GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Computer Engineering/ Information Technology				
Semester	IV		Version	1.0.0.0	
Effective from Academic Year		2026-27	Effective for the batch Admitted in		JULY 2025
Course Code	1CEIT4104	Course Name	Computer Hardware and Troubleshooting		

I. TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course code	Course Title	Teaching & Learning Scheme									Examination Scheme							
			Credit				Actual Contact Hrs/week			SLH	Total Learning Hrs/Week	TH			PR			SLA	Total
			CL	TL	LL	Total	CL	TL	LL			CE	SEE	Total	CE	SEE	Total		
DSC	1CEIT4104	Computer Hardware and Troubleshooting	4	-	1	5	4	-	2	2	8	40	60	100	30	20	50	20	170

Abbreviation:	**CL-** Classroom Learning	**TL**- Tutorial Learning	**LL**-Laboratory Learning
	SLH-Self Learning Hours	**SLA -** Self Learning Assessment	**CE -** Continuous Evaluation
	SEE – Semester End Examination		

II. PRE-REQUISITES

Foundational knowledge of basic computer systems, fundamentals of analogue and digital electronics, introductory operating system concepts, and basic microprocessor architecture is desirable.

III. INDUSTRY /EMPLOYER EXPECTED OUTCOMES

- Perform installation, configuration, and maintenance of computer hardware, operating systems, and peripherals following standard industry practices and safety norms.
- Diagnose and resolve common hardware, firmware, and peripheral issues using systematic troubleshooting methods and appropriate diagnostic tools.
- Evaluate and select suitable computing components, storage solutions, I/O devices, and power systems based on performance, reliability, and application requirements.
- Apply preventive maintenance and quality practices to enhance system uptime, efficiency, and lifecycle management.
- Demonstrate professional, ethical, and sustainable practices by ensuring secure user data handling and compliance with Indian E-Waste Management Rules and relevant provisions of the IT Act, in alignment with workplace expectations.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1: Analyse the architecture and functions of core hardware components, including multi-core CPUs, motherboards, and UEFI firmware, to understand how they work together during the system startup and data flow process.

CO2: Evaluate various memory hierarchies and high-speed storage technologies, such as NVMe SSDs and multi-channel RAM, to optimize system performance and design efficient disk partitioning layouts.

CO3: Examine input devices and human-computer interaction technologies, including biometric and QR scanners, to select appropriate hardware based on usability, precision, and security requirements.

CO4: Compare modern display technologies, GPU architectures, and printing systems based on performance parameters like DPI and PPM to support high-quality visual and physical output.

CO5: Determine power requirements for computer systems by analysing SMPS specifications, laptop power delivery standards, and UPS capacity calculations to ensure safe and stable electrical operation.

