IUC ACADEMY

INCLUSIVE UNIVERSAL CAREERS ACADEMY

Learn. Prepare. Progress. • www.iucacademy.com

IUC ACADEMY NOTES

Complete Syllabus • Conceptual Flowcharts • Comparative Tables • Solved Practice Questions

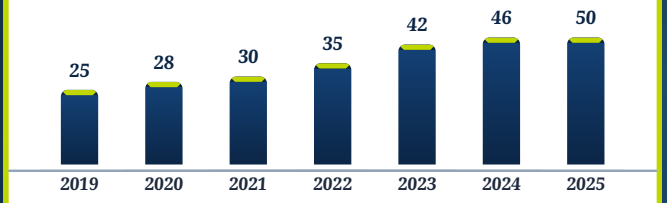
COMPUTER KNOWLEDGE, INFORMATION TECHNOLOGY & CYBER SECURITY

Computer Architecture, Memory Hierarchy, Number Systems, Operating Systems, MS Office 365 Shortcuts & Formulas, Computer Networks (OSI/TCP-IP), DBMS/SQL, Cyber Security, IT Act 2000, DPDP Act 2023 & AI

Topic-Wise Exam Weightage Distribution (%)



Previous Years' Question Trend Analysis



Target Competitive, Entrance & Departmental Examinations

SSC CGL/CHSL Tier-2 • IBPS/SBI/RBI • Delhi/UP Police • RPF • KVS/DSSSB • UPSC EPFO • Cyber Security

Core Syllabus Pillars & Exam Question Weightage (%)

- MS Office 365 (Word, Excel Formulas, PowerPoint & Shortcuts) (26%)
- Networking, OSI 7-Layer & TCP/IP Models, Protocols & Ports (22%)
- Cyber Security, Malware, Cryptography, IT Act 2000 & DPDP Act 2023 (20%)
- Computer Architecture, CPU Registers, Memory & Number Conversions (18%)
- Operating Systems, Relational DBMS, SQL, Cloud & AI Technologies (14%)

Complete Theory
NCERT & Official Sources

Visual Flowcharts
Comparative Matrices

Memory Tricks
Exam Trap Alerts

75+ Solved MCQs
One-Liner Capsules

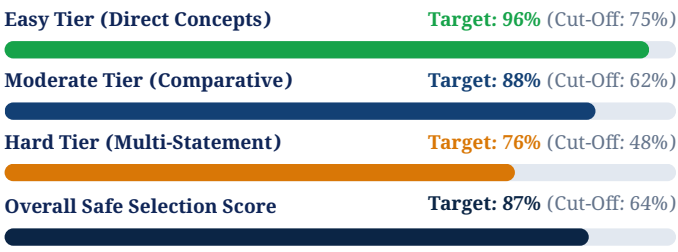
Preface, Exam Weightage Dashboard & Study Strategy — COMPUTER KNOWLEDGE, INFORMATION TECHNOLOGY & CYBER SECURITY

IUC Academy (Inclusive Universal Careers Academy | www.iucacademy.com) • Official English Medium Study Notes

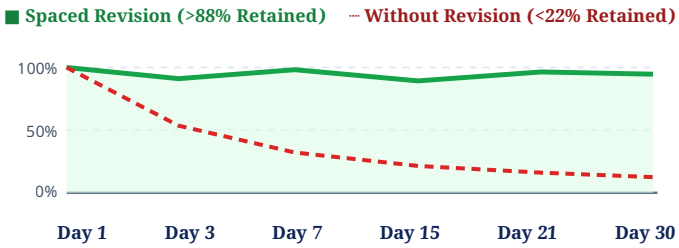
Dear Aspirants,

Modern competitive, entrance, and departmental promotion examinations demand a combination of deep conceptual clarity, statutory precision, and rapid revision tools. Prepared by **Inclusive Universal Careers Academy (IUC Academy — www.iucacademy.com)**, these comprehensive English-medium study notes integrate **structured chapter theory, 4-node conceptual process flowcharts, multi-column comparative tables, inline mathematical/scientific formulas, 'Did You Know?' boxes, 'Exam Trap Alert' callouts, 'Memory Trick' mnemonics, Chapter-End Analytical Synthesis Matrices, 75+ Step-by-Step Solved MCQs, and Rapid-Fire One-Liner Revision Capsules**.

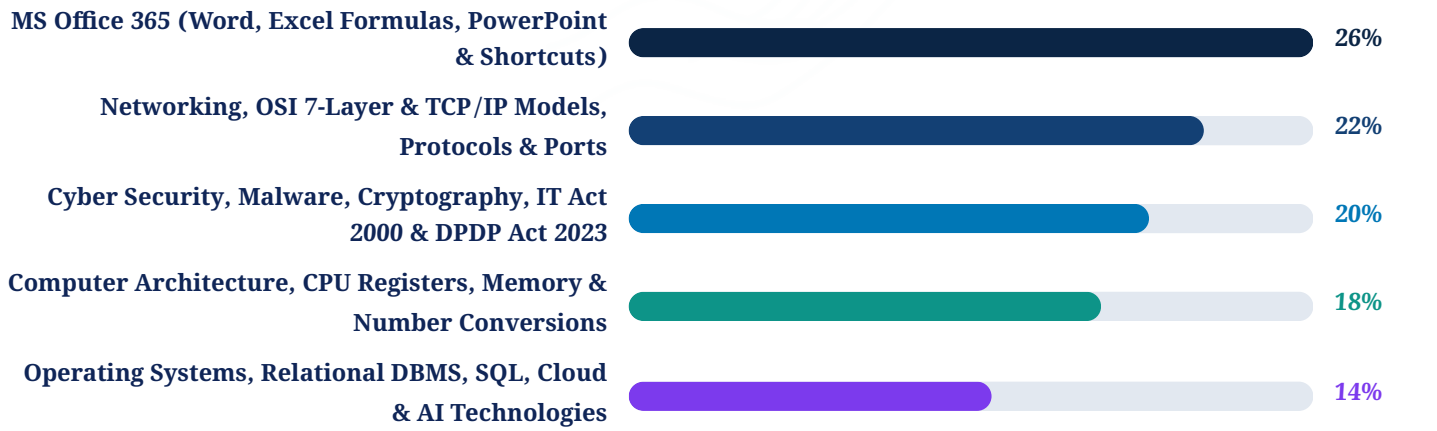
Target Accuracy vs Qualifying Cut-Off Benchmark (%)



Spaced Revision (1-3-7-21 Day Rule) & Retention Curve



Topic-Wise Exam Question Weightage Index (%)



Verified Official Curriculum & Statutory Reference Portals

- **Ministry of Electronics & IT (MeitY)** (https://www.meity.gov.in/)
- **India Code Digital Repository** (https://www.indiacode.nic.in/)
- **SSC Official Portal** (https://ssc.gov.in/)
- **NCERT Computer Science** (https://ncert.nic.in/textbook.php)
- **IUC Academy Official Portal** (https://www.iucacademy.com)

Detailed Table of Contents & Chapter Architecture

COMPUTER KNOWLEDGE, INFORMATION TECHNOLOGY & CYBER SECURITY • Complete Chapters, Comparative Matrices, Solved MCQs & Rapid Revision

1. Chapter 1: Computer Architecture, Hardware Generations, CPU & Memory Hierarchy

- 1.1 Evolution of Five Computer Generations & Core Switching Technologies
- 1.2 Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units

2. Chapter 2: Number Systems, Logic Gates, Operating Systems & Process Scheduling

- 2.1 Positional Number Systems, Base Conversions & Character Encodings
- 2.2 Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks

3. Chapter 3: Microsoft Office 365 & Productivity Suite (MS Word, MS Excel & MS PowerPoint)

- 3.1 Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts
- 3.2 Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes

4. Chapter 4: Computer Networks, Topologies, OSI 7-Layer Model & TCP/IP Protocols

- 4.1 Network Classifications, Topologies & Transmission Media
- 4.2 IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers

5. Chapter 5: Database Management Systems (DBMS), Relational Algebra, Normalization & SQL

- 5.1 Three-Schema Architecture, Relational Model & Keys
- 5.2 SQL Command Sub-Languages & ACID Transaction Properties

6. Chapter 6: Cyber Security, Malware Taxonomy, Cryptography & Network Defense

- 6.1 Comprehensive Malware Taxonomy & Social Engineering Attacks
- 6.2 Cryptography, CIA Triad, Digital Signatures & Firewalls

7. Chapter 7: Information Technology Act 2000 (Amended 2008), DPDP Act 2023 & Digital India

- 7.1 Information Technology Act, 2000 & Amendment Act, 2008 — Statutory Matrix
- 7.2 Digital Personal Data Protection (DPDP) Act, 2023 & Bharatiya Sakshya Adhiniyam, 2023

8. Chapter 8: Emerging Technologies — Artificial Intelligence (AI), Cloud Computing, IoT & Blockchain

- 8.1 Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models
- 8.2 Cloud Computing Deployment Models, Internet of Things (IoT) & Blockchain

9. Solved Exam Practice Questions (MCQs)

10. Extended Comparative & Analytical Practice Set (Questions 36–75)

11. Rapid-Fire Last-Minute One-Liner Revision Capsule

Published by: Inclusive Universal Careers Academy (IUC Academy)

Official Curriculum Alignment: Ministry of Electronics and Information Technology (MeitY) | Staff Selection Commission (SSC) | NCERT Computer Science

Edition: Pure English Comprehensive Study Notes for SSC CGL/CHSL Tier-II, IBPS/SBI PO & Clerk, RBI, EPFO, CDS & State Exams

Chapter *1:* Computer Architecture, Hardware Generations, CPU & Memory Hierarchy

Chapter Key Study Pillars — Chapter 1: Computer Architecture, Hardware Generations, CPU & Memory Hierarchy

Key Study Pillar 1
Evolution of Five Computer Generations & Core Switching Technologies

Key Study Pillar 2
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units

1.1 Evolution of Five Computer Generations & Core Switching Technologies

• **First Generation (*1940–1956* — Vacuum Tubes / Thermionic Valves):** Invented by Lee De Forest and utilized in **ENIAC** (Electronic Numerical Integrator and Computer, built by J. Presper Eckert and John Mauchly, *1945*), **EDVAC** (introduced stored-program concept by John von Neumann), **EDSAC** (built by Maurice Wilkes), and **UNIVAC-I** (first commercial electronic computer, *1951*). Relied on magnetic drums for memory, punched cards for input, and raw Machine Language (`0` s and `1` s) with millisecond (`10^-3 s`) switching speeds.

• **Second Generation (*1956–1963* — Transistors):** Invented at Bell Laboratories in *1947* by John Bardeen, Walter Brattain, and William Shockley. Utilized magnetic core primary memory and magnetic tapes/disks, operated in microseconds (`10^-6 s`), and introduced **Assembly Language** (symbolic mnemonics translated via an Assembler) alongside early High-Level Languages (**FORTRAN** by John Backus at IBM, and **COBOL** led by Grace Hopper). Representative systems: IBM *1401*, IBM *7090*, CDC *1604*.

• **Third Generation (*1964–1971* — Integrated Circuits [SSI & MSI]):** Invented independently by **Jack Kilby** (Texas Instruments, Germanium IC) and **Robert Noyce** (Fairchild Semiconductor, Silicon planar IC). Operated in nanoseconds (`10^-9 s`), introduced time-sharing multiprogramming operating systems, keyboards/monitors, and high-level languages like **BASIC, Pascal, and C**. Representative systems: IBM System/*360*, PDP-8,PDP-11.

• **Fourth Generation (*1971*–Present — Microprocessors [LSI & VLSI]):** Began with the **Intel *4004*** (4-bit microprocessor designed by Federico Faggin, Ted Hoff, and Stan Mazor in *1971*). Replaced magnetic core with semiconductor RAM (SRAM/DRAM), introduced GUI operating systems, LAN/WAN networking, and SQL databases, operating in picoseconds (`10^-12 s`). India's first indigenous supercomputer **PARAM *8000*** (developed by C-DAC Pune under Dr. Vijay Bhatkar in *1991*) belongs to this high-performance era, as documented on MeitY Official Portal.

• **Fifth Generation (Present & Beyond — ULSI, GSI, Parallel Processing & Quantum/AI):** Uses Ultra Large Scale Integration (millions/billions of transistors on a single silicon die), voice recognition, natural language processing, neural networks, and optical/quantum computing paradigms (**PROLOG, LISP, Python, Julia**).

Step-by-Step Conceptual Process Flowchart

STEP 1
Input Unit Encodes Raw Data

STEP 2
CPU Control Unit Fetches & Decodes Instruction

STEP 3
ALU Executes Operation Using Registers

STEP 4
Results Stored in Memory & Dispatched to Output

Memory Tier	Volatility	Access Speed & Latency	Hardware Technology & Use Case	Official Source
CPU Registers	Volatile	Fastest (`< 1 ns`)	Flip-flops inside CPU (PC, IR, MAR, MBR, Accumulator)	NCERT Computer Science
Cache Memory (L1/L2/L3)	Volatile	Ultra-Fast (`1–10 ns`)	**SRAM** (6 transistors/cell; requires no refresh cycle)	SSC Exam Portal
Main Memory (RAM)	Volatile	Fast (`50–100 ns`)	**DRAM / DDR4 / DDR5** (1 transistor + 1 capacitor; needs periodic refresh)	IUC Academy
Firmware (ROM/BIOS/UEFI)	Non-Volatile	Moderate Read	**PROM, EPROM** (UV-erased), **EEPROM / Flash** (electrically erased)	MeitY Portal
Secondary Storage	Non-Volatile	Slow (`ms` to `us`)	**NVMe SSD, SATA SSD, Magnetic HDD, Optical Blu-ray/DVD**	NCERT Computer Science

1.2 Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units

• **Special-Purpose CPU Registers:**

• **Program Counter (PC) / Instruction Pointer (IP):** Holds the memory address of the **next instruction** to be fetched and executed.

• **Memory Address Register (MAR):** Holds the exact memory location in RAM currently being read from or written to via the unidirectional Address Bus.

• **Memory Buffer Register (MBR) / Memory Data Register (MDR):** Holds the data word or instruction just fetched from memory or waiting to be written to memory via the bidirectional Data Bus.

• **Instruction Register (IR):** Holds the **current instruction** that is actively being decoded by the Control Unit.

• **Accumulator (ACC):** Stores immediate inputs and intermediate arithmetic/logical results produced by the ALU.

• **System Bus Tri-Architecture:**

• **Address Bus:** Strictly **unidirectional** (from CPU to Memory/I/O); an `n`-bit address bus can address `2^n` distinct memory locations (e.g., a 32-bit address bus addresses `2^32 = 4 GB` of byte-addressable RAM).

• **Data Bus:** Strictly **bidirectional** (between CPU, Memory, and I/O controllers); its bit width (`32-bit` or `64-bit`) determines the processor's **word size**.

• **Control Bus:** Carries timing signals, clock pulses, interrupt requests (`IRQ`), and Read/Write command lines.

• **Exact Binary Storage Hierarchy:**

• `1 Bit` = Binary Digit (`0` or `1`) | `4 Bits` = `1 Nibble` (1 Hexadecimal digit) | `8 Bits` = `1 Byte` (1 ASCII/UTF-8 character).

• `1,024 Bytes (2^10 B)` = `1 KB` | `1,024 KB (2^20 B)` = `1 MB` | `1,024 MB (2^30 B)` = `1 GB` | `1,024 GB (2^40 B)` = `1 TB` | `1,024 TB (2^50 B)` = `1 PB (Petabyte)` | `1,024 PB (2^60 B)` = `1 EB (Exabyte)` | `1,024 EB (2^70 B)` = `1 ZB (Zettabyte)` | `1,024 ZB (2^80 B)` = `1 YB (Yottabyte)`.

Did You Know?: While **Von Neumann Architecture** shares a single unified memory and bus pathway for both program instructions and data (creating the "Von Neumann Bottleneck"), **Harvard Architecture** (widely used in microcontrollers and digital signal processors) employs physically separate memory modules and buses for instructions and data, enabling simultaneous instruction fetch and data access, as detailed in NCERT Computer Science.

Exam Trap Alert: Candidates frequently confuse **PC (Program Counter)** with **IR (Instruction Register)** and **SRAM** with **DRAM**. Remember: **PC** holds the address of the **NEXT** instruction, whereas **IR** holds the **CURRENT** instruction. Furthermore, **SRAM** is faster, more expensive, needs **no refreshing**, and builds **CPU Cache**, whereas **DRAM** uses capacitors that leak charge, requires **continuous refreshing** thousands of times per second, and builds **Main RAM**.

★ **Memory Trick:** For storage hierarchy above Terabyte (`TB`), memorize the sequence **"P-E-Z-Y"** (**P**etabyte -> **E**xabyte -> **Z**ettabyte -> **Y**ottabyte = `2^50, 2^60, 2^70, 2^80` bytes).

Chapter *1* Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Evolution of Five Computer Generations & Core Switching Technologies	**First Generation (1940–1956 — Vacuum Tubes / Thermionic Valves)**	Invented by Lee De Forest and utilized in **ENIAC** (Electronic Numerical Integrator and Computer, built by J. Presper Eckert and John Mauchly, 1945), **EDVAC** (introduced stored-program concept by John von Neumann), **EDSAC** (built by Maurice Wilkes), and **UNIVAC-I** (first commercial electronic computer, 1951). Relied on magnetic drums for memory, punched cards for input, and raw Machine Language (`0`s and `1`s) with millisecond (`10^-3 s`) switching speeds.
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units	**Second Generation (1956–1963 — Transistors)**	Invented at Bell Laboratories in 1947 by John Bardeen, Walter Brattain, and William Shockley. Utilized magnetic core primary memory and magnetic tapes/disks, operated in microseconds (`10^-6 s`), and introduced **Assembly Language** (symbolic mnemonics translated via an Assembler) alongside early High-Level Languages (**FORTRAN** by John Backus at IBM, and **COBOL** led by Grace Hopper). Representative systems: IBM 1401, IBM 7090, CDC 1604.
Evolution of Five Computer Generations & Core Switching Technologies	**Third Generation (1964–1971 — Integrated Circuits [SSI & MSI])**	Invented independently by **Jack Kilby** (Texas Instruments, Germanium IC) and **Robert Noyce** (Fairchild Semiconductor, Silicon planar IC). Operated in nanoseconds (`10^-9 s`), introduced time-sharing multiprogramming operating systems, keyboards/monitors, and high-level languages like **BASIC, Pascal, and C**. Representative systems: IBM System/360, PDP-8,PDP-11.
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units	**Fourth Generation (1971–Present — Microprocessors [LSI & VLSI])**	Began with the **Intel 4004** (4-bit microprocessor designed by Federico Faggin, Ted Hoff, and Stan Mazor in 1971). Replaced magnetic core with semiconductor RAM (SRAM/DRAM), introduced GUI operating systems, LAN/WAN networking, and SQL databases, operating in picoseconds (`10^-12 s`). India's first indigenous supercomputer **PARAM 8000** (developed by C-DAC Pune under Dr. Vijay Bhatkar in 1991) belongs to this high-performance era, as documented on MeitY Official Portal.

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Evolution of Five Computer Generations & Core Switching Technologies	**Fifth Generation (Present & Beyond — ULSI, GSI, Parallel Processing & Quantum/AI)**	Uses Ultra Large Scale Integration (millions/billions of transistors on a single silicon die), voice recognition, natural language processing, neural networks, and optical/quantum computing paradigms (**PROLOG, LISP, Python, Julia**).
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units	**Program Counter (PC) / Instruction Pointer (IP)**	Holds the memory address of the **next instruction** to be fetched and executed.
Evolution of Five Computer Generations & Core Switching Technologies	**Memory Address Register (MAR)**	Holds the exact memory location in RAM currently being read from or written to via the unidirectional Address Bus.
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units	**Memory Buffer Register (MBR) / Memory Data Register (MDR)**	Holds the data word or instruction just fetched from memory or waiting to be written to memory via the bidirectional Data Bus.
Evolution of Five Computer Generations & Core Switching Technologies	**Instruction Register (IR)**	Holds the **current instruction** that is actively being decoded by the Control Unit.
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units	**Accumulator (ACC)**	Stores immediate inputs and intermediate arithmetic/logical results produced by the ALU.
Evolution of Five Computer Generations & Core Switching Technologies	**Address Bus**	Strictly **unidirectional** (from CPU to Memory/I/O); an `n`-bit address bus can address `2^n` distinct memory locations (e.g., a 32-bit address bus addresses `2^32 = 4 GB` of byte-addressable RAM).
Von Neumann CPU Architecture, Special-Purpose Registers, Buses & Memory Units	**Data Bus**	Strictly **bidirectional** (between CPU, Memory, and I/O controllers); its bit width (`32-bit` or `64-bit`) determines the processor's **word size**.

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Evolution of Five Computer Generations & Core Switching Technologies	**Control Bus**	Carries timing signals, clock pulses, interrupt requests (**IRQ**), and Read/Write command lines.

Chapter *1* Multi-Statement Exam Verification Drills

Chapter 1 Statement-Verification Drill #1 — **Both Statements Verified Correct**

Statement-I (First Generation (*1940–1956* — Vacuum Tubes / Thermionic Valves)): Invented by Lee De Forest and utilized in **ENIAC** (Electronic Numerical Integrator and Computer, built by J. Presper Eckert and John Mauchly, *1945*), **EDVAC** (introduced stored-program concept by John von Neumann), **EDSAC** (built by Maurice Wilkes), and **UNIVAC-I** (first commercial electronic computer, *1951*). Relied on magnetic drums for memory, punched cards for input, and raw Machine Language (**0**s and **1**s) with millisecond (**10^-3 s**) switching speeds.

