Computer Architecture (3-1-1)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

- To acquaint the students with the fundamentals of computer systems.
- To apprise the students with the architectural and associated components of computer systems.
- To aware the students about the architecture of the computer systems available in the market.

Course Contents:

1. Introduction **4 hrs**

1.1. Computer Organization and Computer Architecture
1.2. Review of Evolution of Computer System
1.3. Basic Structure of Computer System
1.4. Examples of Computer Families
1.5. Future Trends in Computer
1.6. Review of Instruction Sets, Addressing Modes and Instruction Formats

2. Register Transfer and Micro Operations **2 hrs**

2.1. Register Transfer and RTL
2.2. Micro operations
2.3. Data Transfer Micro operations
2.4. Arithmetic and Logical Micro operations
2.5. Shift Micro operations
2.6. Introduction to HDL and VHDL

3. Central Processing Unit **3 hrs**

3.1. CPU Organization/Structure
3.2. Register Organization and Data Paths
3.3. Instruction Cycle
3.4. Arithmetic and Logical Unit
3.5. Design Principles for Modern Systems

4. Computer Arithmetic **6 hrs**

4.1. Integer Representation
4.2. Integer Arithmetic
4.3. Unsigned Binary Addition and Subtraction
4.4. Unsigned Binary Multiplication Algorithm

4.5. Booth's Algorithm
4.6. Unsigned Binary Division Algorithm
4.7. Floating Point Representation
4.8. BCD Arithmetic Unit
- BCD Adder

4.9. Arithmetic Pipelining

5. Control Unit **6 hrs**

5.1. Control of the Processor
5.2. Hardwired Control Unit
- Control Unit Inputs
- Control Unit Logic

5.3. Micro programmed Control Unit
- Micro Instructions and Its Types
- Architecture of Micro programmed Control Unit

5.4. Micro Instruction Sequencing
5.5. Micro Instruction Execution
5.6. Applications of Hardwired and Micro programmed Control Units

6. Memory Organization **6 hrs**

6.1. Memory Hierarchy
6.2. Main Memory
- RAM and ROM

6.3. Auxiliary Memory
- Magnetic Disks and Tapes
- Optical Disks
- Flash Drives
- Review of RAID

6.4. Associative Memory
- Hardware Organization
- Address Matching Logic
- Read/Write Operations

6.5. Cache Memory
- Cache Initialization
- Mapping Cache Memory o Direct, Associative and Set Associative Memory Mapping
- Write Policy
- Replacement Algorithms

7. **Input Output Organization** **4 hrs**

7.1. External Devices
7.2. I/O Module Structure
7.3. Review of Programmed I/O and Interrupt Driven I/O
7.4. Review of DMA, 1/O-Channels and I/O Processors

7.5. External Interfaces

8. Reduced Instruction Set Computers 5 hrs

8.1. RISC VS. CISC
8.2. RISC Pipelining
8.3. Instruction Pipelining
8.4. Conflicts in Instruction Pipelining and their Solutions
8.5. Introduction to Register Windows and Register Renaming

9. Introduction to Parallel Processing 6 hrs

9.1. Parallelism in Uniprocessor System
9.2. Multiprocessor Systems and their Characteristics
9.3. Flynn's Classification
9.4. Interconnection Structures in Multiprocessors
9.5. Cache Coherence
9.6. Introduction to Vector Processing and Array Processors
9.7. Introduction to Multithreaded Architecture

10. Multicore Computers 3 hrs

10.1. Hardware Performance Issues
- Increase in Parallelism
- Alternative Chip Organizations
- Power Consumption

10.2. Software Performance Issues
- Software on Multicore

10.3. Multicore Organization
10.4. Dual Core and Quad Core Processors
10.5 Power efficient Processors

Laboratory

The individual student should develop a project or perform a case study on Computer Architecture. The topic could be either initiated by the student or selected from a list provided by the instructor. An oral presentation with a demonstration in case of project should be part of the laboratory. Reports must be prepared.

Text Books:

1. Stallings, W., *"Computer Organization and Architecture"*, Eighth Edition, 2011, Pearson.
2. Mano, M. M., *"Computer Systems Architecture"*, Third Edition, 2011, Pearson.

References:

1. Tanenbaum, A.S., *"Structured Computer Organization"*, Fourth Edition, 2003, Pearson Education.
2. Carpinelli, J.D., *"Computer Systems Organization and Architecture"*, 2012, Pearson.
3. Rajaraman, V. et all, *"Computer Organization and Architecture"*, 2011, PHI.
4. Sima, D. et all, *"Advanced Computer Architecture"*, 2000, Addison Wesley.