QUESTION ONE  
(a)

1. A computer as a Data Processing Machine: A computer is a machine that uses electronics to receive, process, and show data to allow users to effectively analyse huge amounts of information. This definition centres on operations like data inputting, storage, and retrieval, which are conventionally used in banking, research, and business administration.

2. A computer as a Communication Tool: A computer can also be defined as a tool that supports communication between people through various forms of digital media such as emails, video calling, and chat. This definition refers to computers' application to networking and global connectivity.

(b)

This is a sentence that tells us that computers stick to the orders given to them exactly, no matter whether the orders are correct or incorrect. Computers do not think by themselves; they simply do what they have been trained to do.

Example:

If a computerized banking system is programmed to insert an extra zero into every deposit transaction by mistake, depositing $100 would be wrongly recorded as $1,000. The computer never identifies this as a mistake because it performs the instructions exactly as it was instructed. This demonstrates that computers are only dependent on correct programming to function correctly.   
c)

(i)

The human brain, though very intelligent, is limited by its speed and capacity in handling extremely large amounts of data. Computers, on the other hand, can handle data at incredible speeds and can handle very large sets of data with ease.

Example:

In meteorology, supercomputers are employed by meteorologists to calculate millions of data points like temperature, humidity, and wind patterns in order to predict weather. If a human calculated and processed so much information manually, it would take months or weeks, but a supercomputer can do so in hours or minutes, and it provides timely and accurate predictions.

(ii) 1. Creativity and Innovation:

Computers can generate designs and assist in creative work, but they are not capable of thinking creatively, innovating, or generating new ideas like human beings. For example, in literature, music, and art, human imagination and emotions have an integral role that cannot be substituted by computers.

2. Emotional Intelligence and Decision-Making:

Computers follow logical programming and cannot understand or respond to human emotions appropriately. In fields like counselling, psychology, and diplomacy, human intuition and empathy are essential for effective communication and decision-making.

3. Ethical and Moral Judgments:

Computers run on algorithms and information, but they can't make ethical or moral judgments that involve human judgment. For instance, in medicine, physicians have to determine whether to undertake a dangerous operation based on the emotional and psychological state of a patient—something a computer cannot assess.

4. Unstructured Problem-Solving:

While computers excel in solving well-structured problems with pre-determined rules, they are weak in solving unstructured, dynamic problems requiring flexibility. For instance, under emergency situations like natural disasters, human beings are able to quickly assess unpredictable scenarios and make life-and-death decisions, whereas a computer will lack the flexibility to perform outside of its pre-determined logic.

d)

Supporting the Statement

1. Rapid Technological Advancements

Computer architecture is a fast-evolving discipline with new processors, memory technologies, and hardware designs emerging every now and then. Continuous learning is required to match these developments, and thus the subject becomes more complex.

2. Increased Specialization

Computers these days are designed for various purposes, including supercomputers, quantum computing, embedded systems, and cloud computing. To understand these various architectures, one must possess specialized knowledge in various fields, and thus it becomes more complex.

3. Complexity of Modern Processors

In comparison to the older computers with simple-to-grasp designs, modern processors involve multi-core designs, parallel processing, artificial intelligence accelerators, and sophisticated chipsets. These are more difficult for students to comprehend regarding computer architecture.

4. Software and Hardware Integration

Computer architecture now encompasses both hardware and software integration, for example, how operating systems manage hardware resources, how machine learning algorithms utilize GPUs, and how architectures influence software performance. This contributes to the complexity of learning.

e)

1. Automate Teller Machines (ATMs)

The majority of people use ATMs to withdraw money, check balances, or transfer funds without realizing that an ATM is a specialized computer. It accepts user inputs, performs retrievals from bank servers, and displays the result of transactions like any other computer system.

2. Smart Home Devices (e.g., Smart TVs and Voice Assistants)

Devices like Smart TVs, Amazon Alexa, or Google Home are computers in disguise. When users give voice commands or stream videos, these devices process data, execute commands, and interact with online servers just like a computer, even though people may not recognize them as such.

1. Modern Cars:

Many vehicles have onboard computers that control navigation, fuel efficiency, and safety features like anti-lock braking systems (ABS).