Statement-II (Second Generation (*1956–1963* — Transistors)): Invented at Bell Laboratories in *1947* by John Bardeen, Walter Brattain, and William Shockley. Utilized magnetic core primary memory and magnetic tapes/disks, operated in microseconds (**10^-6 s**), and introduced **Assembly Language** (symbolic mnemonics translated via an Assembler) alongside early High-Level Languages (**FORTRAN** by John Backus at IBM, and **COBOL** led by Grace Hopper). Representative systems: IBM 1401, IBM 7090, CDC 1604.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 1 Statement-Verification Drill #2 — **Both Statements Verified Correct**

Statement-I (Third Generation (*1964–1971* — Integrated Circuits [SSI & MSI])): Invented independently by **Jack Kilby** (Texas Instruments, Germanium IC) and **Robert Noyce** (Fairchild Semiconductor, Silicon planar IC). Operated in nanoseconds (**10^-9 s**), introduced time-sharing multiprogramming operating systems, keyboards/monitors, and high-level languages like **BASIC, Pascal, and C**. Representative systems: IBM System/360, PDP-8,PDP-11.

Statement-II (Fourth Generation (*1971–Present* — Microprocessors [LSI & VLSI])): Began with the **Intel 4004** (4-bit microprocessor designed by Federico Faggin, Ted Hoff, and Stan Mazor in *1971*). Replaced magnetic core with semiconductor RAM (SRAM/DRAM), introduced GUI operating systems, LAN/WAN networking, and SQL databases, operating in picoseconds (**10^-12 s**). India's first indigenous supercomputer **PARAM *8000*** (developed by C-DAC Pune under Dr. Vijay Bhatkar in *1991*) belongs to this high-performance era, as documented on MeitY Official Portal.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 1 Statement-Verification Drill #3 — **Both Statements Verified Correct**

Statement-I (Fifth Generation (Present & Beyond — ULSI, GSI, Parallel Processing & Quantum/AI)): Uses Ultra Large Scale Integration (millions/billions of transistors on a single silicon die), voice recognition, natural language processing, neural networks, and optical/quantum computing paradigms (**PROLOG, LISP, Python, Julia**).

Statement-II (Program Counter (PC) / Instruction Pointer (IP)): Holds the memory address of the **next instruction** to be fetched and executed.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 1 Statement-Verification Drill #4 Both Statements Verified Correct

Statement-I (Memory Address Register (MAR)): Holds the exact memory location in RAM currently being read from or written to via the unidirectional Address Bus.

Statement-II (Memory Buffer Register (MBR) / Memory Data Register (MDR)): Holds the data word or instruction just fetched from memory or waiting to be written to memory via the bidirectional Data Bus.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 1 Statement-Verification Drill #5 Both Statements Verified Correct

Statement-I (Instruction Register (IR)): Holds the **current instruction** that is actively being decoded by the Control Unit.

Statement-II (Accumulator (ACC)): Stores immediate inputs and intermediate arithmetic/logical results produced by the ALU.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 1 Statement-Verification Drill #6 Both Statements Verified Correct

Statement-I (Address Bus): Strictly **unidirectional** (from CPU to Memory/I/O); an `n`-bit address bus can address `2^n` distinct memory locations (e.g., a 32-bit address bus addresses `2^32 = 4 GB` of byte-addressable RAM).

Statement-II (Data Bus): Strictly **bidirectional** (between CPU, Memory, and I/O controllers); its bit width (`32-bit` or `64-bit`) determines the processor's **word size**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter *2:* Number Systems, Logic Gates, Operating Systems & Process Scheduling

Chapter Key Study Pillars — Chapter 2: Number Systems, Logic Gates, Operating Systems & Process Scheduling

Key Study Pillar 1
Positional Number Systems, Base Conversions & Character Encodings

Key Study Pillar 2
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks

2.1 Positional Number Systems, Base Conversions & Character Encodings

• **Radix / Base Systems:**

• **Binary (`Base-2`):** Digits `{0, 1}`. Positional weights are powers of `2` (`..., 2^3, 2^2, 2^1, 2^0 . 2^-1, 2^-2, ...`).

• **Octal (`Base-8`):** Digits `{0, 1, 2, 3, 4, 5, 6, 7}`. Since `8 = 2^3`, each octal digit maps directly to a **3-bit binary group** (`7_8 = 111_2`).

• **Decimal (`Base-10`):** Digits `{0 to 9}`. Standard human positional system.

• **Hexadecimal (`Base-16`):** Digits `{0–9, A=10, B=11, C=12, D=13, E=14, F=15}`. Since `16 = 2^4`, each hexadecimal digit maps directly to a **4-bit binary nibble** (`F_16 = 1111_2`).

• **Signed Binary Representation & Complements:**

• **1's Complement:** Obtained by inverting every bit (`0 -> 1` and `1 -> 0`). For example, 1's complement of `10110010` is `01001101`.

• **2's Complement:** Obtained by adding `1` to the Least Significant Bit (LSB) of the 1's Complement (`2's Complement = 1's Complement + 1`). Modern CPUs use 2's complement to represent negative integers because it eliminates the dual-zero problem (`+0` and `-0`) and performs subtraction using standard addition circuitry.

• **Standard Alphanumeric Codes:**

• **BCD (Binary Coded Decimal):** Encodes each decimal digit (`0–9`) into a 4-bit binary nibble (`4 bits/digit`).

• **EBCDIC (Extended Binary Coded Decimal Interchange Code):** Developed by IBM for mainframes; uses **8 bits** (`2^8 = 256` characters).

• **ASCII (American Standard Code for Information Interchange):** Standard ASCII uses **7 bits** (`2^7 = 128` characters: `A–Z = 65–90`, `a–z = 97–122`, `0–9 = 48–57`, `Space = 32`); Extended ASCII uses **8 bits** (`256` characters).

• **Unicode (UTF-8, UTF-16, UTF-32):** Universal multilingual character encoding supporting Indian scripts (Devanagari block `U+0900` to `U+097F` per MeitY Standards).

Step-by-Step Conceptual Process Flowchart



Logic Gate	Category	Boolean Expression	Truth-Table Output Condition	Official Reference
AND Gate	Basic Gate	`Y = A . B`	Output is `1` **only if all** inputs are `1`	NCERT Textbooks
OR Gate	Basic Gate	`Y = A + B`	Output is `1` if **at least one** input is `1`	NCERT Textbooks
NOT Gate (Inverter)	Basic Gate	`Y = A'`	Output is the exact logical complement of input `A`	SSC Exam Portal
NAND Gate	**Universal Gate**	`Y = (A . B)'`	Output is `0` **only if all** inputs are `1` (complement of AND)	IUC Academy
NOR Gate	**Universal Gate**	`Y = (A + B)'`	Output is `1` **only if all** inputs are `0` (complement of OR)	IUC Academy
XOR (Exclusive-OR)	Derived Gate	`Y = A'B + AB'`	Output is `1` when inputs are **different** (odd-1s detector)	SSC Exam Portal
XNOR (Equivalence)	Derived Gate	`Y = AB + A'B'`	Output is `1` when inputs are **identical** (`A = B`)	NCERT Textbooks

2.2 Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks

• **Core Operating System Architectures:**

• **Batch OS:** Groups similar jobs into batches without direct user interaction during execution (e.g., early IBM OS/360 payroll processing).

• **Multiprogramming vs Multitasking vs Multiprocessing: Multiprogramming** keeps multiple jobs in RAM so the CPU switches to another job whenever the active job waits for I/O (maximizes CPU utilization); **Multitasking (Time-Sharing)** switches the CPU rapidly among processes using short time slices (quanta) for interactive responsiveness; **Multiprocessing** executes multiple threads simultaneously across two or more physical CPU cores.

• **Real-Time Operating System (RTOS):** Guarantees deterministic processing within strict time deadlines. **Hard RTOS** (missile guidance, aircraft fly-by-wire, pacemakers) tolerates zero deadline slippage; **Soft RTOS** (live video streaming) tolerates minor latency.

• **CPU Scheduling Algorithms:**

• **FCFS (First-Come, First-Served):** Non-preemptive queue; suffers from the **Convoy Effect** (short processes stuck behind a long CPU-bound process).

• **SJF (Shortest Job First) / SRTF (Shortest Remaining Time First):** Provably optimal for minimum average waiting time, but risks **Starvation** of long processes (solved via **Aging**, which gradually increases the priority of waiting processes).

• **Time-Quantum Cyclic Scheduling:** Preemptive time-sharing scheduler where each ready process receives a fixed time slice (`quantum`) in a circular queue.

• **Four Necessary Conditions for Deadlock (Coffman Conditions, 1971):** A system enters deadlock if and only if all four conditions hold simultaneously: (1) **Mutual Exclusion** (non-shareable resource), (2) **Hold and Wait** (process holds one resource while waiting for another), (3) **No Preemption** (resources cannot be forcibly taken away), and (4) **Circular Wait** (closed chain of processes waiting on each other). **Banker's Algorithm** (designed by Edsger Dijkstra) is used for **Deadlock Avoidance**.

• **Virtual Memory, Paging, Segmentation & Thrashing:** Virtual Memory allows execution of programs larger than physical RAM by storing inactive pages on disk (**Swap space / Pagefile**). Physical memory is divided into fixed-size **Frames** and logical memory into equal-sized **Pages** mapped via a **Page Table** (accelerated by the hardware **TLB — Translation Lookaside Buffer**). When a requested page is absent from RAM, a **Page Fault** interrupt occurs. **Belady's Anomaly** occurs in the **FIFO (First-In, First-Out)** page-replacement algorithm, where increasing the number of physical page frames paradoxically increases page faults. Excessive paging activity that collapses CPU utilization is called **Thrashing**.

Did You Know?: NAND and **NOR** gates are called **Universal Gates** because any Boolean function or basic logic gate (`NOT, AND, OR, XOR, XNOR`) can be constructed using solely NAND gates or solely NOR gates! Specifically, building an `AND` gate requires `2 NAND` gates (or `3 NOR` gates), and building an `OR` gate requires `3 NAND` gates (or `2 NOR` gates).

Exam Trap Alert: Distinguish between **Cold Booting** (turning on a computer from a completely powered-off state via hardware power button) and **Warm Booting** (restarting an already powered-on system via `Ctrl + Alt + Del` or OS Restart option, which skips certain hardware power-up surges). Also distinguish **Compiler** (translates the entire high-level source code into object code at once) from **Interpreter** (translates and executes high-level code line by line).

★ **Memory Trick:** Memorize ASCII starting codes via **"48-65-97"**: Digit `'0' = 48`, Uppercase `'A' = 65`, Lowercase `'a' = 97` (notice `'a' - 'A' = 32`, a single bit flip!). For Deadlock conditions, remember **"M-H-N-C"** (**M**utual Exclusion, **H**old & Wait, **N**o Preemption, **C**ircular Wait).

Chapter *2* Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Positional Number Systems, Base Conversions & Character Encodings	**Binary (`Base-2`)**	Digits `{0, 1}`. Positional weights are powers of `2` (`..., 2^3, 2^2, 2^1, 2^0 . 2^-1, 2^-2, ...`).
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**Octal (`Base-8`)**	Digits `{0, 1, 2, 3, 4, 5, 6, 7}`. Since `8 = 2^3`, each octal digit maps directly to a **3-bit binary group** (`7_8 = 111_2`).
Positional Number Systems, Base Conversions & Character Encodings	**Decimal (`Base-10`)**	Digits `{0 to 9}`. Standard human positional system.
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**Hexadecimal (`Base-16`)**	Digits `{0–9, A=10, B=11, C=12, D=13, E=14, F=15}`. Since `16 = 2^4`, each hexadecimal digit maps directly to a **4-bit binary nibble** (`F_16 = 1111_2`).
Positional Number Systems, Base Conversions & Character Encodings	**1's Complement**	Obtained by inverting every bit (`0 -> 1` and `1 -> 0`). For example, 1's complement of `10110010` is `01001101`.
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**2's Complement**	Obtained by adding `1` to the Least Significant Bit (LSB) of the 1's Complement (`2's Complement = 1's Complement + 1`). Modern CPUs use 2's complement to represent negative integers because it eliminates the dual-zero problem (`+0` and `-0`) and performs subtraction using standard addition circuitry.
Positional Number Systems, Base Conversions & Character Encodings	**BCD (Binary Coded Decimal)**	Encodes each decimal digit (`0–9`) into a 4-bit binary nibble (`4 bits/digit`).

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**EBCDIC (Extended Binary Coded Decimal Interchange Code)**	Developed by IBM for mainframes; uses **8 bits** (`2^8 = 256` characters).
Positional Number Systems, Base Conversions & Character Encodings	**ASCII (American Standard Code for Information Interchange)**	Standard ASCII uses **7 bits** (`2^7 = 128` characters: `A–Z = 65–90`, `a–z = 97–122`, `0–9 = 48–57`, `Space = 32`); Extended ASCII uses **8 bits** (`256` characters).
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**Unicode (UTF-8, UTF-16, UTF-32)**	Universal multilingual character encoding supporting Indian scripts (Devanagari block `U+0900` to `U+097F` per MeitY Standards).
Positional Number Systems, Base Conversions & Character Encodings	**Batch OS**	Groups similar jobs into batches without direct user interaction during execution (e.g., early IBM OS/360 payroll processing).
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**Multiprogramming vs Multitasking vs Multiprocessing**	**Multiprogramming** keeps multiple jobs in RAM so the CPU switches to another job whenever the active job waits for I/O (maximizes CPU utilization); **Multitasking (Time-Sharing)** switches the CPU rapidly among processes using short time slices (quanta) for interactive responsiveness; **Multiprocessing** executes multiple threads simultaneously across two or more physical CPU cores.
Positional Number Systems, Base Conversions & Character Encodings	**Real-Time Operating System (RTOS)**	Guarantees deterministic processing within strict time deadlines. **Hard RTOS** (missile guidance, aircraft fly-by-wire, pacemakers) tolerates zero deadline slippage; **Soft RTOS** (live video streaming) tolerates minor latency.
Operating System Kernel Functions, Process Scheduling, Paging & Deadlocks	**FCFS (First-Come, First-Served)**	Non-preemptive queue; suffers from the **Convoy Effect** (short processes stuck behind a long CPU-bound process).

Chapter *2* Multi-Statement Exam Verification Drills

Chapter 2 Statement-Verification Drill #1 — **Both Statements Verified Correct**

Statement-I (Binary (`Base-2`)): Digits `{0, 1}`. Positional weights are powers of `2` (`..., 2^3, 2^2, 2^1, 2^0 . 2^-1, 2^-2, ...`).
Statement-II (Octal (`Base-8`)): Digits `{0, 1, 2, 3, 4, 5, 6, 7}`. Since `8 = 2^3`, each octal digit maps directly to a **3-bit binary group** (`7_8 = 111_2`).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 2 Statement-Verification Drill #2 — Both Statements Verified Correct

Statement-I (Decimal (Base-10)): Digits {0 to 9}. Standard human positional system.

Statement-II (Hexadecimal (Base-16)): Digits {0–9, A=10, B=11, C=12, D=13, E=14, F=15}. Since 16 = 2^4, each hexadecimal digit maps directly to a **4-bit binary nibble** (F_16 = 1111_2).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 2 Statement-Verification Drill #3 — Both Statements Verified Correct

Statement-I (1's Complement): Obtained by inverting every bit (0 -> 1 and 1 -> 0). For example, 1's complement of 10110010 is 01001101.

Statement-II (2's Complement): Obtained by adding 1 to the Least Significant Bit (LSB) of the 1's Complement (2's Complement = 1's Complement + 1). Modern CPUs use 2's complement to represent negative integers because it eliminates the dual-zero problem (+0 and -0) and performs subtraction using standard addition circuitry.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 2 Statement-Verification Drill #4 — Both Statements Verified Correct

Statement-I (BCD (Binary Coded Decimal)): Encodes each decimal digit (0–9) into a 4-bit binary nibble (4 bits/digit).

Statement-II (EBCDIC (Extended Binary Coded Decimal Interchange Code)): Developed by IBM for mainframes; uses **8 bits** (2^8 = 256 characters).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 2 Statement-Verification Drill #5 — Both Statements Verified Correct

Statement-I (ASCII (American Standard Code for Information Interchange)): Standard ASCII uses **7 bits** (2^7 = 128 characters: A–Z = 65–90, a–z = 97–122, 0–9 = 48–57, Space = 32); Extended ASCII uses **8 bits** (256 characters).

Statement-II (Unicode (UTF-8, UTF-16, UTF-32)): Universal multilingual character encoding supporting Indian scripts (Devanagari block U+0900 to U+097F per MeitY Standards).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 2 Statement-Verification Drill #6 — Both Statements Verified Correct

Statement-I (Batch OS): Groups similar jobs into batches without direct user interaction during execution (e.g., early IBM OS/360 payroll processing).

Statement-II (Multiprogramming vs Multitasking vs Multiprocessing): Multiprogramming keeps multiple jobs in RAM so the CPU switches to another job whenever the active job waits for I/O (maximizes CPU utilization); **Multitasking (Time-Sharing)** switches the CPU rapidly among processes using short time slices (quanta) for interactive responsiveness; **Multiprocessing** executes multiple threads simultaneously across two or more physical CPU cores.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 3: Microsoft Office 365 & Productivity Suite (MS Word, MS Excel & MS PowerPoint)

Chapter Key Study Pillars — Chapter 3: Microsoft Office 365 & Productivity Suite (MS Word, MS Excel & MS PowerPoint)

Key Study Pillar 1
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts

Key Study Pillar 2
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes

3.1 Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts

• **Default Specifications & Zoom Limits (MS Word 2019 / 2021 / 365):**

• **Default File Extension:** `.docx` (XML-based document), `.dotx` (Word template), `.docm` (Macro-enabled document).

• **Font Size & Zoom Range:** Default font in Office 2016/2019/2021 is **Calibri (11 pt)** (recently updated to **Aptos 11 pt** in latest 365 builds). Font size dropdown list offers **8 pt to 72 pt**, while manual keyboard entry supports **1 pt to 1638 pt**. Zoom slider ranges from **10% (minimum) to 500% (maximum)**.

• **Margins & Page Orientation:** Default page orientation is **Portrait** (with **Landscape** as the horizontal alternative); default margin on all four sides is **1 inch (2.54 cm)**. **Gutter Margin** is extra space added to the **Left** or **Top** margin exclusively for **book binding** so text is not obscured.

• **High-Frequency MS Word Shortcuts (`Ctrl / Function Keys`):**

• **Text Alignment & Spacing:** `Ctrl + L` (Left Align), `Ctrl + E` (Center Align), `Ctrl + R` (Right Align), `Ctrl + J` (Justify), `Ctrl + 1` (Single line spacing), `Ctrl + 2` (Double line spacing), `Ctrl + 5` (`1.5` line spacing), `Ctrl + M` (Increase paragraph indent), `Ctrl + Shift + M` (Decrease indent), `Ctrl + T` (Hanging indent), `Ctrl + Q` (Remove paragraph formatting).

• **Font & Case Styling:** `Ctrl + D` (Open Font dialog box), `Ctrl + Shift + >` or `Ctrl + ]` (Increase font size by 1 step / 1 pt), `Ctrl + Shift + <` or `Ctrl + [` (Decrease font size by 1 step / 1 pt), `Ctrl + =` (**Subscript**, e.g., `H2O`), `Ctrl + Shift + +` (**Superscript**, e.g., `x^2`), `Shift + F3` (Toggle Change Case: `lowercase -> UPPERCASE -> Capitalize Each Word`), `Ctrl + Spacebar` (Clear character formatting).

• **Breaks, Hyperlinks & Proofing:** `Ctrl + Enter` (Insert Page Break), `Ctrl + Shift + Enter` (Insert Column Break), `Shift + Enter` (Line break within same paragraph), `Ctrl + K` (Insert Hyperlink), `F7` (Spelling & Grammar Check), `Shift + F7` (Open **Thesaurus**), `Ctrl + H` (Find and Replace), `Ctrl + G` or `F5` (Go To page/bookmark), `Ctrl + F2` or `Ctrl + Alt + I` (Print Preview), `F12` (Save As dialog box), `Ctrl + W` or `Ctrl + F4` (Close active document window), `Alt + Ctrl + F` (Insert Footnote at bottom of page), `Alt + Ctrl + D` (Insert Endnote at end of document).

Step-by-Step Conceptual Process Flowchart

STEP 1 Select Document View or Cell Range

STEP 2 Apply Formatting, Styles & Formulas

STEP 3 Validate Data & Error Codes

STEP 4 Execute Print, Mail Merge or Slide Show

Application	Zoom Range (Min–Max)	Default Extension	Macro Extension	Key Ribbon Tabs & Signature Feature	Official Portal
MS Word *365*	**10%** to **500%**	**.docx**	**.docm**	Home, Insert, Draw, Design, Layout, **References**, **Mailings**, Review, View	SSC Exam Portal
MS Excel *365*	**10%** to **400%**	**.xlsx**	**.xlsm**	Home, Insert, Page Layout, **Formulas**, **Data**, Review, View (PivotTables)	IUC Academy
MS PowerPoint *365*	**10%** to **400%**	**.odp** / Slide Deck	**.pptm**	Home, Insert, Design, **Transitions**, **Animations**, **Slide Show**, View	NCERT Textbooks

3.2 Microsoft Excel *365* — Grid Limits, Cell Referencing, Functions & Error Codes

• **Worksheet Structural Dimensions & Navigation:**

• **Grid Capacity:** Each worksheet contains **1,048,576 Rows** (**2^20** , numbered **1** to **1048576**) and **16,384 Columns** (**2^14** , labeled **A** to **XFD**). Cell address format is always **ColumnLetter + RowNumber** (e.g., **B15** ; the very last cell is **XFD1048576**).

• **Cell Referencing Modes (Toggled via F4 Key):**

• **Relative Reference (A1):** Both column and row change automatically when copied across cells.

• **Absolute Reference (A1):** Both column and row remain locked when copied.

• **Mixed Reference (A1 or A1):** Either the column (**A1**) or the row (**A1**) is locked.

