Suggested Teaching Guidelines for

Computer Architecture – PG-DHPCSA August 2019

Duration: 30 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 / Other training material

Course ware: No specific courseware for modules, faculty may share some course materials.

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", 4thEdition.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

Session: 4 & 5

Processor vs. System architecture

- Structure of Instruction
- Description of a Processor
- Machine Language Programming
- Algorithms to simulate the Hypothetical Computer
- Enhancing Hypothetical Computer
- Performance issues
- A specific instruction set architecture
- Arithmetic and how to build an ALU
- Constructing a processor to execute instructions
- Introduction to AVX and AVX2 instructions

Session: 6 & 7

CISC vs. RISC architectures

- RISC philosophy,
- RISCs Design Principles
- RISC/CISC Evolution Cycle
- pipelining,
- basic concepts in pipelining,
- delayed branch, branch prediction,
- data dependency,
- influence of pipelining on instruction set design,
- multiple execution units, performance considerations
- Pioneer (University) RISC Machines
- Example of Advanced RISC Machines

Session: 8 & 9

Multi-Processor architecture

- Basic Concepts In Parallel Processing,
- Classification Of Parallel Architectures.
- Vector Processing, Array Processor,
- Literature Review Of Multi-Core Architecture
- The Difficulty of Creating Parallel Processing Programs
- Shared Memory Multiprocessors
- Clusters and Other Message-Passing Multiprocessors
- Hardware Multithreading
- SISD, MIMD, SIMD, SPMD, and Vector
- Introduction to Graphics Processing Units
- Introduction to Multiprocessor Network Topologies
- NVLink – communication protocol for NVIDIA cards
- Multiprocessor Benchmarks

Session: 10

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

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- Virtual Memory
- Address Space And Memory Space
- Associative Memory
- Page Table
- Page Replacement

Session: 11 & 12

Memories and Caches

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

Cache coherency

- Parallelism and Memory Hierarchies: Cache Coherence
- Advanced Material: Implementing Cache Controllers
- Real Stuff: the AMD Opteron X4 (Barcelona) and Intel Nehalem Memory Hierarchies

Session: 13&14

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,
- vectored interrupts,
- Synchronous vs. Asynchronous data transfer,
- Direct Memory Access COMPUTER PERIPHERALS: I/O devices such as magnetic disk, magnetic tape, CD-ROM systems
- Designing an I/O System
- Parallelism and I/O: Redundant Arrays of Inexpensive Disks
- GPU System Architectures
- Programming GPUs
- Multithreaded Multiprocessor Architecture
- Parallel Memory System
- Floating Point Arithmetic

Session: 15

An overview of the latest Intel processor

- Introduction of Intel Processor
- Overview of 32 bit and 64 bit Processor in Intel
- Intel Tera-Scale
- Generations of Intel Core Processor
- Overview of sixth generation Intel Core Processor