**MADC 102 R03 / MCSE 301R03High Performance Scientific Computing**

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**UNIT-I                                                                                                         10 Periods**

Parallel computers – Basic techniques – Demand for computational speed – Potential for increased computational speed – Types of parallel computers – Cluster computing.

**UNIT-II                                                                                                         15 Periods**

Parallel computations – Pipeline techniques - Memory hierarchy and pipelines – Computing platform for pipelined applications – Pipeline program examples: adding numbers, sorting numbers, prime number generation.

**UNIT-III                                                                                                        15 Periods**

Basics of programming using Message Passing Interface – Debugging and evaluating parallel programs – Basic linear algebra: Using BLAS – Vector norms and matrix norms–Parallel matrix multiplication: Triple nested for-loop algorithm, block matrix multiplication algorithms, BMR algorithm – Parallel LU factorization – Parallel triangular solve – Sparse matrices – Parallel direct solvers for sparse matrices.

**UNIT-IV                                                                                                        15 Periods**

Partitioning – Partitioning strategies – Divide and conquer examples: sorting using bucket sort –Heuristic graph partitioning using Kernighan-Lin algorithm - Multilevel graph partitioning using Metis – Numerical integration – Synchronous computations - Barriers: counter based approach, tree based approach, butterfly approach.

**UNIT-V                                                                                                          20Periods**

Data parallel computations – Synchronous iterations –– Solving a system of linear equations by iteration–Conjugate Gradient method–Dynamic load balancing - Searching a graph - Shortest path problem

**List of Experiments (MPI,Open MP,Open CL)**

**Exp-I Programs using Multithreading**

1. **Prime Number Generation**
2. **Sorting- Enumeration Sort, Quick Sort& Heap Sort**

**Exp-IIPrograms based on MPI**

1. **Triple nested for-loop matrix multiplication**
2. **Block matrix multiplication**
3. **BMR algorithm**
4. **LU Factorization**
5. **Triangular Solve**

**Exp-III Programs based on Partitioning**

1. **Sorting using bucket sort**
2. **Numerical Integration – Simpsons 1/3 Rule**
3. **Minimal Spanning Tree – Prims Algorithm**

**Exp-IV Programming using Synchronized Computation**

1. **Dynamic load balancing**
2. **Shortest Path Algorithm –Bellman –Ford**
3. **Graph Searching- BFS & DFS- Searching a Graph**

**Exp-V Performance Analysis of MPI. OpenMP and OpenCL**

**References:**

1. Barry Wilkinson and Michael Allen, **Parallel Programming Techniques and Applications using Networked Workstations and Parallel Computers,** Second Edition, Pearson & Prentice Hall, 2005
2. Kai Hwang, zhiweixu, “**Scalable parallel computing Technology / Architecture / programming**”,McGrawHillInternational, 2000..
3. David.E. Culler, Jaswinder Pal Singh with AnoopGupta, “ **Parallel computer Architecture,AHardwareor Software approach**”,MorganKaufmannPublication,Firstedition1999.
4. MichaelJ.Quinn,“**ParallelComputing,theory&Practice**”,McGrawHillSecond Edition, 1994.
5. IanFoster,“**DesigningandBuildingParallelPrograms**”,Addison-Wesley,ISBN0-201-57594-9, 2004