• **Crucial Excel Keyboard Shortcuts:** **F2** (Edit active cell), **Alt + Enter** (Start a **new line inside the same cell**), **Ctrl + ;** (Insert **current Date**), **Ctrl + Shift + :** (Insert **current Time**), **Alt + =** (Insert **AutoSum** **=SUM(...)**), **Shift + F11** (Insert a new worksheet), **Shift + Spacebar** (Select entire **Row**), **Ctrl + Spacebar** (Select entire **Column**), **Ctrl + 9** (Hide selected rows), **Ctrl + 0** (Hide selected columns), **Ctrl + ~** (Toggle displaying Formulas vs calculated Values), **Ctrl + D** (Fill Down from cell above), **Ctrl + R** (Fill Right from cell to left).

• **Essential Excel Functions & Formula Evaluation:**

• **=SUM(A1:A5)** adds numeric values; **=AVERAGE(A1:A5)** computes arithmetic mean; **=COUNT(A1:A10)** counts cells containing **only numbers/dates**; **=COUNTA(A1:A10)** counts all **non-empty cells** (numbers, text, logicals); **=COUNTBLANK(A1:A10)** counts empty cells.

• **=MOD(17, 5)** returns the remainder (**2**); **=INT(-8.4)** steps down to the nearest integer (**-9**), whereas **=TRUNC(-8.4)** simply truncates the fractional part (**-8**); **=CEILING(14, 5)** steps up to nearest multiple of **5** (**15**); **=FLOOR(14, 5)** steps down to nearest multiple of **5** (**10**); **=LEN("IUC Academy")** returns character count including spaces (**11**); **=MID("GOVERNMENT", 3, 4)** extracts **4** characters starting at position **3** (**"VERN"**).

• **Standard Excel Error Diagnostics:**

• `#####`: Column is too narrow to display the numeric/date value, or a negative date/time was calculated.

• `#DIV/0!`: Division by zero or by an empty cell.

• `#NAME?`: Excel does not recognize a function name or text without quotes (e.g., `=SUMA(A1:A5)`).

• `#VALUE!`: Wrong data type of argument or operand (e.g., `="India" + 10`).

• `#REF!`: Invalid cell reference (e.g., a referenced row or column was deleted).

• `#N/A`: A lookup function (`VLOOKUP, HLOOKUP, XLOOKUP, MATCH`) cannot find the requested lookup value.

• `#NUM!`: Invalid numeric calculation (e.g., `=SQRT(-25)`).

• **MS PowerPoint 365 Essentials:**

• **New Slide vs New Presentation:** `Ctrl + M` inserts a **New Slide** into the current presentation, whereas `Ctrl + N` creates a brand-new presentation file! `Ctrl + D` duplicates the selected slide or object.

• **Slide Show Controls:** `F5` starts the Slide Show from the **first slide**; `Shift + F5` starts the Slide Show from the **current slide**; `W` or `.` (period) turns the screen white during a presentation; `B` or `,` (comma) turns the screen black; `Esc` exits the Slide Show.

• **Slide Master (View Tab):** Controls universal fonts, logos, backdrops, and placeholders across all slides simultaneously. **Transitions** are visual effects applied when moving from **one slide to the next**, whereas **Animations** are visual effects applied to **individual objects/text on a single slide**.

Did You Know?: In MS Word's **Mail Merge** feature (located under the **Mailings** tab), three components are combined to generate personalized bulk letters or admit cards: (1) the **Main Document** (template text), (2) the **Data Source** (Excel sheet/database of recipient records), and (3) the **Merge Fields** (`<<Name>>`, `<<Roll_No>>`).

Exam Trap Alert: Over 80% of candidates confuse `Ctrl + M` in MS Word vs MS PowerPoint, and `Shift + Spacebar` vs `Ctrl + Spacebar` in MS Excel! In **MS Word**, `Ctrl + M` indents a paragraph; in **MS PowerPoint**, `Ctrl + M` inserts a **New Slide**. In **MS Excel**, `Shift + Spacebar` selects the entire **Row**, whereas `Ctrl + Spacebar` selects the entire **Column**.

★ **Memory Trick:** For Excel `COUNT` vs `COUNTA`: **COUNT** = **O**nly **N**umbers; **COUNTA** = **C**ount **A**ll non-blank cells! For Word Footnote vs Endnote: **F**ootnote = **F**oot of the same page (`Alt+Ctrl+F`); **E**ndnote = **E**nd of the whole document (`Alt+Ctrl+D`).

Chapter 3 Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	**Default File Extension**	`.docx` (XML-based document), `.dotx` (Word template), `.docm` (Macro-enabled document).

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	**Font Size & Zoom Range**	Default font in Office 2016/2019/2021 is **Calibri (11 pt)** (recently updated to **Aptos 11 pt** in latest 365 builds). Font size dropdown list offers **8 pt to 72 pt**, while manual keyboard entry supports **1 pt to 1638 pt**. Zoom slider ranges from **10% (minimum) to 500% (maximum)**.
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	**Margins & Page Orientation**	Default page orientation is **Portrait** (with **Landscape** as the horizontal alternative); default margin on all four sides is **1 inch (2.54 cm)**. **Gutter Margin** is extra space added to the **Left** or **Top** margin exclusively for **book binding** so text is not obscured.
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	**Text Alignment & Spacing**	**Ctrl + L** (Left Align), **Ctrl + E** (Center Align), **Ctrl + R** (Right Align), **Ctrl + J** (Justify), **Ctrl + 1** (Single line spacing), **Ctrl + 2** (Double line spacing), **Ctrl + 5** (**1.5** line spacing), **Ctrl + M** (Increase paragraph indent), **Ctrl + Shift + M** (Decrease indent), **Ctrl + T** (Hanging indent), **Ctrl + Q** (Remove paragraph formatting).
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	**Font & Case Styling**	**Ctrl + D** (Open Font dialog box), **Ctrl + Shift + >** or **Ctrl +]** (Increase font size by 1 step / 1 pt), **Ctrl + Shift + <** or **Ctrl + [** (Decrease font size by 1 step / 1 pt), **Ctrl + =** (**Subscript**, e.g., **H2O**), **Ctrl + Shift + +** (**Superscript**, e.g., **x^2**), **Shift + F3** (Toggle Change Case: **lowercase -> UPPERCASE -> Capitalize Each Word**), **Ctrl + Spacebar** (Clear character formatting).
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	**Breaks, Hyperlinks & Proofing**	**Ctrl + Enter** (Insert Page Break), **Ctrl + Shift + Enter** (Insert Column Break), **Shift + Enter** (Line break within same paragraph), **Ctrl + K** (Insert Hyperlink), **F7** (Spelling & Grammar Check), **Shift + F7** (Open **Thesaurus**), **Ctrl + H** (Find and Replace), **Ctrl + G** or **F5** (Go To page/ bookmark), **Ctrl + F2** or **Ctrl + Alt + I** (Print Preview), **F12** (Save As dialog box), **Ctrl + W** or **Ctrl + F4** (Close active document window), **Alt + Ctrl + F** (Insert Footnote at bottom of page), **Alt + Ctrl + D** (Insert Endnote at end of document).
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	**Grid Capacity**	Each worksheet contains **1,048,576 Rows** (**2^20**, numbered **1** to **1048576**) and **16,384 Columns** (**2^14**, labeled **A** to **XFD**). Cell address format is always **ColumnLetter + RowNumber** (e.g., **B15**; the very last cell is **XFD1048576**).
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	**Relative Reference (A1)**	Both column and row change automatically when copied across cells.
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	**Absolute Reference (A1)**	Both column and row remain locked when copied.

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	**Mixed Reference (`A1` or `A1`)**	Either the column (`A1`) or the row (`A1`) is locked.
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	**Crucial Excel Keyboard Shortcuts**	`F2` (Edit active cell), `Alt + Enter` (Start a **new line inside the same cell**), `Ctrl + ;` (Insert **current Date**), `Ctrl + Shift + :` (Insert **current Time**), `Alt + =` (Insert **AutoSum** `=SUM(...)`), `Shift + F11` (Insert a new worksheet), `Shift + Spacebar` (Select entire **Row**), `Ctrl + Spacebar` (Select entire **Column**), `Ctrl + 9` (Hide selected rows), `Ctrl + 0` (Hide selected columns), `Ctrl + ~` (Toggle displaying Formulas vs calculated Values), `Ctrl + D` (Fill Down from cell above), `Ctrl + R` (Fill Right from cell to left).
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	**`=SUM(A1**	A5) **adds numeric values;** =AVERAGE(A1:A5) **computes arithmetic mean;** =COUNT(A1:A10) **counts cells containing only numbers/dates;** =COUNTA(A1:A10) **counts all non-empty cells (numbers, text, logicals);** =COUNTBLANK(A1:A10)` counts empty cells.
Microsoft Word 365 — Formatting, Page Layout & Master Keyboard Shortcuts	`#####`	Column is too narrow to display the numeric/date value, or a negative date/time was calculated.
Microsoft Excel 365 — Grid Limits, Cell Referencing, Functions & Error Codes	`#DIV/0!`	Division by zero or by an empty cell.

Chapter *3* Multi-Statement Exam Verification Drills

Chapter 3 Statement-Verification Drill #1 — **Both Statements Verified Correct**

Statement-I (Default File Extension): `.docx` (XML-based document), `.dotx` (Word template), `.docm` (Macro-enabled document).

Statement-II (Font Size & Zoom Range): Default font in Office 2016/2019/2021 is **Calibri (11 pt)** (recently updated to **Aptos 11 pt** in latest 365 builds). Font size dropdown list offers **8 pt to 72 pt**, while manual keyboard entry supports **1 pt to 1638 pt**. Zoom slider ranges from **10% (minimum) to 500% (maximum)**.

✔ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 3 Statement-Verification Drill #2 Both Statements Verified Correct

Statement-I (Margins & Page Orientation): Default page orientation is **Portrait** (with **Landscape** as the horizontal alternative); default margin on all four sides is **1 inch (2.54 cm)**. **Gutter Margin** is extra space added to the **Left** or **Top** margin exclusively for **book binding** so text is not obscured.

Statement-II (Text Alignment & Spacing): `Ctrl + L` (Left Align), `Ctrl + E` (Center Align), `Ctrl + R` (Right Align), `Ctrl + J` (Justify), `Ctrl + 1` (Single line spacing), `Ctrl + 2` (Double line spacing), `Ctrl + 5` (`1.5` line spacing), `Ctrl + M` (Increase paragraph indent), `Ctrl + Shift + M` (Decrease indent), `Ctrl + T` (Hanging indent), `Ctrl + Q` (Remove paragraph formatting).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 3 Statement-Verification Drill #3 Both Statements Verified Correct

Statement-I (Font & Case Styling): `Ctrl + D` (Open Font dialog box), `Ctrl + Shift + >` or `Ctrl + ]` (Increase font size by 1 step / 1 pt), `Ctrl + Shift + <` or `Ctrl + [` (Decrease font size by 1 step / 1 pt), `Ctrl + =` (**Subscript**, e.g., `H2O`), `Ctrl + Shift + +` (**Superscript**, e.g., `x^2`), `Shift + F3` (Toggle Change Case: **lowercase -> UPPERCASE -> Capitalize Each Word**), `Ctrl + Spacebar` (Clear character formatting).

Statement-II (Breaks, Hyperlinks & Proofing): `Ctrl + Enter` (Insert Page Break), `Ctrl + Shift + Enter` (Insert Column Break), `Shift + Enter` (Line break within same paragraph), `Ctrl + K` (Insert Hyperlink), `F7` (Spelling & Grammar Check), `Shift + F7` (Open **Thesaurus**), `Ctrl + H` (Find and Replace), `Ctrl + G` or `F5` (Go To page/bookmark), `Ctrl + F2` or `Ctrl + Alt + I` (Print Preview), `F12` (Save As dialog box), `Ctrl + W` or `Ctrl + F4` (Close active document window), `Alt + Ctrl + F` (Insert Footnote at bottom of page), `Alt + Ctrl + D` (Insert Endnote at end of document).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 3 Statement-Verification Drill #4 Both Statements Verified Correct

Statement-I (Grid Capacity): Each worksheet contains **1,048,576 Rows** (`2^20`, numbered `1` to `1048576`) and **16,384 Columns** (`2^14`, labeled `A` to `XFD`). Cell address format is always `ColumnLetter + RowNumber` (e.g., `B15`; the very last cell is `XFD1048576`).

Statement-II (Relative Reference (`A1`)): Both column and row change automatically when copied across cells.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 3 Statement-Verification Drill #5 Both Statements Verified Correct

Statement-I (Absolute Reference (`$A$1`)): Both column and row remain locked when copied.

Statement-II (Mixed Reference (`A1` or `A1`)): Either the column (`A1`) or the row (`A1`) is locked.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 3 Statement-Verification Drill #6 Both Statements Verified Correct

Statement-I (Crucial Excel Keyboard Shortcuts): `F2` (Edit active cell), `Alt + Enter` (Start a **new line inside the same cell**), `Ctrl + ;` (Insert **current Date**), `Ctrl + Shift + :` (Insert **current Time**), `Alt + =` (Insert **AutoSum** `=SUM(...)`), `Shift + F11` (Insert a new worksheet), `Shift + Spacebar` (Select entire **Row**), `Ctrl + Spacebar` (Select entire **Column**), `Ctrl + 9` (Hide selected rows), `Ctrl + 0` (Hide selected columns), `Ctrl + ~` (Toggle displaying Formulas vs calculated Values), `Ctrl + D` (Fill Down from cell above), `Ctrl + R` (Fill Right from cell to left).

**Statement-II (`=SUM(A1):** A5) `adds numeric values;` =AVERAGE(A1:A5) `computes arithmetic mean;` =COUNT(A1:A10) `counts cells containing only numbers/dates;` =COUNTA(A1:A10) `counts all non-empty cells (numbers, text, logicals);` =COUNTBLANK(A1:A10)` counts empty cells.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter *4:* Computer Networks, Topologies, OSI 7-Layer Model & TCP/IP Protocols

Chapter Key Study Pillars — Chapter 4: Computer Networks, Topologies, OSI 7-Layer Model & TCP/IP Protocols

Key Study Pillar 1
Network Classifications, Topologies & Transmission Media

Key Study Pillar 2
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers

4.1 Network Classifications, Topologies & Transmission Media

• **Geographic Network Scale: PAN** (Personal Area Network: Bluetooth/IEEE 802.15, IrDA, USB within `1–10 m`), **LAN** (Local Area Network: Ethernet/IEEE 802.3, Wi-Fi/IEEE 802.11 within a building/campus up to a few km), **CAN** (Campus Area Network), **MAN** (Metropolitan Area Network: Cable TV, IEEE 802.16 WiMAX across a city up to `50 km`), and **WAN** (Wide Area Network: Internet, leased MPLS/satellite links across countries/continents).

• **Network Topologies & Cable/Link Formulas (for `n` Nodes):**

• **Bus Topology:** All nodes share a single backbone coaxial cable terminated by terminators at both ends. Uses `1` backbone cable + `n` drop lines; single backbone break halts the entire network; suffers from signal reflection and CSMA/CD collisions.

• **Star Topology:** Every node connects via a dedicated point-to-point cable to a central **Switch or Hub**. Requires `n` cables and `n` I/O ports; failure of one node/cable does not affect others, but failure of the central switch brings down the network.

• **Ring Topology:** Each node connects to exactly two adjacent neighbors forming a closed loop (`n` cables). Uses **Token passing** to prevent collisions; unidirectional unless configured as Dual Ring (FDDI).

• **Mesh Topology (Full Mesh):** Every node has a dedicated point-to-point link to every other node. Number of bidirectional physical links = `n(n - 1) / 2`, and each node requires `(n - 1)` **I/O ports**. Highest fault tolerance, privacy, and wiring cost (e.g., for `n = 8` nodes, links = `8 * 7 / 2 = 28` cables).

• **Transmission Modes (Channel Directionality):**

• **Simplex:** Unidirectional only (Keyboard to CPU, Television broadcast, FM Radio).

• **Half-Duplex:** Bidirectional, but **only one direction at a time** (Walkie-Talkie, CB Radio).

• **Full-Duplex:** Bidirectional **simultaneously in both directions** (Telephone call, modern Switched Ethernet).

Step-by-Step Conceptual Process Flowchart

STEP 1 Application Generates Data Payload

STEP 2 Transport Adds TCP/UDP Port Header (Segment)

STEP 3 Network Adds Source/Dest IP (Packet)

STEP 4 Data Link Adds MAC Frame & Physical Transmits Bits

OSI Layer (Bottom to Top)	Protocol Data Unit (PDU)	Networking Hardware Devices	Core Protocols & Functions	Official Reference
Layer 1: Physical	**Bits** (`0` and `1`)	**Hub**, **Repeater**, Modem, Cables (RJ-45, Fiber)	Bit synchronization, voltage levels, line coding, topology	NCERT Textbooks
Layer 2: Data Link	**Frame**	**Switch (L2)**, **Bridge**, **NIC (Network Card)**	**MAC Addressing (48-bit Hex)**, framing, CRC error detection, LLC/MAC	SSC Exam Portal
Layer 3: Network	**Packet**	**Router**, **Layer-3 Switch**, Brouter	**Logical IP Addressing**, routing (OSPF, BGP, RIP), **ICMP, ARP, IPsec**	IUC Academy
Layer 4: Transport	**Segment** (TCP) / **Datagram** (UDP)	**Gateway**, Load Balancer / Stateful Firewall	End-to-end delivery, **Port numbers (16-bit)**, flow control, **TCP, UDP**	MeitY Portal
Layer 5: Session	**Data**	Gateway / Software Socket	Session establishment, checkpointing, dialog synchronization (NetBIOS, RPC)	NCERT Textbooks
Layer 6: Presentation	**Data**	Gateway / Software Translator	**Encryption/Decryption (TLS/SSL)**, compression, character translation (ASCII, JPEG)	SSC Exam Portal
Layer 7: Application	**Data / Message**	Gateway, Proxy Server, Next-Gen Firewall	User network interface: **HTTP, HTTPS, FTP, SMTP, POP3, IMAP, DNS, DHCP, SSH**	IUC Academy

4.2 IPv*4* vs IPv*6* Addressing, Subnet Classes & Standard Port Numbers

• **MAC Address vs IPv4 vs IPv6:**

• **MAC (Media Access Control) Address: 48-bit (6-byte)** physical hardware address burned into the NIC ROM, written as **12 hexadecimal digits** separated by colons or hyphens (e.g., `00:1A:2B:3C:4D:5E`; first 24 bits = OUI manufacturer ID, last 24 bits = device serial).

• **IPv4 Address: 32-bit (4-byte)** logical address written in **dotted-decimal notation** as four octets separated by periods (`0` to `255` per octet, e.g., `192.168.1.1`), providing `2^32` (~`4.29 billion`) addresses.

• **IPv6 Address: 128-bit (16-byte)** logical address written as **eight groups of 4 hexadecimal digits** separated by colons (e.g., `2001:0db8:85a3:0000:0000:8a2e:0370:7334`), providing `2^128` addresses.

• **IPv4 Classful First-Octet Ranges & Special Addresses:**

• **Class A:** `1.0.0.0` to `126.255.255.255` (Subnet Mask `255.0.0.0` or `/8`; supports vast networks). Note: `127.0.0.1` (`127.x.x.x`) is reserved for **Loopback / Localhost self-testing**!

• **Class B:** `128.0.0.0` to `191.255.255.255` (Subnet Mask `255.255.0.0` or `/16`; medium institutional networks).

• **Class C:** `192.0.0.0` to `223.255.255.255` (Subnet Mask `255.255.255.0` or `/24`; up to `254` usable hosts per network).

• **Class D:** `224.0.0.0` to `239.255.255.255` (Reserved for **Multicasting**; no subnet mask).

• **Class E:** `240.0.0.0` to `255.255.255.255` (Reserved for **Experimental / Research** use).

• **Mandatory Protocol Port Numbers & Resolution Protocols:**

• **FTP (File Transfer Protocol):** Port **20** (Data transfer) & Port **21** (Control connection).

• **SSH (Secure Shell):** Port **22** | **Telnet (Unencrypted Remote Login):** Port **23**.

• **SMTP (Simple Mail Transfer Protocol — Outgoing/Pushing Email):** Port **25** (or **587** / **465** for encrypted submission).

• **DNS (Domain Name System — Translates Domain Name to IP Address):** Port **53**.

• **DHCP (Dynamic Host Configuration Protocol — Automatically assigns IP):** Port **67** (Server) & Port **68** (Client) using the **DORA** process (*Discover -> Offer -> Request -> Acknowledge*).

• **HTTP:** Port **80** | **HTTPS (HTTP over TLS/SSL):** Port **443**.

• **POP3 (Post Office Protocol v3 — Downloads email to single device):** Port **110** (SSL: **995**) | **IMAP (Internet Message Access Protocol — Syncs email on server across devices):** Port **143** (SSL: **993**).

• **ARP (Address Resolution Protocol):** Resolves a known **IP Address -> Physical MAC Address**; **RARP** resolves **MAC -> IP**.

Did You Know?: While the ISO **OSI Reference Model** has **7 layers**, the practical **TCP/IP (DoD) Model** originally defined **4 layers**: (1) **Network Access / Link Layer** (combines OSI Physical + Data Link), (2) **Internet Layer** (matches OSI Network Layer), (3) **Host-to-Host Transport Layer** (matches OSI Transport Layer), and (4) **Application Layer** (combines OSI Session + Presentation + Application layers).

Exam Trap Alert: Remember the Broadcast vs Collision Domain distinction across hardware devices: a **Hub** (Layer 1) splits neither collision nor broadcast domains (all ports share 1 collision domain and 1 broadcast domain); a **Switch** (Layer 2) creates a **separate collision domain per port** while keeping a single broadcast domain; only a **Router** (Layer 3) breaks up **Broadcast Domains**!

★ **Memory Trick:** Memorize OSI Layers 1 to 7 from bottom to top using **"Please Do Not Throw Sausage Pizza Away"** (**P**hysical, **D**ata Link, **N**etwork, **T**ransport, **S**ession, **P**resentation, **A**pplication) and PDU order **"Bits -> Frames -> Packets -> Segments -> Data"**.