1. Smartphones:

Although individuals think of them as merely phones, smartphones are small, effective computers that carry out several computing tasks.

QUESTION 2

a)  
(i) The Pascaline

Blaise Pascal (1642)

The Pascaline was developed to assist French tax authorities with arithmetic computation, addition and subtraction. Hand calculation was cumbersome and error-ridden at that time. Pascal's mechanical calculator significantly decreased errors and accelerated tax computation.

(ii) The Tabulating Machine

Herman Hollerith (1890)

Tabulating Machine was developed to tabulate U.S. Census figures at a faster pace. The data for the census was input manually and analysed prior to its development, and it took a very long time. Hollerith's machine used punched cards to mechanize sorting and counting, reducing the time it took to process census data to months instead of years.

(iii) The Colossus

Alan Turing and British engineers (1943)

The Colossus was created during World War II to break German wartime codes, i.e., those generated by the Lorenz cipher machine. The machine helped the Allies intercept the enemy's messages, contributing most significantly to their victory by providing valuable intelligence.

(iv) The ENIAC (Electronic Numerical Integrator and Computer)

John Presper Eckert and John Mauchly (1945)

The ENIAC was designed to assist the U.S. military in calculating artillery firing tables. The calculations were accomplished manually before it was developed and took weeks to complete. ENIAC automated the process, cutting down the time for calculation drastically from hours to minutes, and it was the first general-purpose electronic computer.

b)  
Computer generations are determined based on the hardware and software technology advancements that significantly improve computing power, efficiency, and use. They are listed below:

i) Type of Technology Used in Processing Units:

Each computer generation is categorized based on the type of electronic component used in creating the processors and circuits.

First Generation (1940s–1956) – Used vacuum tubes (e.g., ENIAC, UNIVAC), which were big in size and used a lot of heat.

Second Generation (1956–1963) – Used transistors, which made computers smaller and more reliable (e.g. IBM 1401).

Third Generation (1964–1971) – Integrated circuits (ICs) were used, making computers smaller and more efficient (e.g. IBM System/360).

Fourth Generation (1971–Present) – Microprocessors are employed, which makes the size smaller, the cost lower, and the power greater of computers (e.g., Intel 4004, IBM PC, Apple Macintosh).

Fifth Generation (Future & Present) – Merges AI, quantum computing, and high-level neural networks to enhance computing power (e.g., IBM Watson, Google AI).

ii) Processing Speed and Performance

Each generation has significantly enhanced processing speed through technological advancements. For example, first-generation computers processed at the speed of milliseconds, while modern supercomputers process at the speed of nanoseconds.

iii) Memory and Storage Technology

Storage area has evolved from magnetic drums (First Gen) to hard drives and SSDs (Fourth and Fifth Gen) with faster access and more storage. Second Generation introduced magnetic tape and magnetic core memory. Third Generation adopted hard disk drives (HDDs), increasing storage capacity.

iv) Size, Cost, and Energy Efficiency

As computers developed, they grew smaller, cheaper, and energy-efficient:

First Generation: Huge room-sized computers with high energy consumption.

Second Generation: Smaller and cheaper because of transistor technology.

Third and Fourth Generations: PCs became available to businesses and consumers.

Fifth Generation: Wearable technology, AI-based devices, and cloud computing reduce energy consumption and increase portability.

Example: When computers were first introduced, e.g. the ENIAC, they weighed 30 tons, whereas modern laptops are only a few kilograms and thousands of times more efficient.

c)

The IAS (Institute for Advanced Study) computer, designed by John von Neumann in the late 1940s, was one of the first stored-program computers. Instead of using external means (like punched cards or plugboards) to hold instructions, the computer could store data and instructions (programs) in its memory.

The stored-program concept allowed the computer to modify its own instructions, making programming more flexible and efficient.

This architecture served as the foundation for modern computer systems, where programs and data are both stored in the same memory.

Other Stored-Program Computers and Their Inventors

Manchester Baby (1948) – Built by Frederic C. Williams, Tom Kilburn, and Geoff Tootill at the University of Manchester.

It was the first computer to successfully run a stored program, showing that programs could be stored in electronic memory.

EDSAC (Electronic Delay Storage Automatic Calculator) (1949) ; Constructed by Maurice Wilkes at the University of Cambridge.