CO6: Apply systematic troubleshooting methods and diagnostic tools to repair hardware faults while following Indian E-Waste Management Rules and IT Act provisions for ethical and legal data handling.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's)&CO's	Marks	Hours
Unit-1 **Introduction to Computer System and Core Hardware Components**	**TLO 1.1** Define a computer system and differentiate between hardware, software, and firmware to classify various computer types and their internal parts. **TLO 1.2** Explain the functions of a motherboard and its components while analysing different form factors and data flow using a block diagram. **TLO 1.3** Compare BIOS and UEFI firmware architectures and their roles in system security and startup, including the use of Secure Boot and NVRAM. **TLO 1.4** Analyze modern CPU architectures, including multi-core designs (P-cores and E-cores) and NPUs, while identifying suitable socket types and cooling methods for performance. **TLO 1.5** Evaluate the role of chipsets and Platform Controller Hubs (PCH) in system logic, and explain the architecture of System on Chip (SoC) for modern mobile applications. **TLO 1.6** Describe modern bus standards and expansion interfaces, such as PCIe generations and USB standards, to determine their impact on data transfer and hardware upgrades.	**1.1** Computer - Definition, Hardware, Software and Firmware, Classification, Internal Parts. **1.2** Motherboard - Functions, Form Factors, Components, Block Diagram **1.3** System Firmware - BIOS and UEFI, BIOS - Functions, Limitations, UEFI - Architecture, Advantages, Secure Boot, NVRAM, Motherboard Battery **1.4** Central Processing Unit (CPU) - Modern CPU Architecture, Multi-Core Processors, Performance Cores, Efficiency Cores, Neural Processing Unit (NPU) and TOPS, Socket Types, Cooling Methods **1.5** Chipsets and System on Chip (SoC) - Chipset Functions, Platform Controller Hub (PCH), System on Chip (SoC) - Architecture, Applications **1.6** Modern Bus and Expansion Standards - Bus Architecture PCIe, PCIe Generations, Expansion Cards, External Interface Standards (USB)	**12**	**11**
Unit–2: **Computer Memory and Storage Technologies**	**TLO 2.1** Analyse the computer memory hierarchy and evaluate how different RAM types and multi-channel memory configurations enhance overall system bandwidth and speed. **TLO 2.2** Explain the architecture of cache memory levels (L1, L2, L3) and describe their specific roles in improving CPU performance by reducing data access latency. **TLO 2.3** Categorize various types of ROM and Flash memory to explain their use in storing system firmware and providing reliable, non-volatile data	**2.1** Memory Hierarchy - RAM, Types of RAMs, Memory Modules, Dual Channel and Multi-Channel Memory **2.2** Cache Memory - Levels, Role of Cache in System Performance **2.3** ROM - Types, Flash Memory, Firmware Storage **2.4** Hard Disk Drive- Physical Structure, Logical Structure, Disk Performance Parameters **2.5** Solid State Drive - Structure, Types, M.2 Form Factor, Performance Characteristics	**12**	**12**

	storage. **TLO 2.4** Examine the physical and logical structure of Hard Disk Drives (HDD) and calculate performance parameters such as seek time and rotational latency to assess drive efficiency. **TLO 2.5** Describe the internal structure and types of Solid-State Drives (SSD), specifically comparing the M.2 form factor and performance characteristics against traditional storage. **TLO 2.6** Distinguish between storage interfaces and protocols, such as SATA and NVMe, to select the most efficient connection for modern high-speed data transfer needs. **TLO 2.7** Compare MBR and GPT partitioning schemes and design a storage layout that utilizes the EFI System Partition (ESP) for modern UEFI-based booting.	**2.6** Storage Interfaces and Protocols, SATA, NVMe, USB Storage **2.7** Disk Partitioning and Storage layout - MBR and Limitations, GPT, Partition Types, EFI System Partition (ESP)		
Unit–3: **Input Devices and Human–Computer Interaction**	**TLO 3.1** Classify various input devices and explain their fundamental role in the data entry process and human-computer interaction. **TLO 3.2** Compare keyboard types, connection interfaces, and switch mechanisms to select the most appropriate hardware for durability and user comfort. **TLO 3.3** Describe the technology and interfaces of mouse and trackpads to ensure precise navigation. **TLO 3.4** Explain the working principles of different scanner types and evaluate image quality parameters like DPI to produce high-standard digital images. **TLO 3.5** Analyse the application of modern input technologies, including biometrics and QR scanners, to enhance system security and operational efficiency in real-world scenarios.	**3.1** Basics of Input Devices **3.2** Keyboard - Types (Wired, Wireless), Switch Mechanism, Interfaces **3.3** Mouse - Types, Interfaces, Trackpads **3.4** Scanner - Types, Working Principle, Image Quality Parameters. **3.5** Modern Input Devices - Touch Screen, Biometric, Barcode and QR Code Scanners, Webcam	**12**	**8**