Chapter 4 Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Network Classifications, Topologies & Transmission Media	**Geographic Network Scale**	**PAN** (Personal Area Network: Bluetooth/IEEE 802.15, IrDA, USB within `1–10 m`), **LAN** (Local Area Network: Ethernet/IEEE 802.3, Wi-Fi/IEEE 802.11 within a building/campus up to a few km), **CAN** (Campus Area Network), **MAN** (Metropolitan Area Network: Cable TV, IEEE 802.16 WiMAX across a city up to `50 km`), and **WAN** (Wide Area Network: Internet, leased MPLS/ satellite links across countries/continents).
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	**Bus Topology**	All nodes share a single backbone coaxial cable terminated by terminators at both ends. Uses `1` backbone cable + `n` drop lines; single backbone break halts the entire network; suffers from signal reflection and CSMA/CD collisions.
Network Classifications, Topologies & Transmission Media	**Star Topology**	Every node connects via a dedicated point-to-point cable to a central **Switch or Hub**. Requires `n` cables and `n` I/O ports; failure of one node/cable does not affect others, but failure of the central switch brings down the network.
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	**Ring Topology**	Each node connects to exactly two adjacent neighbors forming a closed loop (`n` cables). Uses **Token passing** to prevent collisions; unidirectional unless configured as Dual Ring (FDDI).
Network Classifications, Topologies & Transmission Media	**Mesh Topology (Full Mesh)**	Every node has a dedicated point-to-point link to every other node. Number of bidirectional physical links = `n(n - 1) / 2`, and each node requires `(n - 1)` **I/O ports**. Highest fault tolerance, privacy, and wiring cost (e.g., for `n = 8` nodes, links = `8 * 7 / 2 = 28` cables).
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	**Simplex**	Unidirectional only (Keyboard to CPU, Television broadcast, FM Radio).
Network Classifications, Topologies & Transmission Media	**Half-Duplex**	Bidirectional, but **only one direction at a time** (Walkie-Talkie, CB Radio).
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	**Full-Duplex**	Bidirectional **simultaneously in both directions** (Telephone call, modern Switched Ethernet).
Network Classifications, Topologies & Transmission Media	**MAC (Media Access Control) Address**	**48-bit (6-byte)** physical hardware address burned into the NIC ROM, written as **12 hexadecimal digits** separated by colons or hyphens (e.g., `00:1A:2B:3C:4D:5E`; first 24 bits = OUI manufacturer ID, last 24 bits = device serial).

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	IPv4 Address	**32-bit (4-byte)** logical address written in **dotted-decimal notation** as four octets separated by periods (`0` to `255` per octet, e.g., `192.168.1.1`), providing `2^32` (~ `4.29 billion`) addresses.
Network Classifications, Topologies & Transmission Media	IPv6 Address	**128-bit (16-byte)** logical address written as **eight groups of 4 hexadecimal digits** separated by colons (e.g., `2001:0db8:85a3:0000:0000:8a2e:0370:7334`), providing `2^128` addresses.
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	Class A	`1.0.0.0` to `126.255.255.255` (Subnet Mask `255.0.0.0` or `/8`; supports vast networks). Note: `127.0.0.1` **(** `127.x.x.x` **)** is reserved for **Loopback / Localhost self-testing**!
Network Classifications, Topologies & Transmission Media	Class B	`128.0.0.0` to `191.255.255.255` (Subnet Mask `255.255.0.0` or `/16`; medium institutional networks).
IPv4 vs IPv6 Addressing, Subnet Classes & Standard Port Numbers	Class C	`192.0.0.0` to `223.255.255.255` (Subnet Mask `255.255.255.0` or `/24`; up to `254` usable hosts per network).

Chapter 4 Multi-Statement Exam Verification Drills

Chapter 4 Statement-Verification Drill #1 — Both Statements Verified Correct

Statement-I (Geographic Network Scale): **PAN** (Personal Area Network: Bluetooth/IEEE 802.15, IrDA, USB within `1–10 m`), **LAN** (Local Area Network: Ethernet/IEEE 802.3, Wi-Fi/IEEE 802.11 within a building/campus up to a few km), **CAN** (Campus Area Network), **MAN** (Metropolitan Area Network: Cable TV, IEEE 802.16 WiMAX across a city up to `50 km`), and **WAN** (Wide Area Network: Internet, leased MPLS/satellite links across countries/continents).

Statement-II (Bus Topology): All nodes share a single backbone coaxial cable terminated by terminators at both ends. Uses `1` backbone cable + `n` drop lines; single backbone break halts the entire network; suffers from signal reflection and CSMA/CD collisions.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 4 Statement-Verification Drill #2 — Both Statements Verified Correct

Statement-I (Star Topology): Every node connects via a dedicated point-to-point cable to a central **Switch or Hub**. Requires `n` cables and `n` I/O ports; failure of one node/cable does not affect others, but failure of the central switch brings down the network.

Statement-II (Ring Topology): Each node connects to exactly two adjacent neighbors forming a closed loop (`n` cables). Uses **Token passing** to prevent collisions; unidirectional unless configured as Dual Ring (FDDI).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 4 Statement-Verification Drill #3 Both Statements Verified Correct

Statement-I (Mesh Topology (Full Mesh)): Every node has a dedicated point-to-point link to every other node. Number of bidirectional physical links = `n(n - 1) / 2`, and each node requires `(n - 1)` **I/O ports**. Highest fault tolerance, privacy, and wiring cost (e.g., for `n = 8` nodes, links = `8 * 7 / 2 = 28` cables).

Statement-II (Simplex): Unidirectional only (Keyboard to CPU, Television broadcast, FM Radio).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 4 Statement-Verification Drill #4 Both Statements Verified Correct

Statement-I (Half-Duplex): Bidirectional, but **only one direction at a time** (Walkie-Talkie, CB Radio).

Statement-II (Full-Duplex): Bidirectional **simultaneously in both directions** (Telephone call, modern Switched Ethernet).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 4 Statement-Verification Drill #5 Both Statements Verified Correct

Statement-I (MAC (Media Access Control) Address): 48-bit (6-byte) physical hardware address burned into the NIC ROM, written as **12 hexadecimal digits** separated by colons or hyphens (e.g., `00:1A:2B:3C:4D:5E`; first 24 bits = OUI manufacturer ID, last 24 bits = device serial).

Statement-II (IPv4 Address): 32-bit (4-byte) logical address written in **dotted-decimal notation** as four octets separated by periods (`0` to `255` per octet, e.g., `192.168.1.1`), providing `2^32` (~ `4.29 billion`) addresses.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 4 Statement-Verification Drill #6 Both Statements Verified Correct

Statement-I (IPv6 Address): 128-bit (16-byte) logical address written as **eight groups of 4 hexadecimal digits** separated by colons (e.g., `2001:0db8:85a3:0000:0000:8a2e:0370:7334`), providing `2^128` addresses.

Statement-II (Class A): `1.0.0.0` to `126.255.255.255` (Subnet Mask `255.0.0.0` or `/8`; supports vast networks). Note: `127.0.0.1` (`127.x.x.x`) is reserved for **Loopback / Localhost self-testing**!

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 5: Database Management Systems (DBMS), Relational Algebra, Normalization & SQL

Chapter Key Study Pillars — Chapter 5: Database Management Systems (DBMS), Relational Algebra, Normalization & SQL

Key Study Pillar 1
Three-Schema Architecture, Relational Model & Keys

Key Study Pillar 2
SQL Command Sub-Languages & ACID Transaction Properties

5.1 Three-Schema Architecture, Relational Model & Keys

- **ANSI-SPARC Three-Level DBMS Architecture:**

• **Internal (Physical) Level:** Describes how data is physically stored in byte blocks and B-Tree indices on storage media (lowest level).

• **Conceptual (Logical) Level:** Describes what data is stored in the entire database (tables, columns, data types, relationships, and constraints) for the Database Administrator (DBA).

• **External (View) Level:** Provides customized, restricted sub-views of the database to individual end-users (highest level of abstraction).

• **Logical Data Independence** is the ability to modify the Conceptual Schema without altering External Views/ application programs; **Physical Data Independence** is the ability to modify the Internal/Physical storage without altering the Conceptual Schema.

• **Relational Terminology (E.F. Codd's Relational Model, 1970):**

• **Relation** = Table | **Tuple** = Row / Record | **Attribute** = Column / Field | **Domain** = Set of permitted atomic values for an attribute.

• **Degree (Arity)** = Total number of **Attributes (Columns)** in a relation.

• **Cardinality** = Total number of **Tuples (Rows)** currently present in a relation.

• **Relational Keys & Integrity Constraints:**

• **Super Key:** Any single attribute or set of attributes that uniquely identifies a tuple in a table (if a candidate key has 1 attribute in a table of `n` attributes, there are `2^(n-1)` super keys).

• **Candidate Key:** A **minimal Super Key** (containing no redundant attributes; a table can have multiple Candidate Keys).

• **Primary Key:** The single Candidate Key selected by the database designer to uniquely identify tuples; obeys **Entity Integrity** (cannot be `NULL` and cannot have duplicate values).

• **Alternate (Secondary) Key:** Any Candidate Key that was **not** chosen as the Primary Key (`Alternate Keys = Candidate Keys - Primary Key`).

• **Foreign Key:** An attribute in one table that references the Primary Key of another (or the same) table; enforces **Referential Integrity** (its value must either match an existing Primary Key value in the parent table or be `NULL`).

Step-by-Step Conceptual Process Flowchart



Normal Form	Core Anomaly Eliminated	Exact Mathematical / Functional Dependency Rule	Official Reference
1NF (First Normal Form)	Multi-valued & composite attributes	Every attribute must contain only **atomic (indivisible)** values	NCERT Computer Science
2NF (Second Normal Form)	**Partial Functional Dependency**	Must be in 1NF + every non-prime attribute is **fully functionally dependent** on the whole Candidate Key	SSC Exam Portal

Normal Form	Core Anomaly Eliminated	Exact Mathematical / Functional Dependency Rule	Official Reference
3NF (Third Normal Form)	**Transitive Dependency**	Must be in 2NF + no non-prime attribute depends on another non-prime attribute (`X -> Y` and `Y -> Z`)	IUC Academy
BCNF (Boyce-Codd NF)	Remaining FD anomalies (3.5 NF)	Must be in 3NF + for every non-trivial dependency `X -> Y`, `X` **must be a Super Key**	NCERT Computer Science
4NF (Fourth Normal Form)	**Multi-Valued Dependency (MVD)**	Must be in BCNF + contains no non-trivial multi-valued dependencies (`X ->> Y`)	IUC Academy

5.2 SQL Command Sub-Languages & ACID Transaction Properties

• **Five SQL Command Categories (Structured Query Language):**

1. **DDL (Data Definition Language — Schema level; auto-committed):** `CREATE`, `ALTER`, `DROP`, `TRUNCATE`, `RENAME`.

2. **DML (Data Manipulation Language — Row/Data level; not auto-committed):** `INSERT`, `UPDATE`, `DELETE`, `MERGE`.

3. **DQL (Data Query Language):** `SELECT` (with clauses strictly ordered in syntax as: `SELECT -> FROM -> WHERE -> GROUP BY -> HAVING -> ORDER BY`, while logical execution order is `FROM/JOIN -> WHERE -> GROUP BY -> HAVING -> SELECT -> DISTINCT -> ORDER BY -> LIMIT`).

4. **DCL (Data Control Language — Permissions/Security):** `GRANT` (gives privileges) and `REVOKE` (withdraws privileges).

5. **TCL (Transaction Control Language):** `COMMIT` (permanently saves changes), `ROLLBACK` (undoes uncommitted changes), `SAVEPOINT` (creates an intermediate rollback marker).

• **Critical Comparison:** `DELETE` **vs** `TRUNCATE` **vs** `DROP`**:**

• `DELETE` is a **DML** command that removes specific rows matching a `WHERE` clause (can be rolled back; fires triggers; keeps table structure and space).

• `TRUNCATE` is a **DDL** command that rapidly removes **all rows** from a table by deallocating data pages without scanning row-by-row (cannot use `WHERE`; preserves table schema/columns).

• `DROP` is a **DDL** command that deletes **both all data rows and the entire table structure/schema** permanently from the data dictionary.

• **ACID Properties of Database Transactions:**

• **Atomicity ("All or Nothing"):** Either every operation in a transaction completes successfully (`COMMIT`) or none take effect (`ROLLBACK`); managed by the Transaction Recovery Manager.

• **Consistency:** A transaction must transition the database from one valid state satisfying all integrity constraints to another valid state.

• **Isolation:** Concurrent transactions execute without interfering with each other's intermediate states; managed by the Concurrency Control Manager (Two-Phase Locking / Timestamp ordering).

• **Durability:** Once a transaction is committed, its updates persist permanently even in the event of a power failure or system crash (via Write-Ahead Logging).

Did You Know?: In SQL queries, the `WHERE` clause filters individual rows **before** grouping and **cannot** contain aggregate functions (`COUNT(), SUM(), AVG(), MAX(), MIN()`), whereas the `HAVING` clause filters aggregated groups **after** the `GROUP BY` clause and **can** contain aggregate functions (e.g., `SELECT Dept, COUNT() FROM Emp GROUP BY Dept HAVING COUNT() > 5;`), as taught in NCERT Class XII Computer Science.

Exam Trap Alert: Candidates often confuse **Degree** and **Cardinality** when a question states: "*Table A has 12 rows and 5 columns.*" Here, **Degree = 5 (Columns)** and **Cardinality = 12 (Rows)**. If 3 new rows and 2 new columns are added, the new Degree is `5 + 2 = 7` and the new Cardinality is `12 + 3 = 15`. Also remember that `UNIQUE` constraint in SQL allows `NULL` **values** (unlike `PRIMARY KEY`, which forbids `NULL`).

★ **Memory Trick:** Remember **"D-C = Columns, C-R = Rows"** (**D**egree = **C**olumns; **C**ardinality = **R**ows). For SQL execution order: **"F-W-G-H-S-O"** (**F**rom -> **W**here -> **G**roup By -> **H**aving -> **S**elect -> **O**rder By).

Chapter 5 Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Three-Schema Architecture, Relational Model & Keys	**Internal (Physical) Level**	Describes how data is physically stored in byte blocks and B-Tree indices on storage media (lowest level).
SQL Command Sub-Languages & ACID Transaction Properties	**Conceptual (Logical) Level**	Describes what data is stored in the entire database (tables, columns, data types, relationships, and constraints) for the Database Administrator (DBA).
Three-Schema Architecture, Relational Model & Keys	**External (View) Level**	Provides customized, restricted sub-views of the database to individual end-users (highest level of abstraction).
SQL Command Sub-Languages & ACID Transaction Properties	**Logical Data Independence**	is the ability to modify the Conceptual Schema without altering External Views/application programs; **Physical Data Independence** is the ability to modify the Internal/Physical storage without altering the Conceptual Schema.
Three-Schema Architecture, Relational Model & Keys	**Relation**	= Table | **Tuple** = Row / Record | **Attribute** = Column / Field | **Domain** = Set of permitted atomic values for an attribute.
SQL Command Sub-Languages & ACID Transaction Properties	**Degree (Arity)**	= Total number of **Attributes (Columns)** in a relation.

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Three-Schema Architecture, Relational Model & Keys	Cardinality	= Total number of **Tuples (Rows)** currently present in a relation.
SQL Command Sub-Languages & ACID Transaction Properties	Super Key	Any single attribute or set of attributes that uniquely identifies a tuple in a table (if a candidate key has 1 attribute in a table of `n` attributes, there are `2^(n-1)` super keys).
Three-Schema Architecture, Relational Model & Keys	Candidate Key	A **minimal Super Key** (containing no redundant attributes; a table can have multiple Candidate Keys).
SQL Command Sub-Languages & ACID Transaction Properties	Primary Key	The single Candidate Key selected by the database designer to uniquely identify tuples; obeys **Entity Integrity** (cannot be `NULL` and cannot have duplicate values).
Three-Schema Architecture, Relational Model & Keys	Alternate (Secondary) Key	Any Candidate Key that was **not** chosen as the Primary Key (`Alternate Keys = Candidate Keys - Primary Key`).
SQL Command Sub-Languages & ACID Transaction Properties	Foreign Key	An attribute in one table that references the Primary Key of another (or the same) table; enforces **Referential Integrity** (its value must either match an existing Primary Key value in the parent table or be `NULL`).
Three-Schema Architecture, Relational Model & Keys	DDL (Data Definition Language — Schema level; auto-committed)	`CREATE`, `ALTER`, `DROP`, `TRUNCATE`, `RENAME`.
SQL Command Sub-Languages & ACID Transaction Properties	DML (Data Manipulation Language — Row/Data level; not auto-committed)	`INSERT`, `UPDATE`, `DELETE`, `MERGE`.

Chapter *5* Multi-Statement Exam Verification Drills

Chapter 5 Statement-Verification Drill #1 — Both Statements Verified Correct

Statement-I (Internal (Physical) Level): Describes how data is physically stored in byte blocks and B-Tree indices on storage media (lowest level).

Statement-II (Conceptual (Logical) Level): Describes what data is stored in the entire database (tables, columns, data types, relationships, and constraints) for the Database Administrator (DBA).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 5 Statement-Verification Drill #2 Both Statements Verified Correct

Statement-I (External (View) Level): Provides customized, restricted sub-views of the database to individual end-users (highest level of abstraction).

Statement-II (Logical Data Independence): is the ability to modify the Conceptual Schema without altering External Views/ application programs; **Physical Data Independence** is the ability to modify the Internal/Physical storage without altering the Conceptual Schema.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 5 Statement-Verification Drill #3 Both Statements Verified Correct

Statement-I (Relation): = Table | **Tuple** = Row / Record | **Attribute** = Column / Field | **Domain** = Set of permitted atomic values for an attribute.

Statement-II (Degree (Arity)): = Total number of **Attributes (Columns)** in a relation.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 5 Statement-Verification Drill #4 Both Statements Verified Correct

Statement-I (Cardinality): = Total number of **Tuples (Rows)** currently present in a relation.

Statement-II (Super Key): Any single attribute or set of attributes that uniquely identifies a tuple in a table (if a candidate key has 1 attribute in a table of `n` attributes, there are `2^(n-1)` super keys).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 5 Statement-Verification Drill #5 Both Statements Verified Correct

Statement-I (Candidate Key): A **minimal Super Key** (containing no redundant attributes; a table can have multiple Candidate Keys).

Statement-II (Primary Key): The single Candidate Key selected by the database designer to uniquely identify tuples; obeys **Entity Integrity** (cannot be `NULL` and cannot have duplicate values).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 5 Statement-Verification Drill #6 Both Statements Verified Correct

Statement-I (Alternate (Secondary) Key): Any Candidate Key that was **not** chosen as the Primary Key (`Alternate Keys = Candidate Keys - Primary Key`).

Statement-II (Foreign Key): An attribute in one table that references the Primary Key of another (or the same) table; enforces **Referential Integrity** (its value must either match an existing Primary Key value in the parent table or be `NULL`).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 6: Cyber Security, Malware Taxonomy, Cryptography & Network Defense

Chapter Key Study Pillars — Chapter 6: Cyber Security, Malware Taxonomy, Cryptography & Network Defense

Key Study Pillar 1
Comprehensive Malware Taxonomy & Social Engineering Attacks

Key Study Pillar 2
Cryptography, CIA Triad, Digital Signatures & Firewalls

6.1 Comprehensive Malware Taxonomy & Social Engineering Attacks

• **Malicious Software (Malware) Classification:**

• **Computer Virus (Vital Information Resources Under Siege):** Malicious code that **requires a host file/program** and **human action** (opening an infected file) to execute and replicate. Types include **Boot Sector Virus** (infects MBR), **Macro Virus** (written in VBA inside `.docm/.xlsm` documents), **Polymorphic Virus** (mutates its decryption signature on every infection to evade signature-based antivirus), and **Stealth/Multipartite Virus**. Note: **Creeper** (1971, by Bob Thomas on ARPANET) was the first experimental self-replicating program (**Reaper** was created to delete it), **Elk Cloner** (1982) was the first wild microcomputer virus, and **Brain** (1986) was the first MS-DOS PC virus.

• **Computer Worm (Write Once, Read Many / Self-Propagating Malware):** Unlike a virus, a **Worm is a standalone program that does NOT need a host file or human intervention**; it self-replicates automatically across networks by exploiting OS/network vulnerabilities (e.g., *Morris Worm*, *ILOVEYOU*, *Stuxnet*, *WannaCry*) and consumes network bandwidth.

• **Trojan Horse:** Malware disguised as legitimate, useful software; **does NOT self-replicate**, but opens unauthorized access for attackers.

• **Ransomware:** Encrypts the victim's files or locks the operating system and demands cryptocurrency payment for the decryption key (*WannaCry [exploited SMBv1 EternalBlue]*, *Petya*, *LockBit*, *Akira*).

• **Spyware & Keyloggers:** Secretly monitors user activity or records keystrokes to steal banking credentials and passwords (*Pegasus* is a zero-click mobile spyware).

• **Rootkit:** Conceals deep administrative/kernel-level unauthorized access by modifying core OS utilities so malware remains invisible to task managers and antivirus scans.

• **Logic Bomb / Time Bomb:** Malicious code Dormantly embedded inside software that triggers only when a specific logical condition or date/time occurs (e.g., deleting payroll records if an employee ID is terminated).

• **Social Engineering & Network Intrusion Techniques:**

• **Phishing / Spear Phishing / Whaling / Vishing / Smishing / Quishing: Phishing** uses fraudulent bulk emails/websites mimicking banks; **Spear Phishing** targets a specific individual/organization; **Whaling** targets senior executives (`CEO/CFO`); **Vishing** uses voice phone calls; **Smishing** uses SMS text messages; **Quishing** uses malicious QR codes.

• **Spoofing (IP, ARP, DNS Cache Poisoning):** Forging source identity headers to impersonate a trusted host or redirect domain traffic to a fake IP address.

