Gyanmanjari
Innovative University

Subject: Computer Hardware and Troubleshooting-DET1XX10103

Type of course:

Prerequisite: Basic programming fundamentals, logical and problem-solving skills, mathematical logic and a general understanding of computer components.

Rationale:

A solid foundation in programming, logic, and mathematical reasoning is essential for understanding the structure and function of computer systems, enabling effective diagnosis and resolution of hardware issues through systematic analysis and troubleshooting techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
0	0	4	2	50	50	100

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; MSE- Mid Semester Examination; LWA - Lab Work Assessment; V – Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.

Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Theory Topics** - Computers through Generations, Basic Computer Hardware Structure, Hardware and Software, Different types of Computers, Features of Computer Systems. Safety Information, Front Panel View, Rear Panel View, Internal Arrangements, Disassembling the Computer. **Practical:** • Identify and explain the components and connectors of an SMPS by observing internal power supply design. • Classify and compare different generations of computers	P:10	15%

- based on technology, processing speed, and size.
- Identify and describe basic computer hardware components such as CPU, RAM, motherboard, and storage devices.
- Distinguish between hardware and software by listing real-world examples and their functions.
- Explore and categorize different types of computers like desktops, laptops, tablets, and servers through observation.
- List and describe key features of modern computers including processor type, memory capacity, and connectivity.
- Identify front panel ports such as USB, audio jack, and power button through physical inspection of the cabinet.
- Identify rear panel ports and connectors including HDMI, VGA, Ethernet, and power input.
- Observe and explain internal arrangement and cabling inside a computer cabinet, including SATA and power cables.
- Disassemble and reassemble a computer system by removing and reinstalling components correctly.
- List and follow essential safety measures and best practices to be maintained in a computer lab environment.

Examination Style:

Sr. No.	Evolution Methods	SEE	CCE
1	Disassembling the Computer and Identifying Components.	05	05
2	Front & Rear Panel View, Features, and Ports.	00	05

• **Debugging Task (10 Marks)**:
1. Disassemble the system unit (CPU cabinet) carefully and identify any five internal components. For each component: Write the name, Function, and Generation of computer in which it first appeared prominently (if applicable).
2. Each debugging question carries 05 marks to help the examiner assess code quality and correctness.
   - **05 Marks:** component identification with explanation.
   - **05 Marks:** correct disassembling procedure.
   - **00 Marks:** if failed do above both.

• **Front & Rear Panel View, Features, and Ports (10 Marks)**:
1. Observe the front and rear panel of the CPU. Sketch both views and label at least 5 ports/features (e.g., USB, HDMI, power switch, audio jack).
2. Each question carries 05 marks for evaluating code optimization.

	• **05 Marks:** sketching and labelling. • **05 Marks:** functionality explanation and classification. • **00 Marks:** if failed do above both.		
2	**Theory Topics**: Features of Motherboards, Components of Motherboard, Processor Support, Motherboard Controller, Memory Support, Graphics Support, BIOS, IDE and SATA Connectors, Power Supply Connectors, External Devices Interfaces, Buses and Expansion Slots, Front Panel Headers, I/O Addresses and Interrupts, Selection of Motherboards, Using Modem Cards, External Interfaces and Connectors, Troubleshooting and Maintenance of Motherboards, Motherboard: Common Problems and Solutions. **Practical:** • Identify various motherboard features such as chipset, slots, ports, and explain different motherboard form factors like ATX, Micro-ATX, and Mini-ITX. • Demonstrate the installation of a processor on a motherboard and verify socket compatibility for different CPU models. • Check memory support on a motherboard and configure dual channel RAM installation for optimized performance. • Identify available graphics support options and expansion slots (PCI, PCIe) on a motherboard and explain their uses. • Verify processor support with BIOS/UEFI version and update BIOS if required to ensure compatibility. • Check RAM compatibility (type, speed, voltage) and configure memory settings in BIOS for stable operation. • Identify and explain the use of various graphics interfaces and available expansion slots for additional hardware. • Locate IDE, SATA data, and power connectors on the motherboard and explain their purpose in storage configuration. • Identify front-panel headers (power, reset, LEDs) and understand I/O address assignments for peripheral control. • Install modem and external interface cards on expansion slots and verify detection in Device Manager or BIOS. • Trace bus lines and signals on the motherboard layout to understand data flow and device communication. • Perform basic troubleshooting on motherboard-related issues and conduct routine maintenance checks. • Select an appropriate motherboard based on a given PC build requirement considering CPU, RAM, GPU, and connectivity needs.	P:14	25%

