wide area network such as the internet
- explain the terms IP addressing, MAC addressing, packet and protocols
- explain the need for security measures in networks, such as user access levels, suitable passwords and encryption techniques
- describe and justify network policies such as acceptable use, disaster recovery, failover, back up, archiving.

The internet

- describe the nature of the internet as a worldwide collection of computer networks
- describe the hardware needed to connect to the internet including modems, routers
- explain the need for IP addressing of resources on the internet and how this can be facilitated by the role of DNS services
- explain the importance of HTML and its derivatives as a standard for the creation of web pages
- describe common file standards associated with the internet such as JPG, GIF, PDF, MP3, MPEG
- explain the importance of compressing files that are transmitted via the internet
- describe the differences between lossy and lossless compression.

Topic 7 – Programming

Students need to learn about:

Algorithms

- understand algorithms (written in pseudocode or flow diagram), explain what they do, and correct or complete them
- produce algorithms in pseudocode or flow diagrams to solve problems.

Programming Languages

- explain the difference between high level code and machine code
- explain the need for translators to convert high level code to machine code
- describe the characteristics of an assembler, a compiler and an interpreter
- describe common tools and facilities available in an integrated development environment (IDE): editors, error diagnostics, run-time environment, translators, auto-documentation.

Control flow in imperative languages

- understand and use sequence in an algorithm
- understand and use selection in an algorithm (IF and CASE statements)
- understand and use iteration in an algorithm (FOR, WHILE and REPEAT loops).

Handling data in algorithms

- define the terms variable and constant as used in an imperative language
- use variables and constants
- describe the data types integer, real, Boolean, character and string
- select and justify appropriate data types for a given program
- perform common operations on numeric and Boolean data
- use one-dimensional arrays.

Testing

- describe syntax errors and logic errors which may occur while developing a program
- understand and identify syntax and logic errors
- select and justify test data for a program, stating the expected outcome of each test.