• **DoS & DDoS (Distributed Denial of Service):** Flooding a target server with overwhelming traffic (such as **SYN Floods, UDP Floods, or Ping of Death**) from a **Botnet** (network of compromised **Zombie** computers controlled by a Command-and-Control server) to exhaust resources and deny service to legitimate users.

• **Zero-Day Exploit:** A cyberattack that exploits a previously unknown software/hardware vulnerability before the vendor has released a security patch (**0** days of patch availability).

• **SQL Injection (SQLi) & Cross-Site Scripting (XSS): SQLi** injects malicious SQL statements into unvalidated web input fields to dump or alter backend databases; **XSS** injects malicious client-side scripts (JavaScript) into web pages viewed by other users.

Step-by-Step Conceptual Process Flowchart

STEP 1
Plaintext Input & SHA-256 Hash

STEP 2
Sign Hash with Sender Private Key (Digital Signature)

STEP 3
Encrypt Payload with Receiver Public Key / AES Session Key

STEP 4
Receiver Verifies Signature & Decrypts Payload

Cryptographic Category	Key Architecture	Core Algorithms	Speed & Primary Security Purpose	Official Reference
Symmetric-Key (Secret Key)	**1 Shared Key** (Same key encrypts & decrypts)	**AES (128/192/256-bit)**, DES (56-bit), 3DES, Blowfish, RC4	**Very Fast**; bulk data confidentiality	MeitY Portal
Asymmetric-Key (Public Key)	**2 Keys (Public Key + Private Key)**	**RSA**, Diffie-Hellman, **ECC** (Elliptic Curve), DSA	Slower; secure key exchange & **Digital Signatures**	NCERT Textbooks
Cryptographic Hashing	**0 Keys (One-Way Irreversible Function)**	**SHA-256, SHA-3**, MD5 (128-bit, deprecated)	Fixed-length digest; verifies **Data Integrity** & password storage	IUC Academy

6.2 Cryptography, CIA Triad, Digital Signatures & Firewalls

• **The CIA Security Triad (+ Non-Repudiation):**

• **Confidentiality:** Ensuring data is accessible only to authorized parties (enforced via **Encryption** and Access Control Lists).

• **Integrity:** Ensuring data has not been tampered with or altered in transit or storage (enforced via **Cryptographic Hash Functions** like **SHA-256** and Message Authentication Codes).

• **Availability:** Ensuring systems and data remain continuously accessible to authorized users (protected via **Redundancy, RAID, Load Balancers, and DDoS Mitigation**).

• **Non-Repudiation:** Guaranteeing that the sender of a message cannot later deny having sent it (enforced via **Asymmetric Digital Signatures**).

• **Asymmetric Key Rules (Encryption vs Digital Signature):**

• **For Confidentiality (Encryption):** The sender encrypts the message using the **Receiver's Public Key**, and only the receiver can decrypt it using the **Receiver's Private Key**.

• **For Authentication & Non-Repudiation (Digital Signature):** The sender signs the message hash using the **Sender's Private Key**, and anyone can verify the signature's authenticity using the **Sender's Public Key**.

• **Firewalls, IDS/IPS & VPN:** A **Packet-Filtering Firewall** operates at **Layers 3 & 4** (inspecting IP addresses and TCP/UDP ports), whereas a **Proxy / Application-Gateway / Next-Generation Firewall (NGFW)** operates up to **Layer 7** (Deep Packet Inspection). An **IDS (Intrusion Detection System)** passively monitors and alerts on suspicious traffic, whereas an **IPS (Intrusion Prevention System)** sits inline and actively blocks malicious packets in real time.

Did You Know?: Under India's national cyber defense framework supervised by **Ministry of Electronics and Information Technology (MeitY)**, **CERT-In (Indian Computer Emergency Response Team)** was established in **January 2004** and is designated under **Section 70B of the IT Act, 2000** as the national nodal agency for responding to computer security incidents and issuing mandatory 6-hour cyber incident reporting directives for critical organizations.

Exam Trap Alert: Pay close attention to whose key is used in Asymmetric Cryptography: **Encryption** uses the **Receiver's Public Key** (so only the receiver can read it), whereas creating a **Digital Signature** uses the **Sender's Private Key** (so only the sender could have signed it)!

★ **Memory Trick:** Distinguish **Virus vs Worm vs Trojan**: **V**irus = **V**isitor needing a host file; **W**orm = **W**alks alone across networks without a host; **T**rojan = **T**rickster disguised as a gift without self-replication.

Chapter *6* Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Computer Virus (Vital Information Resources Under Siege)**	Malicious code that **requires a host file/program** and **human action** (opening an infected file) to execute and replicate. Types include **Boot Sector Virus** (infects MBR), **Macro Virus** (written in VBA inside **.docm/.xlsm** documents), **Polymorphic Virus** (mutates its decryption signature on every infection to evade signature-based antivirus), and **Stealth/Multipartite Virus**. Note: **Creeper** (1971, by Bob Thomas on ARPANET) was the first experimental self-replicating program (**Reaper** was created to delete it), **Elk Cloner** (1982) was the first wild microcomputer virus, and **Brain** (1986) was the first MS-DOS PC virus.
Cryptography, CIA Triad, Digital Signatures & Firewalls	**Computer Worm (Write Once, Read Many / Self-Propagating Malware)**	Unlike a virus, a **Worm is a standalone program that does NOT need a host file or human intervention**; it self-replicates automatically across networks by exploiting OS/network vulnerabilities (e.g., *Morris Worm*, *ILOVEYOU*, *Stuxnet*, *WannaCry*) and consumes network bandwidth.
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Trojan Horse**	Malware disguised as legitimate, useful software; **does NOT self-replicate**, but opens unauthorized access for attackers.
Cryptography, CIA Triad, Digital Signatures & Firewalls	**Ransomware**	Encrypts the victim's files or locks the operating system and demands cryptocurrency payment for the decryption key (*WannaCry [exploited SMBv1 EternalBlue]*, *Petya*, *LockBit*, *Akira*).

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Spyware & Keyloggers**	Secretly monitors user activity or records keystrokes to steal banking credentials and passwords (*Pegasus* is a zero-click mobile spyware).
Cryptography, CIA Triad, Digital Signatures & Firewalls	**Rootkit**	Conceals deep administrative/kernel-level unauthorized access by modifying core OS utilities so malware remains invisible to task managers and antivirus scans.
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Logic Bomb / Time Bomb**	Malicious code Dormantly embedded inside software that triggers only when a specific logical condition or date/time occurs (e.g., deleting payroll records if an employee ID is terminated).
Cryptography, CIA Triad, Digital Signatures & Firewalls	**Phishing / Spear Phishing / Whaling / Vishing / Smishing / Quishing**	**Phishing** uses fraudulent bulk emails/websites mimicking banks; **Spear Phishing** targets a specific individual/organization; **Whaling** targets senior executives (`CEO/CFO`); **Vishing** uses voice phone calls; **Smishing** uses SMS text messages; **Quishing** uses malicious QR codes.
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Spoofing (IP, ARP, DNS Cache Poisoning)**	Forging source identity headers to impersonate a trusted host or redirect domain traffic to a fake IP address.
Cryptography, CIA Triad, Digital Signatures & Firewalls	**DoS & DDoS (Distributed Denial of Service)**	Flooding a target server with overwhelming traffic (such as **SYN Floods, UDP Floods, or Ping of Death**) from a **Botnet** (network of compromised **Zombie** computers controlled by a Command-and-Control server) to exhaust resources and deny service to legitimate users.
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Zero-Day Exploit**	A cyberattack that exploits a previously unknown software/hardware vulnerability before the vendor has released a security patch (`0` days of patch availability).
Cryptography, CIA Triad, Digital Signatures & Firewalls	**SQL Injection (SQLi) & Cross-Site Scripting (XSS)**	**SQLi** injects malicious SQL statements into unvalidated web input fields to dump or alter backend databases; **XSS** injects malicious client-side scripts (JavaScript) into web pages viewed by other users.
Comprehensive Malware Taxonomy & Social Engineering Attacks	**Confidentiality**	Ensuring data is accessible only to authorized parties (enforced via **Encryption** and Access Control Lists).
Cryptography, CIA Triad, Digital Signatures & Firewalls	**Integrity**	Ensuring data has not been tampered with or altered in transit or storage (enforced via **Cryptographic Hash Functions** like `SHA-256` and Message Authentication Codes).

Chapter *6* Multi-Statement Exam Verification Drills

Chapter *6* Statement-Verification Drill #1 — Both Statements Verified Correct

Statement-I (Computer Virus (Vital Information Resources Under Siege)): Malicious code that **requires a host file/program** and **human action** (opening an infected file) to execute and replicate. Types include **Boot Sector Virus** (infects MBR), **Macro Virus** (written in VBA inside `.docm/.xlsm` documents), **Polymorphic Virus** (mutates its decryption signature on every infection to evade signature-based antivirus), and **Stealth/Multipartite Virus**. Note: **Creeper** (1971, by Bob Thomas on ARPANET) was the first experimental self-replicating program (**Reaper** was created to delete it), **Elk Cloner** (1982) was the first wild microcomputer virus, and **Brain** (1986) was the first MS-DOS PC virus.

Statement-II (Computer Worm (Write Once, Read Many / Self-Propagating Malware)): Unlike a virus, a **Worm is a standalone program that does NOT need a host file or human intervention**; it self-replicates automatically across networks by exploiting OS/network vulnerabilities (e.g., *Morris Worm*, *ILOVEYOU*, *Stuxnet*, *WannaCry*) and consumes network bandwidth.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter *6* Statement-Verification Drill #2 — Both Statements Verified Correct

Statement-I (Trojan Horse): Malware disguised as legitimate, useful software; **does NOT self-replicate**, but opens unauthorized access for attackers.

Statement-II (Ransomware): Encrypts the victim's files or locks the operating system and demands cryptocurrency payment for the decryption key (*WannaCry [exploited SMBv1 EternalBlue]*, *Petya*, *LockBit*, *Akira*).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter *6* Statement-Verification Drill #3 — Both Statements Verified Correct

Statement-I (Spyware & Keyloggers): Secretly monitors user activity or records keystrokes to steal banking credentials and passwords (*Pegasus* is a zero-click mobile spyware).

Statement-II (Rootkit): Conceals deep administrative/kernel-level unauthorized access by modifying core OS utilities so malware remains invisible to task managers and antivirus scans.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter *6* Statement-Verification Drill #4 — Both Statements Verified Correct

Statement-I (Logic Bomb / Time Bomb): Malicious code Dormantly embedded inside software that triggers only when a specific logical condition or date/time occurs (e.g., deleting payroll records if an employee ID is terminated).

Statement-II (Phishing / Spear Phishing / Whaling / Vishing / Smishing / Quishing): Phishing uses fraudulent bulk emails/websites mimicking banks; **Spear Phishing** targets a specific individual/organization; **Whaling** targets senior executives (`CEO/CFO`); **Vishing** uses voice phone calls; **Smishing** uses SMS text messages; **Quishing** uses malicious QR codes.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 6 Statement-Verification Drill #5 Both Statements Verified Correct

Statement-I (Spoofing (IP, ARP, DNS Cache Poisoning)): Forging source identity headers to impersonate a trusted host or redirect domain traffic to a fake IP address.

Statement-II (DoS & DDoS (Distributed Denial of Service)): Flooding a target server with overwhelming traffic (such as **SYN Floods, UDP Floods, or Ping of Death**) from a **Botnet** (network of compromised **Zombie** computers controlled by a Command-and-Control server) to exhaust resources and deny service to legitimate users.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 6 Statement-Verification Drill #6 Both Statements Verified Correct

Statement-I (Zero-Day Exploit): A cyberattack that exploits a previously unknown software/hardware vulnerability before the vendor has released a security patch (**0** days of patch availability).

Statement-II (SQL Injection (SQLi) & Cross-Site Scripting (XSS)): SQLi injects malicious SQL statements into unvalidated web input fields to dump or alter backend databases; **XSS** injects malicious client-side scripts (JavaScript) into web pages viewed by other users.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 7: Information Technology Act *2000* (Amended *2008*), DPDP Act *2023* & Digital India

Chapter Key Study Pillars — Chapter 7: Information Technology Act 2000 (Amended 2008), DPDP Act 2023 & Digital India

Key Study Pillar 1
Information Technology Act, 2000 & Amendment Act, 2008 — Statutory Matrix

Key Study Pillar 2
Digital Personal Data Protection (DPDP) Act, 2023 & Bharatiya Sakshya Adhiniyam, 2023

7.1 Information Technology Act, *2000* & Amendment Act, *2008* — Statutory Matrix

• **Enactment & Constitutional History:** The **Information Technology Act, 2000** (Act No. 21 of 2000), drafted on the basis of the **UNCITRAL (United Nations Commission on International Trade Law) Model Law on Electronic Commerce (1996)**, received Presidential assent on **9 June 2000** and came into force across India on **17 October 2000**, as published on **India Code Official Portal**. It originally comprised **13 Chapters, 94 Sections, and 4 Schedules**.

• **Information Technology (Amendment) Act, 2008:** Passed in December 2008 (following the 26/11 Mumbai attacks) and enforced on **27 October 2009**, it substituted technology-neutral **Electronic Signatures (Section 3A)** alongside Digital Signatures, inserted comprehensive cybercrime offences (**Sections 66A to 66F, 67A, 67B**), designated **NCIIPC (Section 70A)** and **CERT-In (Section 70B)**, and strengthened intermediary safe-harbor accountability (**Section 79**).

Step-by-Step Conceptual Process Flowchart

STEP 1
Electronic Record & Signature Recognition (Sec 3-5)

STEP 2
Certifying Authorities & Controller Regulation (Sec 17-34)

STEP 3
Civil Compensation & Cyber Offences Adjudication (Sec 43-78)

STEP 4
Intermediary Safe Harbor & Nodal Protection (Sec 70A, 70B, 79)

IT Act Section	Statutory Title & Legal Provision	Penalty / Judicial Landmark	Official Source
Section 3 & 3A	**Digital Signature (Sec 3)** (Asymmetric crypto + hash) & **Electronic Signature (Sec 3A)** (2008 Amendment)	Legal authentication of electronic records	India Code Portal
Section 4 & 5	Legal recognition of **Electronic Records (Sec 4)** and **Electronic Signatures (Sec 5)**	Equates e-records/e-signatures with paper/ handwritten equivalents	India Code Portal
Section 43 & 43A	**Penalty/Compensation** for unauthorized access/ damage (Sec 43); **Corporate failure to protect Sensitive Personal Data (Sec 43A)**	Civil compensation by Adjudicating Officer / Court	MeitY Portal
Section 65	Tampering with computer **Source Documents** (concealing, destroying, or altering source code)	Imprisonment up to **3 years**, or fine up to **Rs 2 Lakh**, or both	India Code Portal
Section 66	Computer-related offences (dishonestly/fraudulently committing acts under Sec 43 — **Hacking**)	Imprisonment up to **3 years**, or fine up to **Rs 5 Lakh**, or both	India Code Portal
Section 66A	Sending offensive messages through communication service	**Struck down as Unconstitutional** by Supreme Court in ***Shreya Singhal v. Union of India* (2015)** for violating Article 19(1)(a)	India Code Portal
Section 66B	Dishonestly receiving stolen computer resource or communication device	Imprisonment up to **3 years**, or fine up to **Rs 1 Lakh**, or both	MeitY Portal
Section 66C	**Identity Theft** (fraudulently using another person's electronic signature, password, or unique ID)	Imprisonment up to **3 years** and fine up to **Rs 1 Lakh**	India Code Portal
Section 66D	**Cheating by Personation** by using computer resource (online impersonation/phishing fraud)	Imprisonment up to **3 years** and fine up to **Rs 1 Lakh**	India Code Portal
Section 66E	**Violation of Physical Privacy** (capturing/publishing images of private areas without consent)	Imprisonment up to **3 years**, or fine up to **Rs 2 Lakh**, or both	MeitY Portal
Section 66F	**Cyber Terrorism** (threatening unity, integrity, security, or sovereignty of India via denial of access or unauthorized intrusion into Critical Information Infrastructure)	Imprisonment extendable to **Imprisonment for Life**	India Code Portal

IT Act Section	Statutory Title & Legal Provision	Penalty / Judicial Landmark	Official Source
Section 67, 67A, 67B	Publishing/transmitting obscene material (**Sec 67**), sexually explicit acts (**Sec 67A**), and **Child Sexual Abuse Material — CSAM (Sec 67B)**	Up to **5 years** + **Rs 10 Lakh** (1st conviction under 67A/67B); **7 years** on 2nd conviction	India Code Portal
Section 69 & 69A	Power to issue directions for interception/monitoring/decryption (**Sec 69**) & **Blocking public access to information (Sec 69A)**	Upheld as constitutional in *Shreya Singhal* (2015)	MeitY Portal
Section 70, 70A, 70B	**Protected Systems (Sec 70)**, **NCIIPC (Sec 70A)** for Critical Information Infrastructure, and **CERT-In (Sec 70B)**	National nodal cyber security institutions	India Code Portal
Section 78	Power to **investigate offences** under the IT Act vested in a Police Officer not below the rank of **Inspector**	Amended from DSP (2000) to **Inspector** (2008 Amendment)	India Code Portal
Section 79	**Exemption from liability of Intermediary** in certain cases ("Safe Harbor" subject to due diligence and takedown compliance)	Read down in *Shreya Singhal* to require court/govt order for takedown	MeitY Portal

7.2 Digital Personal Data Protection (DPDP) Act, 2023 & Bharatiya Sakshya Adhiniyam, 2023

• **Digital Personal Data Protection Act, 2023 (Act No. 22 of 2023):**

• Enacted in **August 2023** (Presidential assent on **11 August 2023**) under **MeitY**.

• **Key Statutory Entities: Data Principal** (the individual to whom the personal data relates; for a child **< 18 years**, includes parents/lawful guardian), **Data Fiduciary** (any entity that determines the purpose and means of processing personal data), **Significant Data Fiduciary (SDF)** (notified based on volume/sensitivity of data, required to appoint an India-based Data Protection Officer and Independent Data Auditor), **Data Processor** (processes data on behalf of a Fiduciary), and **Consent Manager**.

• **Data Protection Board of India (DPBI):** Adjudicatory body empowered to impose financial penalties up to **Rs 250 Crore** for failure to maintain reasonable security safeguards to prevent personal data breaches, and up to **Rs 200 Crore** for failure to give notice of a data breach or failure to fulfill obligations regarding children's data. Note: Section 44(2) of the DPDP Act omits **Section 43A** of the IT Act, 2000.

• **Electronic Evidence under Bharatiya Sakshya Adhiniyam (BSA), 2023:**

• Replaced the Indian Evidence Act, 1872 (effective **1 July 2024**). Under **Section 61** of BSA 2023, electronic or digital records have the exact same legal effect, validity, and enforceability as paper documents. Under **Section 63 of BSA 2023** (which replaced the famous **Section 65B** of the old Evidence Act), admissibility of computer outputs/electronic records as secondary evidence requires a mandatory signed **Certificate of Authenticity** from the person in charge of the device and an expert.

Did You Know?: Through the **Finance Act, 2017**, the autonomous Cyber Appellate Tribunal (CyAT) established under the IT Act, 2000 was merged into the **Telecom Disputes Settlement and Appellate Tribunal (TDSAT)**, which now hears appeals against orders of Adjudicating Officers under the IT Act.

Exam Trap Alert: Examiners frequently test **Section 78 of the IT Act, 2000**: under the original 2000 Act, the minimum police rank empowered to investigate cyber offences was **Deputy Superintendent of Police (DSP)**, but the **2008 Amendment lowered the minimum rank to Police Inspector**! Also remember the exact distinction between **66C (Identity Theft — stealing password/ID)** and **66D (Cheating by Personation — pretending to be someone else online)**.

★ **Memory Trick:** Memorize the **Section 66 Series (A to F)**: **A** = Abusive message (Struck down), **B** = Buying/Receiving stolen device, **C** = Credentials/Identity theft, **D** = Disguise/Personation cheating, **E** = Exposure of private images, **F** = Federal Cyber Terrorism (Life imprisonment).

Chapter 7 Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Information Technology Act, 2000 & Amendment Act, 2008 — Statutory Matrix	**Enactment & Constitutional History**	The **Information Technology Act, 2000** (Act No. 21 of 2000), drafted on the basis of the **UNCITRAL (United Nations Commission on International Trade Law) Model Law on Electronic Commerce (1996)**, received Presidential assent on **9 June 2000** and came into force across India on **17 October 2000**, as published on India Code Official Portal. It originally comprised **13 Chapters, 94 Sections, and 4 Schedules**.
Digital Personal Data Protection (DPDP) Act, 2023 & Bharatiya Sakshya Adhiniyam, 2023	**Information Technology (Amendment) Act, 2008**	Passed in December 2008 (following the 26/11 Mumbai attacks) and enforced on **27 October 2009**, it substituted technology-neutral **Electronic Signatures (Section 3A)** alongside Digital Signatures, inserted comprehensive cybercrime offences (**Sections 66A to 66F, 67A, 67B**), designated **NCIIPC (Section 70A)** and **CERT-In (Section 70B)**, and strengthened intermediary safe-harbor accountability (**Section 79**).
Information Technology Act, 2000 & Amendment Act, 2008 — Statutory Matrix	**Key Statutory Entities**	**Data Principal** (the individual to whom the personal data relates; for a child **< 18 years**, includes parents/lawful guardian), **Data Fiduciary** (any entity that determines the purpose and means of processing personal data), **Significant Data Fiduciary (SDF)** (notified based on volume/sensitivity of data, required to appoint an India-based Data Protection Officer and Independent Data Auditor), **Data Processor** (processes data on behalf of a Fiduciary), and **Consent Manager**.
Digital Personal Data Protection (DPDP) Act, 2023 & Bharatiya Sakshya Adhiniyam, 2023	**Data Protection Board of India (DPBI)**	Adjudicatory body empowered to impose financial penalties up to **Rs 250 Crore** for failure to maintain reasonable security safeguards to prevent personal data breaches, and up to **Rs 200 Crore** for failure to give notice of a data breach or failure to fulfill obligations regarding children's data. Note: Section 44(2) of the DPDP Act omits **Section 43A** of the IT Act, 2000.

