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Class	9th	Chapter	01
Subject	Computer Science	Board	Punjab

Chapter 01: INTRODUCTION TO SYSTEMS

Exercise Solution

PART I: MULTIPLE CHOICE QUESTIONS (MCQs)

1. What is the primary function of a system?

a) To work independently | b) To achieve a common goal | c) To create new systems | d) To provide entertainment

Answer: b) To achieve a common goal

2. What is one of the fundamental concepts of any system?

a) Its size | b) Its objective | c) Its age | d) Its price

Answer: b) Its objective

3. What is an example of a simple system?

a) A human body | b) A computer network | c) A thermostat regulating temperature | d) The Internet

Answer: c) A thermostat regulating temperature

4. What type of environment remains unchanged unless the system provides an output?

a) Dynamic | b) Static | c) Deterministic | d) Non-deterministic

Answer: b) Static

5. What are the basic components of a system?

a) Users, hardware, software | b) Objectives, components, environment, communication | c) Inputs, outputs, processes | d) Sensors, actuators, controllers

Answer: b) Objectives, components, environment, communication

6. What concept does the theory of systems aim to understand?

a) Hardware design | b) System interactions and development over time | c) Software applications | d) Network security

Answer: b) System interactions and development over time

7. What role does the Operating System (OS) play in a computer?

a) It performs calculations and executes instructions | b) It temporarily stores data and instructions for the CPU | c) It receives input from interface components and decides what to do with it | d) It provides long-term storage of data and software

Answer: c) It receives input from interface components and decides what to do with it

8. Which of the following describes the Von Neumann architecture's main characteristic?

a) Separate memory for data and instructions | b) Parallel execution of instructions | c) Single memory store for both program instructions and data | d) Multiple CPUs for different tasks

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Answer: c) Single memory store for both program instructions and data

9. What is a disadvantage of the Von Neumann architecture?

a) Complex design due to separate memory spaces | b) Difficult to modify programs stored in memory | c) Bottleneck due to single memory space for instructions and data | d) Lack of flexibility in executing instructions

Answer: c) Bottleneck due to single memory space for instructions and data

10. Which of the following transports data inside a computer among different components?

a) Control Unit | b) System Bus | c) Memory | d) Processor

Answer: b) System Bus

PART II: SHORT QUESTIONS

Q1. Define a system. What are its basic components?

Answer:

A system is a collection of interrelated components or elements working together in an organized manner to achieve a specific common goal or objective.

Its basic components are:

1. **Objectives:** The defined goal or purpose of the system.
2. **Components:** The constituent parts or subsystems.
3. **Environment:** Everything outside the system boundary that interacts with it.
4. **Communication:** Methods and pathways through which components exchange data or energy.

Q2. Differentiate between natural and artificial systems.

Answer:

Natural Systems: Created by nature without human intervention. Examples include the human digestive system, solar system, and water cycle.

Artificial Systems: Man-made systems designed and built to fulfill human needs. Examples include computers, automobiles, and traffic management systems.

Q3. Describe the main components of a computer system.

Answer:

1. **Hardware:** Physical electronic and mechanical devices, such as the CPU, RAM, hard disk, keyboard, and monitor.
2. **Software:** Programs, routines, and operating systems that instruct hardware on the tasks to perform.
3. **Data:** Raw facts and input figures processed into meaningful information.
4. **Users / Peopleware:** Individuals who operate, program, or interact with the computer.

Q4. List and describe the types of computing systems.

Answer:

1. **Computers (Personal/Desktop/Laptop):** General-purpose standalone processing devices.

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2. **Software Systems:** Collections of integrated software modules and applications that perform structured computing tasks.
3. **Computer Networks:** Groups of connected computing devices that share resources and data.
4. **The Internet:** A global system of interconnected computer networks facilitating worldwide communication.

Q5. What are the main components of the Von Neumann architecture?
Answer:

1. **Central Processing Unit (CPU):** Comprises the Control Unit (CU) and Arithmetic Logic Unit (ALU).
2. **Main Memory (RAM):** A shared memory unit storing both program instructions and data.
3. **Input / Output (I/O) Interfaces:** Devices that allow interaction with the external world.
4. **Buses:** High-speed signal pathways (data, address, and control buses) connecting components.