Examination Style:

Sr. No.	Evolution Methods	SEE	CCE
1	Identity and Label Components: Students will be given a motherboard	05	10
2	Perform a Practical: Connect SATA cable to HDD and motherboard, Reset BIOS using CMOS jumper	05	05

• **Identity and Label Components: Students will be given a motherboard (15 Marks):**

1. The examiner will provide each student (or pair) with a real, unpowered desktop motherboard placed on a static-safe surface. Students are given 10–15 minutes to identify and label the following 8 components directly on the board using stickers, flags, or by noting component numbers on the answer sheet provided.
2. Each question carries 10 marks to help the examiner assess quality and correctness.
   - **10 Marks:** All 8 components correctly identified and labeled. Clear understanding shown. No mistakes.
   - **05 Marks:** 4–6 components correctly labeled. Minor confusion or missing items. Some labels may be inaccurate or misplaced
   - **00 Marks:** Fewer than 4 correct labels, or major mislabeling (e.g., confusing power connector with PCI slot). Indicates lack of understanding.

• **Perform a Practical (10 Marks)**

1. **Connect SATA Cable to HDD and Motherboard:** To connect a SATA cable, first power off and unplug the PC. Open the cabinet, connect one end of the SATA data cable to the motherboard and the other to the HDD. Then, connect the SATA power cable from the PSU to the HDD. Secure the HDD in the drive bay, close the cabinet, and power on the system to check HDD detection in BIOS.
2. **Reset BIOS using CMOS Jumper:**
   1. Properly connect a SATA hard drive to the motherboard and power supply. Perform a BIOS reset using the CMOS jumper method.
   2. The question is evaluated based on accuracy and correctness.
      - **10 Marks:** Connect SATA Cable.

	• **10 Marks:** Reset BIOS using CMOS Jumper. • **00 Marks:** No task completed successfully.			
3	**Theory Topics:** Prccessor Feature, Developmental Staged of CPU, Multiple Core Processors, Processor Architectural Details, Processor Specifications, Installing and Uninstalling CPU, CPU Overheating Issues, Processor: Common Problems and Solutions, Graphics Processing Units. **Practical:** • Explore the evolution of processor features by comparing historical and modern CPUs in terms of speed, architecture, and instruction sets. • Demonstrate staged CPU development through hands-on observation of early, mid, and modern processors to understand generational improvements. • Work with multi-core processors to understand core counts, threading, and performance benefits in real-world applications. • Dissect processor microarchitecture by identifying key components such as ALU, control unit, cache levels, and instruction pipeline stages. • Read and compare processor specifications like clock speed, cache size, thermal design power (TDP), and socket type using official datasheets. • Perform installation and uninstallation of a CPU onto a motherboard, ensuring proper alignment, socket handling, and thermal paste application. • Diagnose CPU overheating issues by monitoring temperature using software tools and inspecting cooling system setup. • Identify and troubleshoot common CPU problems such as no POST, overheating, or system freezes, and suggest appropriate solutions. • Introduce the concept of GPUs and parallel processing by comparing CPU vs GPU roles in computation and visualization. • Install a GPU into a system, configure drivers, and verify successful setup using device manager or GPU diagnostic software. **Examination Style:**	P:10	15%	

Sr. No.	Evolution Methods	SEE	CCE
1	CPU Installation & Overheating Diagnosis	00	10

2	GPU Installation & Basic Compute Test	05	00		

• CPU Installation & Overheating Diagnosis (15 Marks):

1. This section consists of three tasks, each carrying 05 marks, focusing on CPU installation, overheating diagnosis, and GPU installation with basic compute test.