Chapter 7 Multi-Statement Exam Verification Drills

Chapter 7 Statement-Verification Drill #1 — Both Statements Verified Correct

Statement-I (Enactment & Constitutional History): The **Information Technology Act, 2000** (Act No. 21 of 2000), drafted on the basis of the **UNCITRAL (United Nations Commission on International Trade Law) Model Law on Electronic Commerce (1996)**, received Presidential assent on **9 June 2000** and came into force across India on **17 October 2000**, as published on **India Code Official Portal**. It originally comprised **13 Chapters, 94 Sections, and 4 Schedules**.

Statement-II (Information Technology (Amendment) Act, 2008): Passed in December 2008 (following the 26/11 Mumbai attacks) and enforced on **27 October 2009**, it substituted technology-neutral **Electronic Signatures (Section 3A)** alongside Digital Signatures, inserted comprehensive cybercrime offences (**Sections 66A to 66F, 67A, 67B**), designated **NCIIPC (Section 70A)** and **CERT-In (Section 70B)**, and strengthened intermediary safe-harbor accountability (**Section 79**).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 7 Statement-Verification Drill #2 — Both Statements Verified Correct

Statement-I (Key Statutory Entities): Data Principal (the individual to whom the personal data relates; for a child **< 18 years**, includes parents/lawful guardian), **Data Fiduciary** (any entity that determines the purpose and means of processing personal data), **Significant Data Fiduciary (SDF)** (notified based on volume/sensitivity of data, required to appoint an India-based Data Protection Officer and Independent Data Auditor), **Data Processor** (processes data on behalf of a Fiduciary), and **Consent Manager**.

Statement-II (Data Protection Board of India (DPBI)): Adjudicatory body empowered to impose financial penalties up to **Rs 250 Crore** for failure to maintain reasonable security safeguards to prevent personal data breaches, and up to **Rs 200 Crore** for failure to give notice of a data breach or failure to fulfill obligations regarding children's data. Note: Section 44(2) of the DPDP Act omits **Section 43A** of the IT Act, 2000.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 8: Emerging Technologies — Artificial Intelligence (AI), Cloud Computing, IoT & Blockchain

Chapter Key Study Pillars — Chapter 8: Emerging Technologies — Artificial Intelligence (AI), Cloud Computing, IoT & Blockchain

Key Study Pillar 1
Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models

Key Study Pillar 2
Cloud Computing Deployment Models, Internet of Things (IoT) & Blockchain

8.1 Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models

• **Evolution & Foundations of AI:** The term **"Artificial Intelligence"** was coined by **John McCarthy** in **1956** at the Dartmouth Conference, while **Alan Turing** formulated the foundational **Turing Test ("Imitation Game")** in his **1950** paper "*Computing Machinery and Intelligence*".

• **Three Core Machine Learning (ML) Paradigms:**

1. **Supervised Learning:** Trained on **labeled datasets** (input-output pairs **(X, Y)**). Subdivided into **Classification** (predicting discrete categories, e.g., spam vs non-spam using Logistic Regression, Support Vector Machines, Decision Trees, Random Forests) and **Regression** (predicting continuous numerical values, e.g., house price or temperature using Linear/Polynomial Regression).

2. **Unsupervised Learning:** Trained on **unlabeled datasets** to discover hidden patterns or structures. Subdivided into **Unsupervised Grouping** (K-Means, Hierarchical, DBSCAN) and **Dimensionality Reduction / Association** (Principal Component Analysis [PCA], Apriori Algorithm).

3. **Reinforcement Learning (RL):** An autonomous **Agent** learns optimal policy actions by interacting with an **Environment** through trial-and-error **Rewards and Penalties** (Markov Decision Processes, Q-Learning, AlphaGo).

• **Deep Learning & Transformer Architecture (GenAI):** Built on multi-layer **Artificial Neural Networks (ANNs)**, **CNNs (Convolutional Neural Networks — computer vision/image recognition)**, and **RNNs/LSTMs (sequential data)**. Modern Generative AI and Large Language Models (LLMs) are powered by the **Transformer Architecture** (introduced in the 2017 paper "*Attention Is All You Need*" using **Self-Attention mechanisms**).

• **IndiaAI Mission & National Supercomputing Initiatives:** Approved by the Union Cabinet under **MeitY** with an outlay of over Rs 10,300 Crore, the **IndiaAI Mission** deploys high-compute GPU infrastructure (**10,000+ GPUs**), indigenous foundational models (**Bhashini** for real-time translation across 22 Scheduled Indian languages, **AIRAWAT** AI supercomputer at C-DAC Pune), and **PARAM Rudra / Pratyush / Mihir** high-performance computing systems under the National Supercomputing Mission (NSM).

Step-by-Step Conceptual Process Flowchart



Cloud Service Model	Full Expansion	Provider vs Customer Responsibility	Real-World Examples	Official Portal
IaaS	**Infrastructure as a Service**	Provider manages hardware/ virtualization; User manages OS, middleware, runtime & apps	AWS EC2, Microsoft Azure VMs, Google Compute Engine, **MeghRaj GI Cloud**	MeitY Portal
PaaS	**Platform as a Service**	Provider manages hardware, OS & runtime; User manages only application code & data	Google App Engine, AWS Elastic Beanstalk, Heroku, Azure App Services	NCERT Textbooks
SaaS	**Software as a Service**	Provider manages the entire stack; User accesses ready-to-use software via browser/app	Microsoft 365, Google Workspace, DigiLocker, Salesforce, Dropbox	IUC Academy

8.2 Cloud Computing Deployment Models, Internet of Things *(IoT)* & Blockchain

• **Cloud Deployment Models: Public Cloud** (shared multi-tenant infrastructure owned by a cloud provider), **Private Cloud** (dedicated exclusively to a single organization), **Hybrid Cloud** (combines Private and Public clouds with orchestration between them), and **Community Cloud** (shared by several organizations with common regulatory/security compliance requirements, such as government ministries using **MeghRaj — GI Cloud** under MeitY).

• **Internet of Things (IoT) & Lightweight Protocols:** Term coined by **Kevin Ashton** in **1999**. Uses low-power communication protocols including **MQTT** (Message Queuing Telemetry Transport — publish/subscribe protocol over TCP), **CoAP** (Constrained Application Protocol — over UDP), **Zigbee (IEEE 802.15.4)**, **BLE (Bluetooth Low Energy)**, **LoRaWAN**, and **6LoWPAN** (IPv6 over Low-Power Wireless PAN). **Edge Computing** and **Fog Computing** process time-sensitive IoT sensor data locally near the source rather than sending all raw streams to a distant centralized cloud, drastically reducing latency.

• **Blockchain & Distributed Ledger Technology (DLT):** Conceptualized in *2008* by **Satoshi Nakamoto**. A Blockchain is an immutable, decentralized, cryptographically linked chain of blocks where each block contains a **Cryptographic Hash of the Previous Block**, a **Timestamp**, a **Nonce**, and a **Merkle Tree Root** of validated transactions. Consensus mechanisms include **Proof of Work (PoW)** and **Proof of Stake (PoS)**. **Smart Contracts** (popularized on Ethereum) are self-executing programs stored on the blockchain that automatically enforce agreement terms when predefined conditions are met.

Did You Know?: India's **Digital Public Infrastructure (DPI)**—known globally as the **India Stack** and administered under MeitY and NPCI—comprises three foundational layers: (1) **Identity Layer** (Aadhaar & e-KYC), (2) **Payments Layer** (UPI, IMPS, Aadhaar Enabled Payment System [AePS]), and (3) **Data Empowerment Layer** (DigiLocker, Account Aggregator framework, and Open Network for Digital Commerce [ONDC]).

Exam Trap Alert: Do not confuse **IaaS, PaaS, and SaaS** in exam case studies: if a developer rents virtual servers/storage and installs their own Linux OS, it is **IaaS**; if a developer uploads Python/Node.js code directly to a managed runtime environment without managing the OS, it is **PaaS**; if an end-user opens **DigiLocker** or **MS Office 365** in a web browser, it is **SaaS**.

★ **Memory Trick:** For ML paradigms, remember **"S-L / U-P / R-R"**: **S**upervised = **L**abeled data; **U**nsupervised = **P**attern discovery on unlabeled data; **R**einforcement = **R**eward & Penalty feedback loop.

Chapter *8* Comprehensive Analytical & Statutory Revision Matrix

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models	**Evolution & Foundations of AI**	The term **"Artificial Intelligence"** was coined by **John McCarthy** in **1956** at the Dartmouth Conference, while **Alan Turing** formulated the foundational **Turing Test ("Imitation Game")** in his **1950** paper "*Computing Machinery and Intelligence*".

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Cloud Computing Deployment Models, Internet of Things (IoT) & Blockchain	**Supervised Learning**	Trained on **labeled datasets** (input-output pairs **(X, Y)**). Subdivided into **Classification** (predicting discrete categories, e.g., spam vs non-spam using Logistic Regression, Support Vector Machines, Decision Trees, Random Forests) and **Regression** (predicting continuous numerical values, e.g., house price or temperature using Linear/Polynomial Regression).
Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models	**Unsupervised Learning**	Trained on **unlabeled datasets** to discover hidden patterns or structures. Subdivided into **Unsupervised Grouping** (K-Means, Hierarchical, DBSCAN) and **Dimensionality Reduction / Association** (Principal Component Analysis [PCA], Apriori Algorithm).
Cloud Computing Deployment Models, Internet of Things (IoT) & Blockchain	**Reinforcement Learning (RL)**	An autonomous **Agent** learns optimal policy actions by interacting with an **Environment** through trial-and-error **Rewards and Penalties** (Markov Decision Processes, Q-Learning, AlphaGo).
Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models	**Deep Learning & Transformer Architecture (GenAI)**	Built on multi-layer **Artificial Neural Networks (ANNs)**, **CNNs (Convolutional Neural Networks — computer vision/image recognition)**, and **RNNs/LSTMs (sequential data)**. Modern Generative AI and Large Language Models (LLMs) are powered by the **Transformer Architecture** (introduced in the 2017 paper "*Attention Is All You Need*" using **Self-Attention mechanisms**).
Cloud Computing Deployment Models, Internet of Things (IoT) & Blockchain	**IndiaAI Mission & National Supercomputing Initiatives**	Approved by the Union Cabinet under **MeitY** with an outlay of over Rs 10,300 Crore, the **IndiaAI Mission** deploys high-compute GPU infrastructure (**10,000+ GPUs**), indigenous foundational models (**Bhashini** for real-time translation across 22 Scheduled Indian languages, **AIRAWAT** AI supercomputer at C-DAC Pune), and **PARAM Rudra / Pratyush / Mihir** high-performance computing systems under the National Supercomputing Mission (NSM).
Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models	**Cloud Deployment Models**	**Public Cloud** (shared multi-tenant infrastructure owned by a cloud provider), **Private Cloud** (dedicated exclusively to a single organization), **Hybrid Cloud** (combines Private and Public clouds with orchestration between them), and **Community Cloud** (shared by several organizations with common regulatory/security compliance requirements, such as government ministries using **MeghRaj — GI Cloud** under **MeitY**).
Cloud Computing Deployment Models, Internet of Things (IoT) & Blockchain	**Internet of Things (IoT) & Lightweight Protocols**	Term coined by **Kevin Ashton** in **1999**. Uses low-power communication protocols including **MQTT** (Message Queuing Telemetry Transport — publish/subscribe protocol over TCP), **CoAP** (Constrained Application Protocol — over UDP), **Zigbee (IEEE 802.15.4)**, **BLE (Bluetooth Low Energy)**, **LoRaWAN**, and **6LoWPAN** (IPv6 over Low-Power Wireless PAN). **Edge Computing** and **Fog Computing** process time-sensitive IoT sensor data locally near the source rather than sending all raw streams to a distant centralized cloud, drastically reducing latency.

Core Sub-Domain	Key Concept / Provision	Verified Analytical Parameters & Exam Distinctions (Ministry of Electronics & IT (MeitY))
Artificial Intelligence (AI), Machine Learning Paradigms & Large Language Models	**Blockchain & Distributed Ledger Technology (DLT)**	Conceptualized in 2008 by **Satoshi Nakamoto**. A Blockchain is an immutable, decentralized, cryptographically linked chain of blocks where each block contains a **Cryptographic Hash of the Previous Block**, a **Timestamp**, a **Nonce**, and a **Merkle Tree Root** of validated transactions. Consensus mechanisms include **Proof of Work (PoW)** and **Proof of Stake (PoS)**. **Smart Contracts** (popularized on Ethereum) are self-executing programs stored on the blockchain that automatically enforce agreement terms when predefined conditions are met.

Chapter *8* Multi-Statement Exam Verification Drills

Chapter 8 Statement-Verification Drill #1 — Both Statements Verified Correct

Statement-I (Evolution & Foundations of AI): The term **"Artificial Intelligence"** was coined by **John McCarthy** in **1956** at the Dartmouth Conference, while **Alan Turing** formulated the foundational **Turing Test ("Imitation Game")** in his **1950** paper "*Computing Machinery and Intelligence*".

Statement-II (Supervised Learning): Trained on **labeled datasets** (input-output pairs **(X, Y)**). Subdivided into **Classification** (predicting discrete categories, e.g., spam vs non-spam using Logistic Regression, Support Vector Machines, Decision Trees, Random Forests) and **Regression** (predicting continuous numerical values, e.g., house price or temperature using Linear/Polynomial Regression).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 8 Statement-Verification Drill #2 — Both Statements Verified Correct

Statement-I (Unsupervised Learning): Trained on **unlabeled datasets** to discover hidden patterns or structures. Subdivided into **Unsupervised Grouping** (K-Means, Hierarchical, DBSCAN) and **Dimensionality Reduction / Association** (Principal Component Analysis [PCA], Apriori Algorithm).

Statement-II (Reinforcement Learning (RL)): An autonomous **Agent** learns optimal policy actions by interacting with an **Environment** through trial-and-error **Rewards and Penalties** (Markov Decision Processes, Q-Learning, AlphaGo).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 8 Statement-Verification Drill #3 — Both Statements Verified Correct

Statement-I (Deep Learning & Transformer Architecture (GenAI)): Built on multi-layer **Artificial Neural Networks (ANNs)**, **CNNs (Convolutional Neural Networks — computer vision/image recognition)**, and **RNNs/LSTMs (sequential data)**. Modern Generative AI and Large Language Models (LLMs) are powered by the **Transformer Architecture** (introduced in the 2017 paper "*Attention Is All You Need*" using **Self-Attention mechanisms**).

Statement-II (IndiaAI Mission & National Supercomputing Initiatives): Approved by the Union Cabinet under **MeitY** with an outlay of over Rs 10,300 Crore, the **IndiaAI Mission** deploys high-compute GPU infrastructure (**10,000+ GPUs**), indigenous foundational models (**Bhashini** for real-time translation across 22 Scheduled Indian languages, **AIRAWAT** AI supercomputer at C-DAC Pune), and **PARAM Rudra / Pratyush / Mihir** high-performance computing systems under the National Supercomputing Mission (NSM).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Chapter 8 Statement-Verification Drill #4 Both Statements Verified Correct

Statement-I (Cloud Deployment Models): Public Cloud (shared multi-tenant infrastructure owned by a cloud provider), **Private Cloud** (dedicated exclusively to a single organization), **Hybrid Cloud** (combines Private and Public clouds with orchestration between them), and **Community Cloud** (shared by several organizations with common regulatory/security compliance requirements, such as government ministries using **MeghRaj — GI Cloud** under MeitY).

Statement-II (Internet of Things (IoT) & Lightweight Protocols): Term coined by **Kevin Ashton** in **1999**. Uses low-power communication protocols including **MQTT** (Message Queuing Telemetry Transport — publish/subscribe protocol over TCP), **CoAP** (Constrained Application Protocol — over UDP), **Zigbee (IEEE 802.15.4)**, **BLE (Bluetooth Low Energy)**, **LoRaWAN**, and **6LoWPAN** (IPv6 over Low-Power Wireless PAN). **Edge Computing** and **Fog Computing** process time-sensitive IoT sensor data locally near the source rather than sending all raw streams to a distant centralized cloud, drastically reducing latency.

✔ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per Ministry of Electronics & IT (MeitY) & IUC Academy.**

Solved Exam Practice Questions (MCQs)

Practice Question #1 Solved Exam MCQ

1. **Which special-purpose CPU register holds the memory address of the NEXT instruction to be fetched from main memory?**
(A) Instruction Register (IR)
(B) Program Counter (PC)
(C) Memory Buffer Register (MBR)
(D) Accumulator (ACC)
Answer: (B) — *Explanation:* The Program Counter (PC) tracks the memory address of the next instruction to be executed, whereas the Instruction Register (IR) holds the instruction currently being decoded.

Practice Question #2 Solved Exam MCQ

2. **Which semiconductor memory technology is used to construct ultra-fast CPU Cache memory (L1/L2/L3) and does NOT require periodic refreshing?**
(A) DRAM
(B) SRAM
(C) EEPROM
(D) SDRAM
Answer: (B) — *Explanation:* Static RAM (SRAM) uses bistable latching circuitry (6 transistors per bit), requires no periodic charge refresh, and builds CPU cache.

Practice Question #3 Solved Exam MCQ

3. **How many bytes are equivalent to `1 Petabyte (PB)` in binary storage measurement?**
(A) `2^40` Bytes
(B) `2^50` Bytes
(C) `2^60` Bytes
(D) `2^30` Bytes
Answer: (B) — *Explanation:* `1 KB = 2^10 B`, `1 MB = 2^20 B`, `1 GB = 2^30 B`, `1 TB = 2^40 B`, and `1 PB = 2^50 Bytes` (`1,024 TB`).

Practice Question #4 Solved Exam MCQ

4. **What is the exact hexadecimal and octal equivalent of the decimal number `(219)_10`?**
(A) `(DB)_16` and `(333)_8`
(B) `(DA)_16` and `(331)_8`
(C) `(CD)_16` and `(323)_8`
(D) `(BD)_16` and `(335)_8`
Answer: (A) — *Explanation:* `219 = 13 * 16 + 11 = (DB)_16` (`D=13, B=11`). In binary, `D = 1101` and `B = 1011` -> `11011011_2` = `011 011 011_2 = (333)_8`.

Practice Question #5 Solved Exam MCQ

5. **Which pair of logic gates is universally recognized as "Universal Gates" capable of implementing any Boolean function without needing any other gate type?**
(A) AND and OR
(B) XOR and XNOR
(C) NAND and NOR
(D) NOT and XOR
Answer: (C) — *Explanation:* Both NAND and NOR gates are functionally complete universal gates.

Practice Question #6 Solved Exam MCQ

6. **In Operating Systems, what is the phenomenon called when a process spends more time paging (swapping pages between RAM and disk) than executing actual instructions?**
(A) Spooling
(B) Thrashing
(C) Buffering
(D) Aging
Answer: (B) — *Explanation:* Thrashing occurs when severe page faults cause continuous disk swapping, collapsing CPU utilization.

Practice Question #7 Solved Exam MCQ

7. **Which classical algorithm designed by Edsger Dijkstra is used by Operating Systems for Deadlock Avoidance?**
(A) Peterson's Algorithm
(B) Banker's Algorithm
(C)Dekker's Algorithm
(D) Belady's Algorithm
Answer: (B) — *Explanation:* The Banker's Algorithm tests resource allocation states for safety before granting requests, avoiding deadlock.

Practice Question #8 Solved Exam MCQ

8. **In MS Word 365, which keyboard shortcut opens the Thesaurus pane to find synonyms and antonyms of a selected word?**
(A) `F7`
(B) `Shift + F7`
(C) `Ctrl + F7`
(D) `Alt + F7`
Answer: (B) — *Explanation:* `F7` launches Spelling & Grammar Check, while `Shift + F7` opens the Thesaurus.

Practice Question #9 Solved Exam MCQ

9. **What is the valid range of the Zoom slider in MS Word 365 vs MS Excel 365?**
(A) Word: `10%–400%`; Excel: `10%–500%`
(B) Word: `10%–500%`; Excel: `10%–400%`
(C) Word: `20%–500%`; Excel: `20%–400%`
(D) Both Word and Excel: `10%–500%`
Answer: (B) — *Explanation:* MS Word supports zoom from `10% to 500%`, whereas MS Excel and MS PowerPoint support `10% to 400%`.

Practice Question #10 Solved Exam MCQ

10. **In MS Excel 365, what will be the exact output of the formula `=CEILING(23, 5) + MOD(19, 4)`?**
(A) `25`
(B) `28`
(C) `23`
(D) `27`
Answer: (B) — *Explanation:* `CEILING(23, 5)` steps `23` up to the nearest multiple of `5` (`25`), and `MOD(19, 4)` gives the remainder of `19 / 4` (`3`). Thus `25 + 3 = 28`.

Practice Question #11 Solved Exam MCQ

11. **In MS Excel 365, which keyboard shortcut inserts a new line (line break) inside the same cell while editing?**
(A) `Ctrl + Enter`
(B) `Shift + Enter`
(C) `Alt + Enter`
(D) `Tab + Enter`
Answer: (C) — *Explanation:* `Alt + Enter` wraps text onto a new line within the same Excel cell.

Practice Question #12 Solved Exam MCQ

12. **In MS PowerPoint 365, pressing `Ctrl + M` performs which action?**
(A) Applies a left paragraph indent
(B) Inserts a new slide into the current presentation
(C) Opens the Slide Master view
(D) Mutes presentation audio
Answer: (B) — *Explanation:* In PowerPoint, `Ctrl + M` inserts a new slide (`Ctrl + N` creates a new presentation).