Q6. What is the Von Neumann computer architecture? List its key components.
Answer:
The Von Neumann computer architecture is a fundamental theoretical design model for electronic digital computers. It utilizes a processing unit, a control unit, external mass storage, and a single shared primary memory space to store both program instructions and data sequentially.
Its key components are the Control Unit (CU), Arithmetic Logic Unit (ALU), Primary Memory (RAM), Registers, and System Bus.

Q7. What are the four main steps in the Von Neumann architecture's instruction cycle?
Answer:

1. **Fetch:** Retrieve the next instruction from main memory using the memory address in the Program Counter (PC).
2. **Decode:** The Control Unit decodes and interprets the fetched instruction to determine the required actions.
3. **Execute:** The ALU or CU carries out the operation, such as arithmetic, logical comparison, or data transfer.
4. **Store / Writeback:** Save the output or result of execution back into registers or main memory.

Q8. What is the Von Neumann bottleneck?
Answer:
The Von Neumann bottleneck is a throughput restriction caused by using a single shared bus to transport both data and instructions between the CPU and memory. Because data and instructions cannot be transferred simultaneously over the shared bus, the high-speed CPU is forced to wait for memory transfers, limiting overall system processing speed.

Q9. What is a key advantage of the Von Neumann architecture?

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Answer:
Its key advantage is simplicity and flexibility in hardware design. Using a unified memory space allows for efficient utilization of RAM, ease of program modification, and cost-effective manufacturing compared to dual-memory architectures.

Q10. What are the three main requirements for a computing system to function?
Answer:

1. **Hardware Infrastructure:** Functional physical electronic components, such as the processor, memory, and motherboard.
2. **System Software:** An operating system to manage hardware resources and run applications.
3. **Power Supply & Input:** Electrical power and incoming data or user input to initiate execution cycles.

PART III: LONG QUESTIONS

Q1. Define and describe the concept of a system. Explain the fundamental components, objectives, environment, and methods of communication within a system.
Answer:
Concept of a System:
A system is a structured set of interacting, interdependent components organized to perform functions necessary to achieve an intended objective. Systems exist in physical, biological, and technological domains.

1. Objectives:
The explicit purpose or goal for which the system was constructed. Every system is evaluated by how effectively it meets its objectives.

2. Components:
The structural elements, units, or modules that make up the system. Each component performs a sub-task towards the overarching objective.

3. Environment:
The external context in which the system operates. The system boundary separates internal components from the external environment. A system receives inputs from and provides outputs to its environment.

4. Methods of Communication:
Internal channels and protocol structures through which components pass signals, energy, material, or data. Examples include system buses in computers and signal pathways in biological systems.

Q2. Differentiate between natural and artificial systems. Discuss their characteristics, functions, and purposes with relevant examples.
Answer:
1. Natural Systems

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Characteristics: Natural systems evolve naturally and are highly complex, self-regulating, dynamic, and adaptive over long periods.
Functions and Purpose: They maintain ecological or physiological equilibrium without human engineering.
Examples:

- The human nervous system coordinates sensory responses.
- The hydrological cycle regulates Earth's water distribution.

2. Artificial Systems
Characteristics: Artificial systems are human-designed, deterministic, purpose-built with fixed rules, and dependent on human maintenance.
Functions and Purpose: They solve specific human challenges, automate tasks, or enhance communication and production.
Examples:

- An electric power grid distributes energy to cities.
- A computer operating system manages hardware resources.

Q3. Examine the relationship between systems and different branches of science, including natural science, design science, and computer science. How do these branches utilize system theory to understand and improve their respective fields? Provide specific examples to support your analysis.
Answer:
1. Natural Science:
Natural science uses systems theory to model complex organic and physical phenomena. By viewing living organisms as open biological systems, scientists understand homeostasis and ecosystems.
Example: Modeling climate systems to forecast global weather changes.
2. Design Science:
Design science applies system thinking to create optimal engineering and architectural solutions. Designers break down complex structures into modular subsystems to ensure safety, efficiency, and ergonomic function.
Example: Designing an airplane as a combination of integrated propulsion, navigation, and structural systems.
3. Computer Science:
Computer science relies on system theory to design hardware architectures, operating systems, and software engineering frameworks. Computer scientists structure multi-tiered networks and databases into logical layers to maximize computing performance and security.
Example: Designing distributed cloud computing systems.
Q4. Explore the different types of computing systems such as computers, software systems, computer networks, and the Internet.
Answer:
1. Computers:

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Computers are hardware-driven electronic processing systems that accept data, process it according to instructions, store results, and generate output.