It was the first practical stored-program computer, and it was used for scientific calculations.

EDVAC (Electronic Discrete Variable Automatic Computer) (1949–1951) ;John von Neumann, J. Presper Eckert, and John Mauchly built it.

It improved upon the ENIAC by employing the stored-program architecture, making programming more efficient.

d)

(i) Time Sharing

First Computer with Time Sharing: Compatible Time-Sharing System (CTSS)

Developed By: MIT (Massachusetts Institute of Technology) in 1961

Time sharing refers to the ability to allow more than one user to utilize a computer simultaneously, with each user receiving a tiny portion of the computer's processing time.

The CTSS was one of the first systems to employ time-sharing, in which users could interact with the computer through terminals while it was running other jobs for other users in the background.

This system made computing more economical and effective because it allowed several people to use the computer simultaneously, which improved the utilization of its processing power.

(ii) Computer Games

First Computer with Computer Games: EDSAC (Electronic Delay Storage Automatic Calculator)

Developed By: Maurice Wilkes and his team at the University of Cambridge in 1949

EDSAC is famous for running the first-ever computer-based game, "OXO" (1952), a computerized version of tic-tac-toe.

The game was run on a graphical CRT display and was a significant step in computer graphics and interactive software development.

This paved the way for the future of video games, making computers go beyond calculation machines to entertainment and interactive application platforms.

(iii) Batch Processing and Multiprogramming

First Computer with Batch Processing and Multiprogramming: IBM System/360

Developed By: IBM in 1964

Explanation:

Batch Processing is the mode where computers execute a batch of jobs or tasks sequentially in batch groups without requiring user interaction. This helped organizations process large amounts of data more efficiently, especially for administrative uses.

Multiprogramming is the capacity to have multiple programs being executed by a computer at the same time using the CPU time-sharing. This enhances the overall system performance as it keeps the CPU busy with different tasks rather than idling.

The IBM System/360 was a revolutionary system that merged batch processing and multiprogramming, enabling it to handle complex computing tasks in numerous fields, from business to scientific research.

SECTION B

QUESTION 3

i)

1. USB (Universal Serial Bus)

A standard interface for connecting devices such as keyboards, mice, printers, and storage devices to a computer or other electronic equipment.

2. HDMI (High-Definition Multimedia Interface)

A standard interface for transferring high-definition video and audio among devices such as computers, televisions, and game consoles.

3. Ethernet (LAN Interface)

A network interface used to connect computers or other equipment to a local area network (LAN) to enable data communication on the internet or in a local network.

ii)

1. Receiving and Sorting

Postman's Activity: The postman receives mail and sorts them according to destinations or categories.

Memory Interface Function: Similarly, the memory interface receives data from the system CPU and sorts it to the right location in RAM or storage. It ensures data is directed to the correct segment of the memory.

1. Delivery to Destination

Postman's Activity: The postman delivers sorted mail to the correct addresses.

Memory Interface Function: The memory interface delivers data to the appropriate memory location or reads it when needed by the CPU or other peripherals. It ensures that data gets to the proper destination in memory for retrieval.

1. Routing Instructions

Postman's Activity: The postman follows a route based on the sorting process to ensure delivery is efficient.

Memory Interface Function: The memory interface follows specific protocols to allow for fast data transfer from the CPU to the memory. It uses addressing techniques to access a specific location in the memory.

1. Handling and Organizing

Postman's Activity: The postman sorts the mail systematically so that they can be quickly accessed and delivered.

Memory Interface Function: The memory interface organizes data in the memory according to address spaces and buffers to optimize the process of storage and retrieval so that there are no delays or faults in accessing information.

iii)

1. Passing Commands from the Processor to the Device

Example: When a CPU generates a write command to a printer.

The CPU instructs the I/O interface to print memory data to the printer. The I/O interface transfers the instruction, and the printer responds by printing the asked document.

1. Reporting the Device Status to the Machine

Example: When the CPU is reporting the status of a hard drive to see if it is ready to read or write data.

The I/O interface also notifies the CPU of the hard drive's status. For example, it can tell the CPU that the hard drive is busy, ready, or has an error, so the CPU can respond accordingly (e.g., retrying or proceeding with another task).