Practice Question #13 Solved Exam MCQ

13. **How many point-to-point physical bidirectional cables are required to connect `10` computers in a Full Mesh Topology?**
(A) `100`
(B) `90`
(C) `45`
(D) `19`
Answer: (C) — *Explanation*: Formula for Full Mesh links = `n(n - 1) / 2 = 10 * 9 / 2 = 45` cables.

Practice Question #14 Solved Exam MCQ

14. **At which layer of the ISO-OSI 7-Layer Model do a Router and the Logical IP Addressing/ICMP protocols operate?**
(A) Layer 2 (Data Link Layer)
(B) Layer 3 (Network Layer)
(C) Layer 4 (Transport Layer)
(D) Layer 1 (Physical Layer)
Answer: (B) — *Explanation:* Routers, IP addressing, and ICMP operate at Layer 3 (Network Layer), where the PDU is a **Packet**.

Practice Question #15 Solved Exam MCQ

15. **Which OSI layer is responsible for end-to-end encryption/decryption (SSL/TLS), data compression, and character code translation?**
(A) Session Layer (Layer 5)
(B) Presentation Layer (Layer 6)
(C) Application Layer (Layer 7)
(D) Transport Layer (Layer 4)
Answer: (B) — *Explanation:* Layer 6 (Presentation Layer) acts as the syntax translator, handling encryption, compression, and format conversion.

Practice Question #16 Solved Exam MCQ

16. **What is the bit length of a Physical MAC Address, an IPv4 Address, and an IPv6 Address respectively?**
(A) **32-bit, 48-bit, 128-bit**
(B) **48-bit, 32-bit, 128-bit**
(C) **48-bit, 64-bit, 128-bit**
(D) **64-bit, 32-bit, 256-bit**
Answer: (B) — *Explanation:* MAC address = **48 bits** (6 bytes in Hex), IPv4 = **32 bits** (4 bytes in Decimal), IPv6 = **128 bits** (16 bytes in Hex).

Practice Question #17 Solved Exam MCQ

17. **Which IPv4 address belongs to Class B and which IPv4 address is reserved for Localhost Loopback testing?**
(A) **172.16.10.1** and **127.0.0.1**
(B) **192.168.1.1** and **127.0.0.1**
(C) **120.10.5.1** and **255.255.255.0**
(D) **228.0.0.1** and **127.0.0.1**
Answer: (A) — *Explanation:* Class B first octet ranges from **128 to 191** (**172.16.10.1**), and **127.0.0.1** is the standard Loopback address.

Practice Question #18 Solved Exam MCQ

18. **Which networking protocol automatically assigns an IP address, Subnet Mask, and Default Gateway to client devices using the DORA process on UDP Ports 67 and 68?**
(A) DNS
(B) ARP
(C) DHCP
(D) SNMP
Answer: (C) — *Explanation*: DHCP (Dynamic Host Configuration Protocol) dynamically leases IP configurations via Discover-Offer-Request-Acknowledge.

Practice Question #19 Solved Exam MCQ

19. **What are the standard well-known TCP port numbers for SSH, SMTP, HTTP, and HTTPS respectively?**
(A) **21, 25, 80, 443**
(B) **22, 25, 80, 443**
(C) **23, 110, 80, 8080**
(D) **22, 143, 53, 443**
Answer: (B) — *Explanation*: SSH = **22**, SMTP = **25**, HTTP = **80**, and HTTPS = **443** (FTP is **20/21**, Telnet is **23**, DNS is **53**).

Practice Question #20 Solved Exam MCQ

20. **In a Relational Database (RDBMS), a table 'Employee' has 8 columns and 250 rows. What are its Degree and Cardinality respectively?**
(A) Degree = **250**, Cardinality = **8**
(B) Degree = **8**, Cardinality = **250**
(C) Degree = **8**, Cardinality = **2000**
(D) Degree = **258**, Cardinality = **250**
Answer: (B) — *Explanation*: Degree is the number of attributes/columns (**8**), and Cardinality is the number of tuples/rows (**250**).

Practice Question #21 Solved Exam MCQ

21. **A database relation is in Second Normal Form (2NF) and contains no Transitive Dependency of non-prime attributes on the primary key. Which Normal Form has it achieved?**
(A) 1NF
(B) 3NF
(C) 4NF
(D) 5NF
Answer: (B) — *Explanation*: Eliminating Partial Dependency achieves 2NF; eliminating Transitive Dependency achieves **Third Normal Form (3NF)**.

Practice Question #22 Solved Exam MCQ

22. **Which SQL command belongs to the Data Definition Language (DDL) subset and removes all rows from a table without deleting the table's structure/schema?**
(A) **DELETE**
(B) **DROP**
(C) **TRUNCATE**
(D) **REVOKE**
Answer: (C) — *Explanation*: **TRUNCATE TABLE** is a DDL statement that empties all rows while keeping the table schema intact.

Practice Question #23 Solved Exam MCQ

23. **In an SQL query, which clause is specifically used to apply a filter condition on aggregated groups created by the GROUP BY clause?**
(A) **WHERE**
(B) **HAVING**
(C) **ORDER BY**
(D) **DISTINCT**
Answer: (B) — *Explanation*: **HAVING** filters groups after **GROUP BY** and supports aggregate functions like **COUNT()** and **SUM()**.

Practice Question #24 Solved Exam MCQ

24. **Which type of malware is a standalone program that self-replicates automatically across computer networks by exploiting security vulnerabilities WITHOUT requiring a host program or human activation?**
(A) Trojan Horse
(B) Computer Worm
(C) Macro Virus
(D) Logic Bomb
Answer: (B) — *Explanation*: Worms self-propagate autonomously over networks without attaching to host files.

Practice Question #25 Solved Exam MCQ

25. **In Asymmetric Public-Key Cryptography, if User A wants to send a digitally signed document to User B to guarantee Non-Repudiation and Authentication, which key does User A use to sign the message digest?**
(A) User B's Public Key
(B) User B's Private Key
(C) User A's Private Key
(D) User A's Public Key
Answer: (C) — *Explanation*: A Digital Signature is created using the **Sender's Private Key** and verified by the recipient using the **Sender's Public Key**.

Practice Question #26 Solved Exam MCQ

26. **Under the Information Technology Act, 2000 (as amended in 2008), which Section prescribes punishment up to Life Imprisonment for committing "Cyber Terrorism"?**
(A) Section 65
(B) Section 66C
(C) Section 66F
(D) Section 67B
Answer: (C) — *Explanation*: Section 66F defines and penalizes Cyber Terrorism with imprisonment extendable to life.

Practice Question #27 Solved Exam MCQ

27. **In the landmark judgment *Shreya Singhal v. Union of India* (2015), which Section of the Information Technology Act, 2000 was struck down in its entirety by the Supreme Court as unconstitutional under Article 19(1)(a)?**
(A) Section 66A
(B) Section 69A
(C) Section 79
(D) Section 66D
Answer: (A) — *Explanation*: Section 66A was struck down as vague and overbroad, whereas Sections 69A and 79 were upheld.

Practice Question #28 Solved Exam MCQ

28. **Which Section of the Information Technology Act, 2000 designates CERT-In (Indian Computer Emergency Response Team) as the national agency for incident response?**
(A) Section 69B
(B) Section 70A
(C) Section 70B
(D) Section 72A
Answer: (C) — *Explanation*: Section 70B designates CERT-In (while Section 70A designates NCIIPC for Critical Information Infrastructure protection).

Practice Question #29 Solved Exam MCQ

29. **Under Section 78 of the Information Technology Act, 2000 (subsequent to the 2008 Amendment), what is the minimum rank of a Police Officer empowered to investigate cyber offences?**
(A) Sub-Inspector (SI)
(B) Inspector of Police
(C) Deputy Superintendent of Police (DSP)
(D) Superintendent of Police (SP)
Answer: (B) — *Explanation:* The 2008 IT Amendment Act substituted "Inspector" for "Deputy Superintendent of Police" in Section 78.

Practice Question #30 Solved Exam MCQ

30. **Under the Digital Personal Data Protection (DPDP) Act, 2023, what is the maximum financial penalty that the Data Protection Board of India can impose for failure to take reasonable security safeguards to prevent a personal data breach?**
(A) Rs 50 Crore
(B) Rs 100 Crore
(C) Rs 250 Crore
(D) Rs 500 Crore
Answer: (C) — *Explanation:* The Schedule to the DPDP Act, 2023 specifies a penalty up to Rs 250 Crore for breach of security safeguards.

Practice Question #31 Solved Exam MCQ

31. **Which Section of the Bharatiya Sakshya Adhiniyam (BSA), 2023 governs the admissibility of electronic records and replaces Section 65B of the erstwhile Indian Evidence Act, 1872?**
(A) Section 61
(B) Section 63
(C) Section 65
(D) Section 79A
Answer: (B) — *Explanation:* Section 63 of the BSA, 2023 lays down the framework and certificate requirement for admissibility of electronic records.

Practice Question #32 Solved Exam MCQ

32. **In Machine Learning, training a model on an UNLABELED dataset to discover customer segments is an example of which learning paradigm?**
(A) Supervised Classification
(B) Supervised Regression
(C) Unsupervised Learning
(D) Reinforcement Learning
Answer: (C) — *Explanation:* Discovering natural groupings in unlabeled data is Unsupervised Learning.

Practice Question #33 Solved Exam MCQ

33. **When an organization rents virtual machines and raw block storage from a cloud vendor while installing and managing its own Linux Operating System, Database, and Application code, which Cloud Service Model is it using?**
(A) SaaS (Software as a Service)
(B) PaaS (Platform as a Service)
(C) IaaS (Infrastructure as a Service)
(D) FaaS (Function as a Service)
Answer: (C) — *Explanation:* In IaaS, the cloud provider delivers virtualized hardware infrastructure while the user manages the OS and software stack.

Practice Question #34 — Solved Exam MCQ

34. **Which MS Excel error code is displayed when a formula contains an unrecognized function name (such as `=AVERG(A1:A10)`)?**
(A) **`#VALUE!`**
(B) **`#NAME?`**
(C) **`#REF!`**
(D) **`#N/A`**
Answer: (B) — *Explanation:* **`#NAME?`** occurs when Excel cannot resolve a misspelled function name or unquoted text string.

Practice Question #35 — Solved Exam MCQ

35. **Which lightweight publish/subscribe messaging protocol running over TCP/IP is specifically designed for constrained Internet of Things (IoT) sensors with low bandwidth?**
(A) SMTP
(B) MQTT
(C) SNMP
(D) IMAP
Answer: (B) — *Explanation:* MQTT (Message Queuing Telemetry Transport) is the standard lightweight publish/subscribe telemetry protocol for IoT devices.

Extended Comparative & Analytical Practice Set (Questions *36* to *75*)

Practice Question #36 — High-Yield Comparative MCQ

Q36. With reference to Memory Tier and Volatility, which of the following is accurately matched with "CPU Registers"?

(A) Volatile
(B) Non-Volatile
(C) Basic Gate
(D) None of the above parameters for CPU Registers

Correct Answer: (A) | **Explanation:** For **CPU Registers** (Memory Tier), the verified Volatility is **Volatile**. Furthermore, Fastest (**`< 1 ns`**). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #37 — High-Yield Comparative MCQ

Q37. With reference to Memory Tier and Volatility, which of the following is accurately matched with "Cache Memory (L1/L2/L3)"?

(A) Non-Volatile
(B) Volatile
(C) Basic Gate
(D) None of the above parameters for Cache Memory (L1/L2/L3)

Correct Answer: (B) | **Explanation:** For **Cache Memory (L1/L2/L3)** (Memory Tier), the verified Volatility is **Volatile**. Furthermore, Ultra-Fast (**`1–10 ns`**). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #38 High-Yield Comparative MCQ

Q38. With reference to Memory Tier and Volatility, which of the following is accurately matched with "Main Memory (RAM)"?

(A) Non-Volatile
(B) Basic Gate
(C) Volatile
(D) None of the above parameters for Main Memory (RAM)

Correct Answer: (C) | **Explanation:** For **Main Memory (RAM)** (Memory Tier), the verified Volatility is **Volatile**. Furthermore, Fast (`50–100 ns`). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #39 High-Yield Comparative MCQ

Q39. With reference to Memory Tier and Volatility, which of the following is accurately matched with "Firmware (ROM/BIOS/UEFI)"?

(A) Basic Gate
(B) Universal Gate
(C) None of the above parameters for Firmware (ROM/BIOS/UEFI)
(D) Non-Volatile

Correct Answer: (D) | **Explanation:** For **Firmware (ROM/BIOS/UEFI)** (Memory Tier), the verified Volatility is **Non-Volatile**. Furthermore, Moderate Read. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #40 High-Yield Comparative MCQ

Q40. With reference to Memory Tier and Volatility, which of the following is accurately matched with "Secondary Storage"?

(A) Non-Volatile
(B) Basic Gate
(C) Universal Gate
(D) None of the above parameters for Secondary Storage

Correct Answer: (A) | **Explanation:** For **Secondary Storage** (Memory Tier), the verified Volatility is **Non-Volatile**. Furthermore, Slow (`ms` to `us`). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #41 High-Yield Comparative MCQ

Q41. With reference to Logic Gate and Category, which of the following is accurately matched with "AND Gate"?

(A) Universal Gate
(B) Basic Gate
(C) Derived Gate
(D) None of the above parameters for AND Gate

Correct Answer: (B) | **Explanation:** For **AND Gate** (Logic Gate), the verified Category is **Basic Gate**. Furthermore, `Y = A . B`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #42 High-Yield Comparative MCQ

Q42. With reference to Logic Gate and Category, which of the following is accurately matched with “OR Gate”?

(A) Universal Gate
(B) Derived Gate
(C) Basic Gate
(D) None of the above parameters for OR Gate

Correct Answer: (C) | **Explanation:** For **OR Gate** (Logic Gate), the verified Category is **Basic Gate**. Furthermore, `Y = A + B`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #43 High-Yield Comparative MCQ

Q43. With reference to Logic Gate and Category, which of the following is accurately matched with “NOT Gate (Inverter)”?

(A) Universal Gate
(B) Derived Gate
(C) `10%` to `500%`
(D) Basic Gate

Correct Answer: (D) | **Explanation:** For **NOT Gate (Inverter)** (Logic Gate), the verified Category is **Basic Gate**. Furthermore, `Y = A'`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #44 High-Yield Comparative MCQ

Q44. With reference to Logic Gate and Category, which of the following is accurately matched with “NAND Gate”?

(A) Universal Gate
(B) Derived Gate
(C) `10%` to `500%`
(D) `10%` to `400%`

Correct Answer: (A) | **Explanation:** For **NAND Gate** (Logic Gate), the verified Category is **Universal Gate**. Furthermore, `Y = (A . B)'`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #45 High-Yield Comparative MCQ

Q45. With reference to Logic Gate and Category, which of the following is accurately matched with “NOR Gate”?

(A) Derived Gate
(B) Universal Gate
(C) `10%` to `500%`
(D) `10%` to `400%`

Correct Answer: (B) | **Explanation:** For **NOR Gate** (Logic Gate), the verified Category is **Universal Gate**. Furthermore, `Y = (A + B)'`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #46 High-Yield Comparative MCQ

Q46. With reference to Logic Gate and Category, which of the following is accurately matched with "XOR (Exclusive-OR)"?

(A) `10%` to `500%`
(B) `10%` to `400%`
(C) Derived Gate
(D) Bits (`0` and `1`)

Correct Answer: (C) | **Explanation:** For **XOR (Exclusive-OR)** (Logic Gate), the verified Category is **Derived Gate**. Furthermore, `Y = A'B + AB'`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #47 High-Yield Comparative MCQ

Q47. With reference to Logic Gate and Category, which of the following is accurately matched with "XNOR (Equivalence)"?

(A) `10%` to `500%`
(B) `10%` to `400%`
(C) Bits (`0` and `1`)
(D) Derived Gate

Correct Answer: (D) | **Explanation:** For **XNOR (Equivalence)** (Logic Gate), the verified Category is **Derived Gate**. Furthermore, `Y = AB + A'B'`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #48 High-Yield Comparative MCQ

Q48. With reference to Application and Zoom Range (Min–Max), which of the following is accurately matched with "MS Word 365"?

(A) `10%` to `500%`
(B) `10%` to `400%`
(C) Bits (`0` and `1`)
(D) Frame

Correct Answer: (A) | **Explanation:** For **MS Word 365** (Application), the verified Zoom Range (Min–Max) is `10%` **to** `500%`. Furthermore, `.docx`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #49 High-Yield Comparative MCQ

Q49. With reference to Application and Zoom Range (Min–Max), which of the following is accurately matched with "MS Excel 365"?

(A) Bits (`0` and `1`)
(B) `10%` to `400%`
(C) Frame
(D) Packet

Correct Answer: (B) | **Explanation:** For **MS Excel 365** (Application), the verified Zoom Range (Min–Max) is `10%` **to** `400%`. Furthermore, `.xlsx`. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #50 High-Yield Comparative MCQ

Q50. With reference to Application and Zoom Range (Min–Max), which of the following is accurately matched with "MS PowerPoint 365"?

(A) Bits (`0` and `1`)
(B) Frame
(C) `10%` to `400%`
(D) Packet

Correct Answer: (C) | **Explanation:** For **MS PowerPoint 365** (Application), the verified Zoom Range (Min–Max) is `10%` **to** `400%`. Furthermore, `.odp` / Slide Deck. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #51 High-Yield Comparative MCQ

Q51. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 1: Physical"?

(A) Frame
(B) Packet
(C) Segment (TCP) / Datagram (UDP)
(D) Bits (`0` and `1`)

Correct Answer: (D) | **Explanation:** For **Layer 1: Physical** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Bits (`0` and `1`)**. Furthermore, Hub, Repeater, Modem, Cables (RJ-45, Fiber). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #52 High-Yield Comparative MCQ

Q52. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 2: Data Link"?

(A) Frame
(B) Packet
(C) Segment (TCP) / Datagram (UDP)
(D) Data

Correct Answer: (A) | **Explanation:** For **Layer 2: Data Link** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Frame**. Furthermore, Switch (L2), Bridge, NIC (Network Card). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #53 High-Yield Comparative MCQ

Q53. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 3: Network"?

(A) Segment (TCP) / Datagram (UDP)
(B) Packet
(C) Data
(D) Data / Message

Correct Answer: (B) | **Explanation:** For **Layer 3: Network** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Packet**. Furthermore, Router, Layer-3 Switch, Brouter. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #54 High-Yield Comparative MCQ

Q54. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 4: Transport"?

(A) Data
(B) Data / Message
(C) Segment (TCP) / Datagram (UDP)
(D) Multi-valued & composite attributes

Correct Answer: (C) | **Explanation:** For **Layer 4: Transport** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Segment (TCP) / Datagram (UDP)**. Furthermore, Gateway, Load Balancer / Stateful Firewall. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #55 High-Yield Comparative MCQ

Q55. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 5: Session"?

(A) Data / Message
(B) Multi-valued & composite attributes
(C) Partial Functional Dependency
(D) Data

Correct Answer: (D) | **Explanation:** For **Layer 5: Session** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Data**. Furthermore, Gateway / Software Socket. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #56 High-Yield Comparative MCQ

Q56. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 6: Presentation"?

(A) Data
(B) Data / Message
(C) Multi-valued & composite attributes
(D) Partial Functional Dependency

Correct Answer: (A) | **Explanation:** For **Layer 6: Presentation** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Data**. Furthermore, Gateway / Software Translator. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #57 High-Yield Comparative MCQ

Q57. With reference to OSI Layer (Bottom to Top) and Protocol Data Unit (PDU), which of the following is accurately matched with "Layer 7: Application"?

(A) Multi-valued & composite attributes
(B) Data / Message
(C) Partial Functional Dependency
(D) Transitive Dependency

Correct Answer: (B) | **Explanation:** For **Layer 7: Application** (OSI Layer (Bottom to Top)), the verified Protocol Data Unit (PDU) is **Data / Message**. Furthermore, Gateway, Proxy Server, Next-Gen Firewall. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #58 High-Yield Comparative MCQ

Q58. With reference to Normal Form and Core Anomaly Eliminated, which of the following is accurately matched with "1NF (First Normal Form)"?

(A) Partial Functional Dependency
(B) Transitive Dependency
(C) Multi-valued & composite attributes
(D) Remaining FD anomalies (3.5 NF)

Correct Answer: (C) | **Explanation:** For **1NF (First Normal Form)** (Normal Form), the verified Core Anomaly Eliminated is **Multi-valued & composite attributes**. Furthermore, Every attribute must contain only atomic (indivisible) values. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #59 High-Yield Comparative MCQ

Q59. With reference to Normal Form and Core Anomaly Eliminated, which of the following is accurately matched with "2NF (Second Normal Form)"?

(A) Transitive Dependency
(B) Remaining FD anomalies (3.5 NF)
(C) Multi-Valued Dependency (MVD)
(D) Partial Functional Dependency

Correct Answer: (D) | **Explanation:** For **2NF (Second Normal Form)** (Normal Form), the verified Core Anomaly Eliminated is **Partial Functional Dependency**. Furthermore, Must be in 1NF + every non-prime attribute is fully functionally dependent on the whole Candidate Key. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #60 High-Yield Comparative MCQ

Q60. With reference to Normal Form and Core Anomaly Eliminated, which of the following is accurately matched with "3NF (Third Normal Form)"?

(A) Transitive Dependency
(B) Remaining FD anomalies (3.5 NF)
(C) Multi-Valued Dependency (MVD)
(D) 1 Shared Key (Same key encrypts & decrypts)

Correct Answer: (A) | **Explanation:** For **3NF (Third Normal Form)** (Normal Form), the verified Core Anomaly Eliminated is **Transitive Dependency**. Furthermore, Must be in 2NF + no non-prime attribute depends on another non-prime attribute (`X -> Y` and `Y -> Z`). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #61 High-Yield Comparative MCQ

Q61. With reference to Normal Form and Core Anomaly Eliminated, which of the following is accurately matched with "BCNF (Boyce-Codd NF)"?