Unit–4: **Output Devices and Display Technologies**	**TLO 4.1** Classify various output devices and explain their role in converting processed digital data into human-perceivable visual or physical formats. **TLO 4.2** Illustrate display parameters and compare monitor technologies like LCD, LED, IPS, and OLED to evaluate visual quality and suitability for specific tasks. **TLO 4.3** Analyse GPU components and cooling systems while differentiating between integrated and dedicated graphics to support high-performance rendering and processing needs. **TLO 4.4** Categorize printers into impact and non-impact types and describe the working principles of modern Inkjet, Laser, Thermal, and All-in-One printers. **TLO 4.5** Evaluate printer performance using parameters like DPI and PPM and configure connectivity options such as USB, Network, and Wireless for efficient hardware setup.	**4.1** Output Devices **4.2** Display Devices (Monitors) Display Parameters, Types of Monitors - LCD, LED, IPS, OLED **4.3** Graphics Processing Unit - Components, Cooling System, Integrated Graphics vs Dedicated Graphics, Interfaces. **4.4** Printers - Classification (Impact Printers, Non-Impact Printers), Types of Modern Printers - Inkjet Printer, Laser Printer, Thermal Printer, All-in-One **4.5** Printer Performance Parameters - Print Resolution (DPI), Print Speed (PPM), Connectivity (USB, Network, Wireless)	**8**	**9**
Unit–5: **Power Supply and Power Management Systems**	**TLO 5.1** Define the role of the power supply unit in a computer and explain how it converts and regulates electricity for internal components. **TLO 5.2** Explain the working principle of a Switched Mode Power Supply (SMPS) and analyze its block diagram to understand its efficiency advantages over linear supplies. **TLO 5.3** Evaluate SMPS specifications, including 80 PLUS certifications and voltage rails, to ensure compatibility and system protection against electrical faults. **TLO 5.4** Analyze SMPS control signals like PS_ON# and PWR_OK to troubleshoot power-up sequences and standby power issues in a system. TLO 5.5: Identify and differentiate between various SMPS output connectors,	**5.1** Power Supply - Concept, Role **5.2** Switched Mode Power Supply (SMPS) -Working Principle, Block Diagram, Advantages. **5.3** SMPS Specifications, Standards, Power Rating (Wattage), Efficiency and 80 PLUS Certification, Voltage Rails (+12 V, +5 V, +3.3 V), Protection Features (Over Voltage Protection, Over Current Protection, Short Circuit Protection) **5.4** SMPS Signals and Control Lines **5.5** SMPS Output Connectors **5.6** Laptop Power System - Power Architecture, AC Adapter, USB-C Power Delivery (PD) 3.1, Battery Types **5.7** Uninterruptible Power Supply - Types, Capacity and	**8**	**8**

	including ATX, PCIe, and SATA, to ensure correct and safe hardware assembly. TLO 5.6: Describe laptop power architecture and the benefits of USB-C Power Delivery (PD) for standardized high-wattage charging across mobile devices. TLO 5.7: Compare different types of Uninterruptible Power Supplies (UPS) and calculate the required capacity to provide adequate backup time for specific computer setups.	Backup Time		
Unit-6: **Trouble shooting and Repairing of Computer**	**TLO 6.1** Compare preventive, predictive, and breakdown maintenance strategies to maximize system uptime and hardware longevity. **TLO 6.2** Classify computer faults into hardware, software, or firmware categories to determine the most effective repair approach. **TLO 6.3** Analyse the root causes of common system failures, such as thermal throttling and power instability, to prevent recurring hardware issues. **TLO 6.4** Perform a systematic diagnostic check, ranging from visual inspections to technician-level technical checks, to identify system malfunctions. **TLO 6.5** Utilize modern software diagnostic tools and SSD health monitoring utilities to evaluate real-time system stability and performance. **TLO 6.6** Demonstrate the correct use of hardware testing instruments, such as multimeters and POST cards, to debug electrical and motherboard errors. **TLO 6.7** Interpret the BIOS/UEFI boot sequence and POST error codes to isolate failures occurring during the pre-boot phase. **TLO 6.8** Apply logical troubleshooting techniques to resolve hardware conflicts and failures in motherboards, storage devices, and peripherals.	**6.1** Computer Maintenance Strategies - Preventive, Predictive, and Breakdown Maintenance **6.2** Classification of Computer Faults - Hardware, Software, Firmware **6.3** Nature of System Failures - Power Instability, Boot Failures, Thermal Throttling, and Storage Issues **6.4** Diagnostic Procedures - First-Level (Layman) Inspections and Technician-Level Technical Checks **6.5** Diagnostic and Monitoring Utilities - OS Tools, Firmware Diagnostics, and SSD Health (S.M.A.R.T.) Monitoring **6.6** Hardware Testing Instruments - Digital Multimeter, Power Supply Tester, and POST Diagnostic Cards **6.7** System Boot Analysis - BIOS/UEFI Boot Sequence, POST and POST Routines, and Error Code Interpretation **6.8** Advanced Troubleshooting Techniques - Systematic Repair of Motherboard, Storage, and Peripheral Devices **6.9** E-Waste Management and End-of-Life Handling – Concept of e-waste, safe disposal practices, user data treatment, Extended Producer Responsibility (EPR), Indian E-Waste Management Rules, and	**8**	**6**