2. Software Systems:

Software systems are structured collections of programs, libraries, and system configurations, such as Database Management Systems and Operating Systems. They are designed to manage computational tasks and enable user productivity.

3. Computer Networks:

Computer networks are systems formed by interconnecting multiple hardware nodes through physical media or wireless signals to share digital resources and data packets.

Example: Local Area Networks (LANs).

4. The Internet:

The Internet is a global "network of networks" that uses standardized protocols (TCP/IP) to facilitate worldwide communication, web browsing, data exchange, and cloud computing services.

Q5. Describe the main characteristics of a computer as a system, including its objectives, components, and interactions among these components.

Answer:

1. Characteristics:

A computer has high processing speed, precision, storage capacity, and versatility. It follows programmed instructions strictly and operates according to the "garbage in, garbage out" principle.

2. Objectives:

The objective of a computer is to transform raw input data into accurate, structured information rapidly.

3. Components and Their Interactions:

- **Input Devices:** Convert human interaction into electrical signals.
- **Central Processing Unit (CPU):** Fetches and decodes instructions through the Control Unit and performs mathematical operations using the ALU.
- **Primary Memory (RAM):** Provides high-speed temporary storage for active data and running processes.
- **Secondary Storage:** Stores files permanently.
- **Output Devices:** Display or deliver processed results back to the user.

All components interact through the high-speed System Bus.

Q6. Explain the Von Neumann architecture of a computer. Include a discussion on the main components, their functions, and the step-by-step process of how the architecture operates.

Answer:

Von Neumann Architecture:

The Von Neumann architecture is a foundational computing blueprint proposed by John von Neumann in 1945. In this architecture, both data and program instructions share a single memory space.

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Main Components and Their Functions:

1. **Memory Unit:** Holds both program instructions and data values.
2. **Control Unit (CU):** Directs the flow of operations by fetching and decoding instructions from memory.
3. **Arithmetic Logic Unit (ALU):** Performs mathematical calculations (+, −, ×) and logical operations (AND, OR, NOT).
4. **Registers:** High-speed internal CPU storage locations, including the Accumulator, Program Counter, and Instruction Register.
5. **Bus System:** Physical wiring that transports data, memory addresses, and control signals.

Step-by-Step Operation (Fetch–Decode–Execute Cycle):

1. **Fetch:** The CU fetches the instruction stored at the address pointed to by the Program Counter (PC).
2. **Decode:** The CU decodes the instruction inside the Instruction Register (IR).
3. **Execute:** The ALU performs the operation; required data is fetched from memory if needed.
4. **Store:** The result is written back to registers or memory, and the PC increments to the next instruction address.

Q7. Provide a detailed explanation of how a computer interacts with its environment. Include examples of user input, network communication, and power supply.

Answer:

1. User Input Interaction:

Users interact with the computer boundary through input peripherals such as a keyboard, mouse, and touchscreen. Physical presses generate hardware interrupts sent to the operating system (OS), which translates these actions into digital signals.

2. Network Communication:

The computer communicates with remote environments through Network Interface Cards (NICs). Data is encapsulated into Internet Protocol packets and sent over Ethernet or Wi-Fi to servers across the Internet. The computer also receives responses from remote systems.

3. Power Supply Interaction:

The computer draws electrical energy from the external power grid. The Power Supply Unit (PSU) converts high-voltage AC mains power into regulated, low-voltage DC currents (+3.3 V, +5 V, and +12 V) to power electronic circuits inside the computer.

Q8. Describe the process of retrieving and displaying a file using a computer, based on the interactions among different components. Provide a step-by-step explanation of how input is processed, data is transferred, and results are displayed on the screen.

Answer:

1. User Request (Input):

The user double-clicks a document icon using a mouse or types a file request command.

2. Interrupt and Signal Processing:

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The OS receives the hardware interrupt from the input device and identifies the requested file path.

3. Storage Access (Data Transfer):

The CPU instructs the disk controller to locate the file blocks on secondary storage, such as an SSD or hard drive.

4. Loading into Memory:

Data blocks are read from secondary storage and transferred through the System Bus into primary memory (RAM).

5. Processing and Rendering:

The CPU and OS pass the file data to the corresponding software application. The graphics processor (GPU) formats the numerical data into a displayable frame buffer.

6. Output Display:

The GPU sends video output signals through HDMI or DisplayPort to the monitor, illuminating pixels to render the visual document for the user.

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