(A) Multi-Valued Dependency (MVD)
(B) Remaining FD anomalies (3.5 NF)
(C) 1 Shared Key (Same key encrypts & decrypts)
(D) 2 Keys (Public Key + Private Key)

Correct Answer: (B) | **Explanation:** For **BCNF (Boyce-Codd NF)** (Normal Form), the verified Core Anomaly Eliminated is **Remaining FD anomalies (3.5 NF)**. Furthermore, Must be in 3NF + for every non-trivial dependency `X -> Y` , `X` must be a Super Key. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #62 High-Yield Comparative MCQ

Q62. With reference to Normal Form and Core Anomaly Eliminated, which of the following is accurately matched with "4NF (Fourth Normal Form)"?

(A) 1 Shared Key (Same key encrypts & decrypts)

(B) 2 Keys (Public Key + Private Key)

(C) Multi-Valued Dependency (MVD)

(D) 0 Keys (One-Way Irreversible Function)

Correct Answer: (C) | **Explanation:** For **4NF (Fourth Normal Form)** (Normal Form), the verified Core Anomaly Eliminated is **Multi-Valued Dependency (MVD)**. Furthermore, Must be in BCNF + contains no non-trivial multi-valued dependencies (**X ->> Y**). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #63 High-Yield Comparative MCQ

Q63. With reference to Cryptographic Category and Key Architecture, which of the following is accurately matched with "Symmetric-Key (Secret Key)"?

(A) 2 Keys (Public Key + Private Key)

(B) 0 Keys (One-Way Irreversible Function)

(C) Digital Signature (Sec 3) (Asymmetric crypto + hash) & Electronic Signature (Sec 3A) (2008 Amendment)

(D) 1 Shared Key (Same key encrypts & decrypts)

Correct Answer: (D) | **Explanation:** For **Symmetric-Key (Secret Key)** (Cryptographic Category), the verified Key Architecture is **1 Shared Key (Same key encrypts & decrypts)**. Furthermore, AES (128/192/256-bit), DES (56-bit), 3DES, Blowfish, RC4. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #64 High-Yield Comparative MCQ

Q64. With reference to Cryptographic Category and Key Architecture, which of the following is accurately matched with "Asymmetric-Key (Public Key)"?

(A) 2 Keys (Public Key + Private Key)

(B) 0 Keys (One-Way Irreversible Function)

(C) Digital Signature (Sec 3) (Asymmetric crypto + hash) & Electronic Signature (Sec 3A) (2008 Amendment)

(D) Legal recognition of Electronic Records (Sec 4) and Electronic Signatures (Sec 5)

Correct Answer: (A) | **Explanation:** For **Asymmetric-Key (Public Key)** (Cryptographic Category), the verified Key Architecture is **2 Keys (Public Key + Private Key)**. Furthermore, RSA, Diffie-Hellman, ECC (Elliptic Curve), DSA. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #65 High-Yield Comparative MCQ

Q65. With reference to Cryptographic Category and Key Architecture, which of the following is accurately matched with "Cryptographic Hashing"?

(A) Digital Signature (Sec 3) (Asymmetric crypto + hash) & Electronic Signature (Sec 3A) (2008 Amendment)

(B) 0 Keys (One-Way Irreversible Function)

(C) Legal recognition of Electronic Records (Sec 4) and Electronic Signatures (Sec 5)

(D) Penalty/Compensation for unauthorized access/damage (Sec 43); Corporate failure to protect Sensitive Personal Data (Sec 43A)

Correct Answer: (B) | **Explanation:** For **Cryptographic Hashing** (Cryptographic Category), the verified Key Architecture is **0 Keys (One-Way Irreversible Function)**. Furthermore, SHA-256, SHA-3, MD5 (128-bit, deprecated). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #66 High-Yield Comparative MCQ

Q66. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 3 & 3A"?

(A) Legal recognition of Electronic Records (Sec 4) and Electronic Signatures (Sec 5)

(B) Penalty/Compensation for unauthorized access/damage (Sec 43); Corporate failure to protect Sensitive Personal Data (Sec 43A)

(C) Digital Signature (Sec 3) (Asymmetric crypto + hash) & Electronic Signature (Sec 3A) (2008 Amendment)

(D) Tampering with computer Source Documents (concealing, destroying, or altering source code)

Correct Answer: (C) | **Explanation:** For **Section 3 & 3A** (IT Act Section), the verified Statutory Title & Legal Provision is **Digital Signature (Sec 3) (Asymmetric crypto + hash) & Electronic Signature (Sec 3A) (2008 Amendment)**. Furthermore, Legal authentication of electronic records. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #67 High-Yield Comparative MCQ

Q67. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 4 & 5"?

(A) Penalty/Compensation for unauthorized access/damage (Sec 43); Corporate failure to protect Sensitive Personal Data (Sec 43A)

(B) Tampering with computer Source Documents (concealing, destroying, or altering source code)

(C) Computer-related offences (dishonestly/fraudulently committing acts under Sec 43 — Hacking)

(D) Legal recognition of Electronic Records (Sec 4) and Electronic Signatures (Sec 5)

Correct Answer: (D) | **Explanation:** For **Section 4 & 5** (IT Act Section), the verified Statutory Title & Legal Provision is **Legal recognition of Electronic Records (Sec 4) and Electronic Signatures (Sec 5)**. Furthermore, Equates e-records/e-signatures with paper/handwritten equivalents. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #68 High-Yield Comparative MCQ

Q68. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 43 & 43A"?

(A) Penalty/Compensation for unauthorized access/damage (Sec 43); Corporate failure to protect Sensitive Personal Data (Sec 43A)

(B) Tampering with computer Source Documents (concealing, destroying, or altering source code)

(C) Computer-related offences (dishonestly/fraudulently committing acts under Sec 43 — Hacking)

(D) Sending offensive messages through communication service

Correct Answer: (A) | **Explanation:** For **Section 43 & 43A** (IT Act Section), the verified Statutory Title & Legal Provision is **Penalty/Compensation for unauthorized access/damage (Sec 43); Corporate failure to protect Sensitive Personal Data (Sec 43A)**. Furthermore, Civil compensation by Adjudicating Officer / Court. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #69 High-Yield Comparative MCQ

Q69. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 65"?

(A) Computer-related offences (dishonestly/fraudulently committing acts under Sec 43 — Hacking)

(B) Tampering with computer Source Documents (concealing, destroying, or altering source code)

(C) Sending offensive messages through communication service

(D) Dishonestly receiving stolen computer resource or communication device

Correct Answer: (B) | **Explanation:** For **Section 65** (IT Act Section), the verified Statutory Title & Legal Provision is **Tampering with computer Source Documents (concealing, destroying, or altering source code)**. Furthermore, Imprisonment up to 3 years, or fine up to Rs 2 Lakh, or both. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #70 High-Yield Comparative MCQ

Q70. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 66"?

(A) Sending offensive messages through communication service
(B) Dishonestly receiving stolen computer resource or communication device
(C) Computer-related offences (dishonestly/fraudulently committing acts under Sec 43 — Hacking)
(D) Identity Theft (fraudulently using another person's electronic signature, password, or unique ID)

Correct Answer: (C) | **Explanation:** For **Section 66** (IT Act Section), the verified Statutory Title & Legal Provision is **Computer-related offences (dishonestly/fraudulently committing acts under Sec 43 — Hacking)**. Furthermore, Imprisonment up to 3 years, or fine up to Rs 5 Lakh, or both. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #71 High-Yield Comparative MCQ

Q71. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 66A"?

(A) Dishonestly receiving stolen computer resource or communication device
(B) Identity Theft (fraudulently using another person's electronic signature, password, or unique ID)
(C) Cheating by Personation by using computer resource (online impersonation/phishing fraud)
(D) Sending offensive messages through communication service

Correct Answer: (D) | **Explanation:** For **Section 66A** (IT Act Section), the verified Statutory Title & Legal Provision is **Sending offensive messages through communication service**. Furthermore, Struck down as Unconstitutional by Supreme Court in *Shreya Singhal v. Union of India* (2015) for violating Article 19(1)(a). (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #72 High-Yield Comparative MCQ

Q72. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 66B"?

(A) Dishonestly receiving stolen computer resource or communication device
(B) Identity Theft (fraudulently using another person's electronic signature, password, or unique ID)
(C) Cheating by Personation by using computer resource (online impersonation/phishing fraud)
(D) Violation of Physical Privacy (capturing/publishing images of private areas without consent)

Correct Answer: (A) | **Explanation:** For **Section 66B** (IT Act Section), the verified Statutory Title & Legal Provision is **Dishonestly receiving stolen computer resource or communication device**. Furthermore, Imprisonment up to 3 years, or fine up to Rs 1 Lakh, or both. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #73 High-Yield Comparative MCQ

Q73. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 66C"?

(A) Cheating by Personation by using computer resource (online impersonation/phishing fraud)
(B) Identity Theft (fraudulently using another person's electronic signature, password, or unique ID)
(C) Violation of Physical Privacy (capturing/publishing images of private areas without consent)
(D) Publishing/transmitting obscene material (Sec 67), sexually explicit acts (Sec 67A), and Child Sexual Abuse Material — CSAM (Sec 67B)

Correct Answer: (B) | **Explanation:** For **Section 66C** (IT Act Section), the verified Statutory Title & Legal Provision is **Identity Theft (fraudulently using another person's electronic signature, password, or unique ID)**. Furthermore, Imprisonment up to 3 years and fine up to Rs 1 Lakh. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #74 High-Yield Comparative MCQ

Q74. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 66D"?

(A) Violation of Physical Privacy (capturing/publishing images of private areas without consent)

(B) Publishing/transmitting obscene material (Sec 67), sexually explicit acts (Sec 67A), and Child Sexual Abuse Material — CSAM (Sec 67B)

(C) Cheating by Personation by using computer resource (online impersonation/phishing fraud)

(D) Power to issue directions for interception/monitoring/decryption (Sec 69) & Blocking public access to information (Sec 69A)

Correct Answer: (C) | **Explanation:** For **Section 66D** (IT Act Section), the verified Statutory Title & Legal Provision is **Cheating by Personation by using computer resource (online impersonation/phishing fraud)**. Furthermore, Imprisonment up to 3 years and fine up to Rs 1 Lakh. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Practice Question #75 High-Yield Comparative MCQ

Q75. With reference to IT Act Section and Statutory Title & Legal Provision, which of the following is accurately matched with "Section 66E"?

(A) Publishing/transmitting obscene material (Sec 67), sexually explicit acts (Sec 67A), and Child Sexual Abuse Material — CSAM (Sec 67B)

(B) Power to issue directions for interception/monitoring/decryption (Sec 69) & Blocking public access to information (Sec 69A)

(C) Protected Systems (Sec 70), NCIIPC (Sec 70A) for Critical Information Infrastructure, and CERT-In (Sec 70B)

(D) Violation of Physical Privacy (capturing/publishing images of private areas without consent)

Correct Answer: (D) | **Explanation:** For **Section 66E** (IT Act Section), the verified Statutory Title & Legal Provision is **Violation of Physical Privacy (capturing/publishing images of private areas without consent)**. Furthermore, Imprisonment up to 3 years, or fine up to Rs 2 Lakh, or both. (Source: Ministry of Electronics & IT (MeitY) & IUC Academy).

Rapid-Fire Last-Minute One-Liner Revision Capsule

1. First-generation computers (1940–56: ENIAC, EDVAC, UNIVAC-I) used **Vacuum Tubes** and magnetic drums.
2. Second-generation computers (1956–63: IBM 1401) used **Transistors** (invented at Bell Labs in 1947) and magnetic core memory.
3. Third-generation computers (1964–71: IBM 360) used **Integrated Circuits (ICs)** invented by Jack Kilby and Robert Noyce.
4. Fourth-generation computers (1971–Present) use **VLSI Microprocessors** starting with the **Intel 4004** (1971).
5. Fifth-generation computers use **ULSI, parallel processing, and Artificial Intelligence**.
6. India's first supercomputer **PARAM 8000** was developed by **C-DAC Pune** in **1991** under **Dr. Vijay Bhatkar**.
7. **Program Counter (PC)** holds the address of the **next instruction**; **Instruction Register (IR)** holds the **current instruction**.
8. **Address Bus** is strictly **unidirectional**, whereas **Data Bus** is **bidirectional** and defines CPU word size.
9. **SRAM** (Static RAM) uses flip-flop transistors, needs **no refreshing**, and forms **CPU Cache (L1/L2/L3)**.
10. **DRAM** (Dynamic RAM) uses capacitors, requires **periodic refreshing**, and forms **Main System RAM**.
11. **EEPROM** and **Flash Memory** are electrically erasable non-volatile ROM technologies used in **BIOS/UEFI** and **SSDs**.

12. `1 Nibble = 4 Bits`, `1 Byte = 8 Bits`, `1 TB = 2^40 Bytes`, `1 PB = 2^50 Bytes`, `1 EB = 2^60 Bytes`, `1 ZB = 2^70 Bytes`, `1 YB = 2^80 Bytes`.

13. **2's Complement** of a binary number equals `1's Complement + 1` and is used by CPUs for signed subtraction.

14. Standard **ASCII** uses **7 bits** (`128` characters: `'0'=48`, `'A'=65`, `'a'=97`); **EBCDIC** uses **8 bits** (`256` characters).

15. **NAND** and **NOR** are **Universal Logic Gates**; **XOR** outputs `1` when inputs are different; **XNOR** outputs `1` when inputs are identical.

16. The four **Coffman Deadlock Conditions** are **Mutual Exclusion, Hold and Wait, No Preemption, and Circular Wait**.

17. **Banker's Algorithm** is used for **Deadlock Avoidance**; **Belady's Anomaly** occurs in the **FIFO** page-replacement algorithm.

18. Excessive swapping of pages between RAM and disk that collapses CPU throughput is called **Thrashing**.

19. **MS Word** zoom ranges from **10% to 500%**; **MS Excel** and **MS PowerPoint** zoom range from **10% to 400%**.

20. MS Word default font size drop-down ranges from **8 pt to 72 pt** (manual entry supports **1 pt to 1638 pt**).

21. **Gutter Margin** in MS Word adds extra binding space to the **Left** or **Top** margin.

22. In MS Word, `Ctrl + =` applies **Subscript**, `Ctrl + Shift + +` applies **Superscript**, and `Shift + F3` toggles **Change Case**.

23. In MS Word, `F7` runs **Spell Check**, `Shift + F7` opens the **Thesaurus**, `Ctrl + K` inserts a **Hyperlink**, and `Ctrl + H` opens **Find & Replace**.

24. An MS Excel 365 worksheet contains **1,048,576 Rows** (`2^20`) and **16,384 Columns** (`2^14`, ending at column `XFD`).

25. In MS Excel, `F2` edits the active cell, `F4` toggles **Absolute/Relative** `$` **referencing**, and `Alt + Enter` adds a new line inside the same cell.

26. In MS Excel, `Ctrl + ;` inserts the **Current Date** and `Ctrl + Shift + :` inserts the **Current Time**.

27. In MS Excel, `Shift + Spacebar` selects the entire **Row**, and `Ctrl + Spacebar` selects the entire **Column**.

28. Excel `=COUNT()` counts only numeric cells, `=COUNTA()` counts all non-blank cells, and `=COUNTBLANK()` counts empty cells.

29. Excel `#####` error means column width is too narrow; `#NAME?` means unrecognized function/name; `#REF!` means deleted cell reference.

30. In MS PowerPoint, `Ctrl + M` inserts a **New Slide**, `F5` starts Slide Show from the beginning, and `Shift + F5` starts from the current slide.

31. A **Full Mesh Topology** with `n` nodes requires `n(n - 1) / 2` physical cables and `(n - 1)` I/O ports per node.

32. OSI **Layer 1 (Physical)** transmits **Bits** using **Hubs and Repeaters**.

33. OSI **Layer 2 (Data Link)** transmits **Frames** using **Switches, Bridges, and 48-bit MAC addresses**.

34. OSI **Layer 3 (Network)** routes **Packets** using **Routers** and **IP/ICMP/ARP** protocols.

35. OSI **Layer 4 (Transport)** manages end-to-end **Segments/Datagrams** using **TCP** (connection-oriented, reliable) and **UDP** (connectionless, fast).

36. OSI **Layer 6 (Presentation)** handles **SSL/TLS Encryption, Compression, and Data Formatting**.

37. **MAC Address** is **48-bit Hexadecimal** (`6 bytes`), **IPv4** is **32-bit Decimal** (`4 bytes`), and **IPv6** is **128-bit Hexadecimal** (`16 bytes`).

38. IPv4 Class first-octet ranges: **Class A (`1–126`)**, **Class B (`128–191`)**, **Class C (`192–223`)**, **Class D (`224–239`, Multicast)**, **Class E (`240–255`, Research)**.

39. IPv4 address `127.0.0.1` is reserved for **Localhost Loopback diagnostic testing**.

40. Key Ports: **FTP (`20/21`)**, **SSH (`22`)**, **Telnet (`23`)**, **SMTP (`25`)**, **DNS (`53`)**, **DHCP (`67/68`)**, **HTTP (`80`)**, **POP3 (`110`)**, **IMAP (`143`)**, **HTTPS (`443`)**.

41. **ARP** resolves **IP Address to MAC Address**; **DNS** resolves **Domain Name to IP Address**.

42. In RDBMS, **Degree** is the number of **Columns (Attributes)** and **Cardinality** is the number of **Rows (Tuples)**.

43. **Primary Key** enforces **Entity Integrity** (Unique + Not NULL); **Foreign Key** enforces **Referential Integrity**.

44. **1NF** requires atomic values; **2NF** eliminates **Partial Dependency**; **3NF** eliminates **Transitive Dependency**; **BCNF** requires every determinant to be a **Super Key**.

45. SQL **DDL** commands (`CREATE, ALTER, DROP, TRUNCATE`) define schema; **DML** commands (`INSERT, UPDATE, DELETE`) manipulate rows; **DCL** (`GRANT, REVOKE`) controls permissions.

46. Database transactions obey **ACID** properties: **Atomicity, Consistency, Isolation, and Durability**.

47. A **Computer Virus** needs a host file to replicate; a **Worm** self-replicates across networks without a host file; a **Trojan Horse** does not self-replicate.

48. **Ransomware** (*WannaCry*, *LockBit*) encrypts victim files for extortion; a **Rootkit** hides privileged kernel-level access; a **Keylogger** records keystrokes.

49. **Symmetric Encryption** (**AES, DES**) uses **1 shared key**; **Asymmetric Encryption** (**RSA, ECC**) uses a **Public Key + Private Key pair**; **SHA-256** is a keyless one-way **Hash function**.

50. A **Digital Signature** is signed using the **Sender's Private Key** and verified using the **Sender's Public Key** to guarantee **Non-Repudiation**.

51. The **Information Technology Act, *2000*** came into force on **17 October *2000***; the ***2008* Amendment** came into force on **27 October *2009***.

52. **Section 65** of the IT Act penalizes tampering with computer source documents; **Section 66** penalizes hacking/computer-related offences.

53. **Section 66A** was struck down as unconstitutional by the Supreme Court in ***Shreya Singhal v. Union of India* (2015)**.

54. **Section 66C** punishes **Identity Theft**; **Section 66D** punishes **Cheating by Personation**; **Section 66E** punishes **Privacy Violation**; **Section 66F** punishes **Cyber Terrorism** (up to **Life Imprisonment**).

55. **Section 67B** of the IT Act punishes publishing or transmitting Child Sexual Abuse Material (CSAM).

56. **Section 70A** designates **NCIIPC**; **Section 70B** designates **CERT-In**; **Section 78** empowers a **Police Inspector** (and above) to investigate cybercrimes; **Section 79** grants conditional **Intermediary Safe Harbor**.

57. Under the **DPDP Act, 2023**, the **Data Protection Board of India** can impose penalties up to **Rs 250 Crore** for failure to maintain security safeguards against data breaches.

58. **Section 63 of the Bharatiya Sakshya Adhiniyam (BSA), 2023** governs the admissibility of electronic evidence (replacing old Section 65B).

59. **John McCarthy** coined the term **Artificial Intelligence (1956)**; **LLMs** use the **Transformer Architecture** with **Self-Attention**.

60. Cloud Service Models: **IaaS** provides virtual hardware/servers, **PaaS** provides developer runtime platforms, and **SaaS** provides ready-to-use applications, as documented on **IUC Academy** and **MeitY**.

IUC Academy *1-3-7-21* Day Spaced-Revision & Self-Assessment Tracker (www.iucacademy.com)

Chapter / Study Section	Day 1 (First Read)	Day 3 (Active Recall)	Day 7 (MCQ Drill)	Day 21 (Exam Ready)
1. Chapter 1: Computer Architecture, Hardware Generations, CPU & Memory Hierarchy	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
2. Chapter 2: Number Systems, Logic Gates, Operating Systems & Process Scheduling	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
3. Chapter 3: Microsoft Office 365 & Productivity Suite (MS Word, MS Excel & MS PowerPoint)	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
4. Chapter 4: Computer Networks, Topologies, OSI 7-Layer Model & TCP/IP Protocols	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
5. Chapter 5: Database Management Systems (DBMS), Relational Algebra, Normalization & SQL	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
6. Chapter 6: Cyber Security, Malware Taxonomy, Cryptography & Network Defense	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
7. Chapter 7: Information Technology Act 2000 (Amended 2008), DPDP Act 2023 & Digital India	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
8. Chapter 8: Emerging Technologies — Artificial Intelligence (AI), Cloud Computing, IoT & Blockchain	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
9. Solved Exam Practice Questions (MCQs)	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
10. Extended Comparative & Analytical Practice Set (Questions 36–75)	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**
11. Rapid-Fire Last-Minute One-Liner Revision Capsule	☐ Completed (100% Concept Clarity)	☐ Flowchart & Tables Revised	☐ 75+ MCQs Solved (>85% Accuracy)	☐ **Final Rapid Recall Ready**