

Suggested Teaching Guidelines for
Computer Architecture – PG-DHPCSA August 2024

Duration: 40 class room hours

Objective: To reinforce knowledge of Computer Design and Organization

Prerequisites: Knowledge of operating systems Concepts and Fundamentals of Computer.

Evaluation method: CCEE Theory exam – 80% weightage
Internal assessment– 20% weightage

List of Books:

Structured Computer Organization, Tanenbaum - Pearson

Reference Book:

1. “Computer Organization”. 5th Edition. “Peter”, 2003 by V.C. Hamacher, Z.G. Vranesic, S.G. Zaky/ McGraw Hill Education.
2. David A. Patterson and John L. Hennessy. Computer Organization and Design, Revised Printing, Third Edition, Third Edition: The Hardware/Software Interface (The Morgan Kaufmann Series in Computer. Series in Computer Architecture and Design). Morgan Kaufmann; 3rd Edition. 2007
3. Andrew S. Tanenbaum. Structured Computer Organization Prentice Hall; 5th Edition. 2005.
4. W. Stallings. “Computer Organization and Architecture. Designing and Performance”. 7th Edition. Prentice Hall. 2005.
5. J.L. Hennessy, D.A. Patterson. “Computer architecture: A Quantitative Approach”, 4th Edition. Morgan Kaufmann, 2006.
6. UltraSPARC T1™ Supplement to the UltraSPARC Architecture 2005. Sun Microsystems. 2006
7. OpenSPARC™ T2 Core Micro architecture Specification. Sun Microsystems. 2008

Note: Each session having 2 Hours

Session: 1 & 2

Lecture

Basic concepts of computer organization

- Introduction of Organization and Architecture
- A Brief History of Computers
- Designing for Performance

Classes of computer architecture,

- Structure and Function
- The Evolution of the Intel x86 Architecture Data
- Embedded Systems and the ARM
- Performance Assessment.
- Computer Components
- Computer Function
- Interconnection Structures
- Bus Interconnection
- Goals of computer architecture

Session: 3

Elements of computer systems

- Traditional computer inputs/outputs Devices
- Other Input Technologies
- Computer output Devices
- Choosing the Printer

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Session: 4 & 5

Processor vs. System architecture

- Structure of Instruction
- Description of a Processor
- Machine Language Programming
- A specific instruction set architecture
- Arithmetic and how to build an ALU
- Constructing a processor to execute instructions
- Introduction to system bus (PCI- Express) and physical aspects

Session: 6 & 7

CISC vs. RISC architectures

- RISC philosophy,
- RISCs Design Principles
- RISC/CISC Evolution Cycle
- pipelining,
- basic concepts in pipelining,
- Example of Advanced RISC Machines

Session: 8 ,9 & 10

Multi-Processor architecture

- Basic Concepts In Parallel Processing,
- Classification Of Parallel Architectures.
- Vector Processing, Array Processor,
- Literature Review Of Multi-Core Architecture
- Shared Memory Multiprocessors
- Clusters and Other Message-Passing Multiprocessors
- Hardware Multithreading
- Introduction to Graphics Processing Units
- NVLink – communication protocol for NVIDIA cards

Session: 11 &12

Memory Hierarchy

- Various Technologies Used In Memory Design
- Higher Order Memory Design, Memory Hierarchy
- Main Memory
- Auxiliary Memory
- Cache Memory
- Cache Optimization Techniques
- Memory Interleaving
- Virtual Memory
- Address Space and Memory Space
- Associative Memory
- Page Table
- Page Replacement

Session: 13, 14 & 15

Memories and Caches

- The Basics of Caches
- Measuring and Improving Cache Performance
- Virtual Memory
- A Common Framework for Memory Hierarchies
- Using a Finite-State Machine to Control a Simple Cache

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Cache coherency

- Parallelism and Memory Hierarchies: Cache Coherence
- Advanced Material: Implementing Cache Controllers
- Real Stuff: the AMD Zen and Intel Skylake Memory Hierarchies

Session: 16, 17 & 18

Standard IO interfaces GPU elements

- Connecting Processors, Memory, I/O Devices
- Interfacing I/O Devices to the Processor, Memory, and Operating System
- I/O mapped and memory mapped I/O,
- Interrupts and Interrupts handling mechanisms,
- Synchronous vs. Asynchronous data transfer,
- Direct Memory Access COMPUTER PERIPHERALS: I/O devices such as magnetic disk, magnetic tape, CD-ROM systems
- Parallelism and I/O: Redundant Arrays of Inexpensive Disks
- Compute GPU System Architectures

Session: 19 & 20

An overview of the latest processors

- Introduction of Intel Processor
- Overview of 32-bit and 64-bit Processor in Intel
- Generations of Intel Core Processor
- Overview of latest generation Intel Core Processor
- Overview of AMD, POWER and ARM in HPC
- Introduction to Emerging Architecture
- TPU
- Parallel and Distributed Processing