5th Semester	RCS5D004	Parallel & Distributed Systems	L-T-P 3-0-0	3 Credits

Objectives

- To understand parallel computing algorithms and models
- To analyze parallel algorithms for PRAM machines and various interconnection networks
- To understand parallel programming in MPI and POSIX

Module I: **(10 Hours)**

Introduction: Implicit parallelism, Limitations of memory system performance, control structure, communication model, physical organization, and communication costs of parallel platforms, Routing mechanisms for interconnection networks, mapping techniques. **Parallel algorithm design**: Preliminaries, decomposition techniques, tasks and interactions, mapping techniques for load balancing, methods for reducing interaction overheads, parallel algorithm models.

Module II: **(8 Hours)**

Basic communication operations: Meaning of all-to-all, all-reduce, scatter, gather, circular shift and splitting routing messages in parts. Analytical modeling of parallel programs: sources of overhead, performance metrics, the effect of granularity on performance, scalability of parallel systems, minimum execution time, minimum cost-optimal execution time, asymptotic analysis of parallel programs.

Module III: **(6 Hours)**

Programming using message passing paradigm: Principles, building blocks, MPI, Topologies and embedding, Overlapping communication and computation, collective communication operations, Groups and communicators

Module IV: **(6 Hours)**

Programming shared address space platforms: Threads, POSIX threads, Synchronization primitives, attributes of threads, mutex and condition variables, Composite synchronization constructs, OpenMP Threading Building blocks; An Overview of Memory Allocators, An overview of Intel Threading building blocks.

Module V: **(10 Hours)**

Dense Matrix Algorithms: matrix vector multiplication, matrix-matrix multiplication, solving system of linear equations, Sorting: Sorting networks, Bubble sort, Quick sort, Bucket sort andother sorting algorithms Graph algorithms: Minimum spanning tree, single source shortest paths, all-pairs shortest paths, Transitive closure, connected components, algorithms for sparse graphs.

Outcomes

- Ability to analyze parallel algorithms for PRAM machines
- Ability to comprehend and apply parallel algorithms to real world applications
- Ability to design and develop optimal parallel algorithms

Books:

[1] Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar : Introduction to Parallel Computing, Second Edition Pearson Education, 2007

[2] Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series, 2004

Digital Learning Resources:

Course Name:	Distributed Computing Systems
Course Link:	https://nptel.ac.in/courses/106/106/106106107/#
Course Instructor:	Prof. Ananthanarayana V.S, IIT, Madras