17CS011 ADVANCED COMPUTER ARCHITECTURE

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Course Description and objectives:
The objective of this course is to learn the fundamental aspects of parallel computer architecture with an emphasis on system design and analysis. The course focuses on processor design trends - instruction pipeline concepts, out-of-order execution, dynamic hardware scheduling, advanced branch prediction techniques, multiple issue superscalar processors, Multiprocessors and Multi computers.

Course Outcomes:
The student will be able to analysis issues related to advanced computer architectures:

- ✓ Understand the micro-architectural design of the processor
- ✓ Foundations of high speed computation
- ✓ Pipelining
- ✓ Data and resource dependencies
- ✓ Hazards and exceptions

Skills:

- ✓ Analysis on performance of computing using different architectures
- ✓ Know about the different architectures.
- ✓ Familiarity with pipelining concepts.
- ✓ Know how the control transfer based on the instructions.
- ✓ Case studies on MIMD architectures

UNIT - I

Introduction to parallel processing: Basic concepts, Types and Levels of parallelism, Classification of parallel architectures, Basic parallel techniques.

Introduction to IPL-processors: Evolution and overview of ILP processors, Dependencies between instructions, Instruction scheduling, Preserving sequential consistency.

UNIT - II

Pipelined processors: Basic concepts, Design space of pipelines, Overview of pipelined instruction processing, Pipelined execution of Integer and Boolean Instructions.

VLIW Architectures: Basic principles, Overview of proposed and commercial VLIW architectures.

Superscalar Processors: Introduction, Parallel decoding, Superscalar instruction issue, Shelving- The design space, Scope of shelving, Layout of the shelving buffers, Operand fetch policies, Instruction dispatch schemes

UNIT- III

Processing of Control Transfer Instructions: Introduction, Types of branches, How architectures check the results of operations, The branch problems, Performance measures of branch processing, Basic approaches to branch handling, Delayed branching,

Branch processing- The design space, Branch detection, Overview of Branch processing policies, Branch prediction schemes, Accessing the branch target path

UNIT - IV

Introduction to Data-parallel Architectures: Introduction, Connectivity, Alternative architectural classes.

SIMD architectures: Introduction, Design space-Granularity, Connectivity, Processor Complexity, Local autonomy

MIMD architectures: Architectural concepts, Problems of Scalable computers, Main design issues of scalable MIMD computers

UNIT -5

Distributed memory MIMD Architectures: Introduction, Design Space, Direct interconnection networks, Interconnection Topologies, Switching techniques, Routing

Shared Memory MIMD Architectures: Introduction, Dynamic interconnection networks, Shared path networks, Switching networks, Cache coherence problems, Hardware based protocols, Software based protocols.

Activities :

- ✓ Outline the design of a computer system to meet a performance requirement
- ✓ Evaluate performance of different architecture with respect to various parameters.
- ✓ Analyze performance of different ILP techniques.
- ✓ Identify cache and memory related issues in multi-processors.

TEXT BOOK:

1. *DezsoSima, Terence Fountain , Peter Kacsuk, "*Advanced computer architectures: *A Design space Approach*", Pearson Education India,1997.

REFERENCE BOOKS:

1. J.L. Hennessy, and D.A. Patterson "*Computer Architecture: A quantitative approach*, Fifth Edition, Morgan Kaufman Publication, 2012
2. Andrew S. Tanenbaum "Structured Computer Organization " Pearson, 6th ed.2012
3. Sivaraama Dandamudi "Fundamentals of Computer Organization and Design " Springer Int Edition, 2003
4. Anjaneyulu, "Computer Organization" Himalaya Pub house, 2nd edition, 2010
5. J.P. Shen and M.H. Lipasti, "Modern Processor Design", MC Graw Hill, Crow fords ville, 2005.