    1. In the first task, students are expected to demonstrate the correct procedure for installing a CPU, including aligning the processor, securing it in the socket.

    2. The second task assesses students' ability to identify and diagnose common causes of CPU overheating by interpreting symptoms such as thermal throttling, sudden shutdowns, and abnormal temperature readings, along with recommending appropriate solutions.

    3. The third task involves installing a GPU into the PCIe slot, connecting necessary power cables, installing drivers, and performing a basic compute or display test to verify successful installation. These tasks are designed by the faculty to evaluate practical knowledge in system assembly, hardware troubleshooting, and performance verification.

2. Each question carries 05 marks for evaluating code optimization and efficiency.

    • **10 Marks:** Correct slot population; no bent pins; MemTest86 runs without errors or correctly isolates bad DIMM.

    • **05 Marks:** Minor slot choice error (e.g., wrong color slot) but works; MemTest86 detects errors, but isolation unclear.

    • **00 Marks:** No modules execute.

4	Theory Topics: Features of Computer Memory, Types of Computer Memory, Working of Computer Memory, Memory Map, Installing and Uninstalling Memory Modules, Maintenance and Troubleshooting, Memory: Common Problems and Solutions, Hard Disks Details, Installing Hard Disks, Hard Disk Specifications, Partitioning and Formatting Hard Disks, Maintenance and Troubleshooting Hard Disks, Hard Disk: Common Problems and Solutions, Optical Storage Devices Features, Disc Burning Software, Troubleshooting and Maintenance, Blu-ray Discs, External Storage Devices. **Practical:** • Install and test RAM modules to understand memory types, installation procedure, and system detection. • Create and analyze a memory map using BIOS or system tools	P:14	25%

to explore how memory is allocated.
• Install a hard disk drive (HDD) and configure BIOS settings to verify hardware recognition and boot priority.
• Partition and format a hard disk using Disk Management to prepare it for data storage or OS installation.
• Burn data to a CD/DVD using disc burning software and verify the content to understand optical storage usage and maintenance.

Examination Style:

Sr. No.	Evolution Methods	SEE	CCE
1	RAM Installation & Troubleshooting	00	10
2	Hard Disk Partitioning & Optical Burn.	10	00

RAM Installation & Troubleshooting (10 Marks):

1. Install/Remove RAM Modules Under ESD precautions, install two identical DIMMs into the correct slots for dual channel. Remove them safely and inspect for bent contacts. Identify any errors; isolate which module is faulty (if any) and document your findings.
2. Each question carries 05 marks.
- **10 Marks:** Correct slot population; no bent pins; MemTest86 runs without errors or correctly isolates bad DIMM.
- **05 Marks:** Minor slot choice error (e.g., wrong color slot) but works; MemTest86 detects errors, but isolation unclear.
- **00 Marks:** No modules execute.

Hard Disk Partitioning & Optical Burn. (10 Marks):

1. **Partition, Format HDD and Burn, Verify DVD.**

   1.1 Partition Hard Disk:
   Students will learn how to divide a hard disk into multiple sections (partitions) using Disk Management, allowing better file organization or multiple OS setups.

   1.2 Format Hard Disk:
   Students will format a selected partition to prepare it for storing data, understanding file systems like NTFS or FAT32 during the process.

   1.3 Burn Data to DVD and Verify:
   Students will use disc burning software to write files (like images or documents) to a blank DVD and verify the burn by checking if the data opens correctly on another