	TLO 6.9 Explain and apply e-waste management and end-of-life practices, including safe disposal, secure user data treatment, EPR, and compliance with Indian E-Waste Management Rules and the IT Act.	relevant provisions of the IT Act.		

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL			
SR. NO	**PRACTICAL/LABORATORY LEARNING OUTCOME(LLO)**	**PRACTICAL TITLES**	**RELEVANT COs**
1	**LLO 1.1:** Identify internal components of a desktop computer system.	Identify and explain internal components of a desktop computer including motherboard, CPU, RAM, storage devices, and SMPS.	CO1
2	**LLO 1.2:** Perform safe disassembly and reassembly of a computer system and verify its operation.	Disassemble and reassemble a desktop computer system using standard safety procedures and verify proper system operation.	CO1
3	**LLO 2.1:** Examine and classify motherboard form factors and interfaces.	Examine and classify motherboard form factors and identify CPU socket, RAM slots, expansion slots, power connectors, and I/O ports.	CO2
4	**LLO 2.2:** Identify, compare, and configure primary memory modules.	Identify, compare, and configure RAM types and memory modules and demonstrate single-channel and dual-channel memory operation.	CO2
5	**LLO 2.3:** Analyze secondary storage devices based on structure and performance.	Study, compare, and analyze HDD and SSD based on physical structure, specifications, performance parameters, and storage capacity.	CO2
6	**LLO 3.1:** Apply disk management techniques in an operating system environment.	Create, delete, and format disk partitions using MBR and GPT partition schemes through operating system disk management tools.	CO3
7	**LLO 3.2:** Install and configure operating systems and device drivers.	Install and configure an operating system and install drivers for motherboard and peripheral devices.	CO3
8	**LLO 4.1:** Connect, test, and evaluate common input devices.	Study, connect, and test input devices such as keyboard, mouse, scanner, and webcam.	CO3
9	**LLO 4.2:** Compare input device technologies based on usability and performance.	Compare keyboard and mouse technologies based on usability and performance parameters.	CO3

10	**LLO 4.3:** Configure and verify display device parameters.	Configure and verify display devices including resolution, refresh rate, aspect ratio, and colour depth.	CO4
11	**LLO 4.4:** Install, configure, and test output devices.	Install, configure, and operate inkjet, laser, and multifunction printers and perform basic printing and troubleshooting tasks.	CO4
12	**LLO 5.1:** Identify and analyse SMPS operation and power connectors.	Study and identify SMPS operation, power ratings, and connectors including ATX, CPU, SATA, PCIe, and Molex.	CO5
13	**LLO 5.2:** Analyse UPS systems and calculate backup time.	Analyse UPS systems, classify UPS types, and calculate backup time based on connected load and battery capacity.	CO5
14	**LLO 6.1:** Use diagnostic tools to identify and resolve hardware faults.	Use BIOS/UEFI and operating system diagnostic tools to identify, diagnose, and rectify common hardware faults related to booting, display, input devices, and storage.	CO6
15	**LLO 6.2:** Demonstrate preventive maintenance and sustainable end-of-life practices.	Perform preventive maintenance including safe hardware handling, component cleaning, cable inspection, and demonstrate e-waste management, secure user data treatment, and compliance with Indian E-Waste Management Rules, EPR, and the IT Act.	CO6

VII. SUGGESTED MICRO PROJECT/ASSIGNMENTS/ACTIVITIES FOR SELF LEARNING/SKILL DEVELOPMENT (SELF LEARNING)

Micro Projects (Mini Applications / Use Cases)

