Content Product
Detailed syllabus
COMPUTER ARCHITECTURE

UNIT I - OVERVIEW AND INSTRUCTIONS

Eight great ideas in computer architecture - Introduction to eight ideas, Eight ideas. **Introduction to computer architecture -** Introduction, Introduction to system design, Organization of digital system, Design concepts, Digital vs analog, Computer components, Computer organization, Types of computer. **Functional units -** Introduction to functional units, Input devices, Output devices, Bus structures, Single bus structures, Multiple bus structures. **Technology – performance – power wall -** Technologies for building processors and memory, Performance, CPU performance and its factors, Power wall. **Uniprocessors to multiprocessors -** Uniprocessors to multiprocessors, Switch from uniprocessors to multiprocessors. **Instruction execution characteristics -** Introduction, Type of operations, Time consumed by statements, Type of operands, Procedure calls and multiple register sets, Depth of procedure nesting, Use of large register file, Compiler based register optimization, RISC architecture and pipelining, RISC pipelines, Pipeline problems – Overhead, Dynamic branch prediction, Pipeline optimization, RISC Vs CISC. **Instructions -** Introduction to instructions, Instruction sequencing, Representing instructions, Register transfer notation, Assembly language notation, Introduction – basic instruction types, Three Address instruction, Two Address instruction, One address instruction, Zero address instruction, Instruction execution and straight line sequencing. **Logical operations – control operations -** Logical operations. **Addressing modes -** Addressing modes.

UNIT II - ARITHMETIC OPERATIONS

Information representation, arithmetic operations - Arithmetic Logic Unit (ALU), Binary information, Types of data, Information representation, Complements, Subword parallelism. **Floating point representation with examples -** Types of information, Floating point representation with examples, IEEE standard for floating point numbers, Arithmetic operation on floating point numbers, Normalization, Storage considerations. **Fixed point representation with examples -** Fixed point representation, Binary fixed point representation, Signed magnitude representation, Signed-1's complement representation, Signed-2's complement representation, Decimal fixed point representation, Differences between fixed and floating point representation. **Fixed point addition/subtraction using signed magnitude -** Representation of fixed point number operations, Addition and subtraction of signed magnitude numbers, X-OR operation for equality check, Subtraction using 2's complement, Fixed point addition/subtraction of numbers, Multiplication, Flowchart for multiply operation, Division of fixed point binary numbers, Flow chart for fixed point division. **Floating point addition/subtraction –** Normalization, Floating point representation, Addition and subtraction of floating point number, Floating point multiplication, Flow chart for multiplication of floating point numbers, Floating point division examples, Floating point division, Flow chart for floating point division.

UNIT III - PROCESSOR AND CONTROL UNIT

Basic MIPS implementation - Basic MIPS implementation, Logic design conventions, Clock

methodology. **Building datapath -** Introduction to building a datapath, Executing R-format operations, Executing load and store operations, Executing branch and jump operations, Creating a single datapath. **Control implementation scheme -** Simple implementation scheme, ALU control, Designing the main control unit, Operation of datapath. **Pipelining - basic concepts -** Introduction to pipelining, Definition of pipelining, Characteristics of pipelining, Need of pipelining, Benefits of pipelining, Pipelining rules, Advantages and Disadvantages, Pipelining hazards. **Types of Pipelining -** Type of Pipelining, Type of hardware pipelining, Pipelined datapath, Pipelined control. **Handling data hazards and control hazards -** Instruction pipelining, Hazards in instruction pipelining, Structural hazard, Data or data dependent hazard, Forwarding unit, Instruction or control hazard, Control hazard solution, Influence on instruction sets, Data path and control considerations, Effect of instruction hazard, Number of pipeline stages. **Exception/Branch handling -** Introduction to exception/Branch handling, Branch prediction.

UNIT IV – PARALLELISM

Instruction-level-parallelism: Concepts and challenges - Introduction to instruction level parallelism, Dependences, Data dependences, Name dependences, Control dependences, Function Programs critical properties, Data hazards. **Flynn's classification -** Introduction to Flynn's classification, Instruction Cycle, Flynn's classification, Single Instruction and Single Data stream (SISD), Single Instruction and Multiple Data stream (SIMD), Multiple Instruction and Single Data stream (MISD), Multiple Instruction and Multiple Data stream (MIMD). **Hardware multi-threading -** Multi-threading, Blocked multi-threading, Fine grained (Inter leaved) multi-threading, Coarse- grained multithreading, Simultaneous Multi-threading (SMT). **Multicore processors -** Single core processors, Multicore processors, Parallelism and performance in multi-Core CPUs.

UNIT V - MEMORY AND I/O SYSTEMS

Memory basics, memory types - Introduction, Memory unit, Memory operations, Block diagram of memory unit, Types of memories, Basic concepts, Key characteristics of memory, Physical characteristics of memory, Memory hierarchy, Serial vs random access memory. **Semiconductor RAM Memories -** Introduction to Semiconductors RAM Memories, Internal organization of Memory Chip, Static Memories, TTL RAM Cell, MOS Static RAM Cell. **Asynchronous DRAMs -** Introduction to Dynamic RAMs, Basic DRAM Operations, Asynchronous Operations, Types of DRAMs, Static RAM, Comparison between SRAM and DRAM, DRAM Memory Organization. **Synchronous DRAMs -** Introduction to Synchronous DRAMs, Timing Diagram, Performance measures, Double-Data Rate SDRAM, Structure of Large Memories, Memory System Consideration, Ram bus memory. **Read Only Memories -** Introduction to Read Only Memories, ROM and its Organization, (PROM) Programmable Read Only Memory, (EPROM) Erasable Programmable Read only Memory, (EEPROM) Electrically Erasable Programmable Read Only Memory, Flash Memory, Speed, size and cost. **Cache Memories -** Introduction to Cache Memories, Cache Memory System, Elements of Cache Design, Mapping Function, Cache Write/Updating, Cache Coherency, Replacement Algorithms, Performance Considerations, Hit Rate and Miss Penalty, Caches on the CPU Chip. **Associative Memory -** Introduction to Associative Memory, Advantages and Disadvantages of Associative Memory, Operations of

Associative Memory, Application of Associative Memory, Internal Organization of Associative Memory, Read and Write Operation of Associative Memory. **Virtual Memory -** Introduction to Virtual Memory, Address Translation in Virtual Memory, Virtual Memory Implementation in 80386, Demand Paging, Page Replacement Algorithms, Memory Management Requirements. **I/O Organization -** Introduction, Accessing I/O Devices, Address Decoder, I/O Interfacing Techniques, Programmed I/O, Polling, Addressing I/O Devices, I/O Mapping. **Interrupts -** Introduction, Interrupt Processing, Return from Interrupt, Device Identification, Handling multiple interrupts, Interrupt Nesting, Enabling and Disabling interrupts, Vectored Interrupts, Interrupt Priority, Parallel Priority Interrupt, Exception and Debugging, Privilege Exception, Programmed Vs Interrupt. **Direct Memory Access (DMA) -** Data Transfer using DMA Controller, DMA controller, DMA Cycle. **I/O Processor -** I/O Processor, Features I/O processor, Block diagram of I/O processor and its principle.