	computer. 2. Each question carries 05 marks. • **10 Marks:** Partitions created correctly; formatted and mounted; DVD burned error-free and checksum matches. • **05 Marks:** One minor issue (e.g., format error corrected after prompt; DVD burns but checksum mismatch). • **00 Marks:** Incorrect partitioning; formatting fails; DVD burn fails or unreadable.		
5	**Theory Topics:** Computer Power Supply Units, Features of SMPS, Maintenance and Troubleshooting, UPS: Common Problems and Solutions. Types and Features of Keyboards, Keyboards Interfaces, Keyboard: Common Problems and Solutions, Different Mouse Types, Mouse: Common Problems and Solutions. Safety Precautions, Configuring Using BIOS Parameters, Power on Self-Test, Devices and Drivers, Performance Improving Steps, Diagnosing General Problems, Computer System: Common Problems and Solutions, Flashing BIOS. **Practical:** • Demonstrate the internal components and connectors of an SMPS by identifying each part and explaining its function. • Measure and record PSU output voltages using a multimeter to ensure proper power delivery to the system. • Perform a UPS battery replacement and test the backup duration using connected load. • Access BIOS/UEFI settings to configure power management options such as sleep, wake, and AC recovery. • Simulate Power on Self-Test (POST) and interpret beep codes to diagnose hardware issues. • Perform a BIOS or UEFI firmware update (flashing) and verify successful installation. • Explain keyboard interfacing and demonstrate how different protocols like USB and PS/2 function. • Install a new keyboard and troubleshoot non-functioning keys or interface issues. • Compare various types of mice and test DPI settings using control panel or gaming software. • Install appropriate device drivers for input devices and perform basic performance tuning to ensure responsiveness. **Examination Style:**	P:12	20%

Sr. No.	Evolution Methods	SEE	CCE
1	PSU Testing & BIOS Firmware Update	00	10

| 2 | BIOS Configuration & POST Diagnostics | 10 | 00 | | |

• PSU Testing & BIOS Firmware Update (10):

1. In this task, students will first measure the voltage outputs of a Power Supply Unit (PSU) using a multimeter, identifying correct voltage levels on various connectors such as 24-pin ATX, 4/8-pin CPU, and SATA/Molex, carrying 05 marks. They will then perform a BIOS/UEFI firmware update (flashing) using the provided update file and instructions, ensuring proper upgrade procedures and system compatibility. These tasks are designed to assess students' practical understanding of power supply testing, voltage verification, and firmware upgrade processes, guided and evaluated by the faculty.

2. Each debugging question carries 05 marks to help the examiner assess code quality and correctness.
   - **10 Marks:** Both devices correctly installed; driver reinstall without errors; stuck key scan codes shown; DPI change demonstrated.
   - **05 Marks:** One minor issue (e.g., BIOS didn't list PS/2 but OS recognized); driver update with prompt; DPI change explained but not measured.
   - **00 Marks:** Incorrect or unsafe voltage measurement.

• BIOS Configuration & POST Diagnostics (10 Marks):

1. In this task, students will access and configure BIOS/UEFI settings, focusing on power management options, boot sequence, and hardware monitoring features, carrying 05 marks. They will also perform POST (Power-On Self-Test) diagnostics by observing system behavior during startup and interpreting beep codes or error messages to identify hardware issues. These tasks are designed to assess students' practical skills in system setup, BIOS navigation, and hardware fault diagnosis, under the guidance and evaluation of the faculty.

2. This question carries 10 marks for evaluating students.
   1. **10 Marks:** BIOS settings changed exactly as instructed; changes persisted on reboot; correct initial POST beep noted; memory error beep correctly identified and explained.
   2. **05 Marks:** One BIOS setting not saved or reverted (but understood concept); POST beep noted but memory error beep mis matched or partially described.
   3. **00 Marks:** BIOS settings not changed, or system wouldn't boot.

Suggested Specification table with Marks (Theory): 100

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	NA	NA	NA	NA	NA	NA

Course Outcome:

After learning the course the students should be able to:	
CO1	Identify and explain the basic structure and components of computer hardware.
CO2	Understand processor, memory, graphics, and BIOS support provided by modern motherboards.
CO3	Interpret processor specifications and identify suitable processors for specific needs.
CO4	Describe the features of optical and external storage devices and use disc burning software effectively.
CO5	Apply safety precautions while working with computer hardware components and peripherals.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of Active Learning Assignment.

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance, by K. L. James, PHI Learning.

[2] Introduction to PC Hardware and Troubleshooting by Michael Meyers, Mike Meyers, McGraw-Hill/Osborne.

[3] Computer Hardware and Troubleshooting by PROF. SHILPA, Notion Press.

[4] Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance by K.L. James, PHI Learning.

[5] Troubleshooting, Maintaining and Repairing PCs (Hardware) by Stephen J Bigelow.