- Desktop Computer Assembly and Component Identification
  Skills: Hardware identification, system architecture understanding
- Memory and Storage Comparison Study (HDD vs SSD)
  Skills: Memory concepts, storage technologies, analytical comparison
- Disk Partitioning and File System Management
  Skills: Disk management, operating system tools, data organization
- Power Supply and UPS Selection for a Computer System
  Skills: Power calculation, SMPS understanding, backup planning
- Basic Computer Maintenance and Troubleshooting Case Study
  Skills: Fault identification, diagnostic thinking, troubleshooting techniques
- Input and Output Devices Selection Guide for Office Setup
  Skills: Device selection, interface knowledge, practical decision-making

Self-Learning / Skill Building Activities

1. Identify and document internal components of a desktop computer
   Goal: Understand motherboard, CPU, RAM, storage devices, and SMPS functions.
2. Prepare a comparison chart of motherboard form factors and CPU sockets
   Goal: Learn compatibility between motherboard, processor, and memory.
3. Perform disk partitioning and formatting using operating system tools
   Goal: Understand storage layout, MBR/GPT, and file system concepts.

4. Compare HDD, SSD, and NVMe storage devices
   Goal: Analyse performance, capacity, cost, and real-world applications.
5. Explore BIOS/UEFI setup and document hardware detection settings
   Goal: Understand boot process, firmware role, and system configuration.
6. Study and configure display settings on a computer system
   Goal: Learn resolution, refresh rate, aspect ratio, and color depth settings.
7. Prepare a report on types of printers and their applications
   Goal: Understand printer technologies and selection criteria.
8. Calculate power requirement of a computer system and select suitable SMPS and UPS
   Goal: Learn power rating, efficiency, and backup planning.
9. Perform basic preventive maintenance of a computer system
   Goal: Develop safe handling, cleaning, and maintenance skills.
10. Document common computer faults and troubleshooting steps
    Goal: Build logical thinking and systematic troubleshooting ability.

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD	
1	Desktop Computer System
2	Input and Output Devices (Keyboard, Mouse, Monitor, Printer)
3	Power Supply and Backup Devices
4	Basic maintenance and testing tools (hardware tool kit, diagnostic utilities)

IX. LIST OF REFERENCE BOOKS

Sr.No	Title	Author	Publication
1	*PC Hardware and Troubleshooting*	Scott Mueller	Pearson Education
2	*IBM PC and Clones*	Govind Rajalu	Tata McGraw-Hill Publishing
3	*Upgrading and Repairing PCs*	Scott Mueller,	Pearson Education

X. LINK OF LEARNING WEB RESOURCE	
1	https://www.netacad.com/courses/computer-hardware-basics
2	https://www.learnvern.com/course/computer-hardware
3	https://www.mygreatlearning.com/computer-hardware/free-courses
4	https://alison.com/course/introduction-to-computer-hardware-and-software
5	https://www.coursera.org/learn/core1-hardware-and-network-troubleshooting

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Introduction to Computer System and Core Hardware Components	CO1	11	3	3	4	10
2	Computer Memory and Storage Technologies	CO2	12	3	4	3	10
3	Input Devices and Human–Computer Interaction	CO3	9	3	3	2	8
4	Output Devices and Display Technologies	CO4	11	4	3	2	9
5	Power Supply and Power	CO5	8	2	3	5	10

	Management Systems						
6	Computer Maintenance and Troubleshooting	CO6	9	2	5	6	13
	Grand Total		**60**	**17**	**23**	**28**	**60**

XIII. COs AND POs AND PSOs MAPPING

Course Outcome (Cos)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	0	0	1	0	1	2	1
CO2	3	3	2	0	0	1	0	1	2	1
CO3	2	2	1	0	0	0	0	0	3	1
CO4	2	2	1	0	0	0	0	0	3	1
CO5	3	3	2	2	0	0	0	0	3	1
CO6	3	3	3	3	2	1	1	0	3	3

Legends: - *3-High; 2-Moderate/Medium; 1-Slight/Low; 0-None*