

Devi Ahilya University, Indore, India Institute of Engineering & Technology				II Year B.E. (Information Technology)			
Subject Code & Name	Instructions Hours per Week			Credits			
<b>3ITRG1</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>
<b>Computer Organization &amp; Architecture</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>
<b>Duration of Theory Paper: 3 Hours</b>							

**Learning Objectives:**

- Provide a framework for understanding the fundamentals of computing.
- To familiarize students with relationship between hardware and software to focus on the concepts that are the basis for current computers.
- Develop skills to understand how to design a computer.
- Develop ability to understand how to enhance performance of a computer system.

**Prerequisites:** Knowledge of Digital Electronics and Computer Programming.

## COURSE CONTENTS

### Unit-I

**Introduction:** Difference Between Computer Organization and Computer Architecture, Computer Types, Flynn's Classification, Functional Units, Basic Operational Concepts: Bus Structures, Software; Performance: Processor Clock, Basic Performance Equation, Clock Rate, Compiler, Performance Measurement; Multiprocessors and Multicomputers, Historical Perspective: Generation of computer, Evolution of Performance; Arithmetic for Computers: Addition and Subtraction of Signed Numbers, Multiplication of Positive Numbers, Booth Algorithm, Floating Point Arithmetic: Addition and Multiplication.

### Unit-II

**Memory System:** Basic Concepts, Semiconductor RAM Memories, Read-Only Memories: ROM, PROM, EPROM, EEPROM, Flash Memory; Memory Speed, Size and Cost Considerations; Cache Memories: Mapping Functions, Replacement Algorithms, Performance Considerations, Hit Rate and Miss Penalty, Caches on the Processor Chip; Virtual Memories: Address Translation; Memory Management Requirements.

### Unit-III

**Processing Unit:** Addressing Modes, Connections between the Processor and the Memory, Processor Activity, Instruction cycle, John Von Neumann Architecture, State Machine Concept, Processor as a State Machine, Data Path Architecture, Data Path Controller: Microprogrammed; Hardwired Design, Firmware Design, Microcontroller Design, Design of Flip-Flop to understand the Design of CPU.

#### **Unit-IV**

**Input Output Organization:** I/O Devices: Introduction, Typical Collection, Diversity; Dependability, Reliability, Availability, Disk Storage, Flash Storage, Connecting Processor Memory and I/O Devices, Connection Basics, Interfacing I/O Devices to the Processor Memory and Operating System: Giving Commands to I/O Devices, Communicating with the Processor, Interrupt Priority Levels, Transferring the Data between a Device and Memory, Direct Memory Access and the Memory System; I/O Performance Measures, Impact of I/O on System Performance.

#### **Unit-V**

**Pipelining & Multiprocessors:** Principles of Pipelining, Principles of Linear Pipelining, Clock Period, Speedup, Efficiency, Throughput, Classification of Pipeline Processor, General Pipelines and Reservation Tables, Collision Vector, State Diagram for a Pipeline, Pipeline Hazards, Shared Memory Multiprocessors, Clusters and Other Message-Passing Multiprocessors, Introduction to Graphics Processing Units, Introduction to Multiprocessor Network Topologies.

#### **Learning Outcomes:**

1. Upon completing the course, students will be able to:
2. Acquire advance knowledge and understanding of computing.
3. Use skills in computer design.
4. Apply acquired knowledge to improve performance of a computer.
5. In addition to development in technology student will be able to innovate in the architecture of computers, such as the use of caches and pipelining.
- 6.

#### **Books Recommended:**

1. Computer Organization, 5th Ed., C. Hamacher, Z. Vranesic, S. Zaky, McGraw Hill International Edition 2002.
2. Computer Organization and Design, 5th Ed. ,David A. Patterson, John L. Hennessy, The hardware/software interface, Morgan Kaufmann Publisher, 2014.
3. Patterson & Hennessy, Computer Organization and Design, Morgan Kaufmann Publisher, 2007.
4. Computer Architecture and Parallel Processing, Kai Hwang, Faye A. Briggs, McGraw Hill Education, 2012.

**List of Assignments (Theory):** During the learning of course, students need to do assignments:

1. Performance measurement of a Computer.
2. Arithmetic for Computers.
3. Cache Hit Rate/Miss Penalty issues.
4. Virtual Memory : Address Translation.
5. Use of Addressing Modes.
6. Study on designs of CPU.
7. Secondary storage performance.
8. Impact of I/O on system performance.
9. Pipelining performance.
10. Multi-core, GPU Processor and Multiprocessor : A Comparison.