

**ECE302**

**Computer Organization and Architecture**

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**Version No.:** 1.20

**Prerequisite:** ECE103 Digital Logic Design

**Objectives:**

- To demonstrate the application of discrete mathematics, Boolean algebra, and simple digital design to the field of computers and computer architecture.
- To describe the functioning of the control unit and look at the different implementations of the control unit (hardwired and microprogrammed)
- Recognize and analyze the basics of hierarchical memory and virtual memory.
- To describe I/O system and its interconnection with CPU and memory.
- To expose the learners the different architectural and organizational design issues that can affect the performance of a computer such as Instruction Sets design, Pipelining, RISC architecture, and Superscalar architecture.
- Recognize and illustrate parallel architectures and interconnection networks

**Expected Outcome:**

- The knowledge of how previous engineering science curricula have been applied in the field of computers and computer architecture.
- The ability to perform basic computer system component designs, defines an instruction set architecture and assembly language for the computer system, analyze the performance of the computer and identify a range of performance enhancements.
- An ability to engage in lifelong learning of the computing system performance and architecture evolution.
- A knowledge of contemporary issues related to the architecture, design, implementation and use of Computers.

**Unit I                      Computing Systems- An Introduction**

Definitions - Organization and Architecture, Structure and Functional blocks, Bus interconnection, designing for Performance, Structure of IAS computer.

**Unit II                      Central Processing Unit**

Register organization, Arithmetic and Logic Unit- numbering systems, Integer Representation, Integer Arithmetic – Addition , 2's Complement subtraction, Multiplication and division, Floating point Representation and Arithmetic Instruction set, Addressing modes, Data path implementation, Register Transfer Notation (RTN), Abstract RTN, and Concrete RTN, Control Unit - Hardwired control unit and Micro instruction, sequencing and execution.

**Unit III                      Memory System & I/O Organization**

Semiconductor RAM memories-Internal organization of Memory Chips, SRAM, DRAM, Read-Only memories-ROM, PROM, EPROM, EEPROM, Secondary storage- magnetic disk, optical memory.

Cache Memories-Mapping Function-Direct, Set Associative, (Replacement algorithms), Performance consideration-Interleaving, Hit Rate and Miss Penalty.

Virtual memory - Address translation, Paging and segmentation.

#### **Unit IV I/O Organization**

Interfacing I/O Devices with CPU- Programmed I/O, Interrupt driven I/O, DMA controlled I/O

#### **OPERATING SYSTEM SUPPORT**

Overview, Scheduling-FCFS, SJF, Priority, Mutual exclusion, Memory management.

#### **Unit V Computing System Performance and Architecture Evolution**

Von-Neumann vs. Harvard architectures, Instruction Cycle- Fetch, Decode, Execute Decode, Moore's law, RISC -Instruction execution Characteristics, use of a large register file, compiler-based registers optimization, pipelining and Pipeline hazards, No. of Pipeline stage, Performance consideration .Instruction level parallelism-overview, Design issues, Super Scalar Processors, VLIW.

#### **Unit VI Multiprocessors**

Processor level parallelism-Dependency, Flynn taxonomy, Memory organization for Multiprocessors system, Symmetric Multiprocessor, Cache Coherence and The MESI Protocol.

#### **Textbooks:**

1. Computer Organization and Architecture - William Stallings Sixth Edition, Pearson/PHI 2003.
2. Computer Systems Architecture - M.Moris Mano, IIIrd Edition, Pearson/PHI 2003.

#### **Reference Book:**

1. Computer Organization and Design-the hardware/software interface -David A. Patterson, John L. Hennessy, Third edition, Morgan Kaufmann Publishers, 2009.

**Mode of Evaluation** CAT- I & II, Quiz, Assignments, Term End Examination.

**Carl Hamacher, Text**  
**Hwang and Briggs**  
**Harold Stone**