Course Code	Course Title		L	T	P	C
BITE406L	**Parallel Computing**		**3**	**0**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**				
		1.0				

Course Objectives:

1. To understand the parallelization of basic mathematical and engineering algorithms.
2. To learn the contemporary parallel architectures and their programming.

Course Outcomes:

1. Investigate the applicability of the basic parallel algorithms in solving complex problems
2. Design efficient algorithms for a given parallel architecture and processor network
3. Analyse the different algorithm designs for performing the key compute-intensive operations
4. Use OpenMP, MPI libraries to implement the parallel algorithms
5. Engage in individual study to write abstract of research paper related to parallel algorithms.

Module:1	**PRAM Algorithms**	**6 hours**
Basics of Parallel Processing - Introduction to Flynn's Taxonomy - PRAM Model of Parallel Computation – EREW, CREW, CRCW - Mapping Theorem - Parallel Reduction - Prefix Sums - List Ranking - Preorder Tree Traversal - Merging Two Sorted Lists - Graph Coloring - Reducing Processors - Brent's Theorem.		
Module:2	**Processor Networks and Processor-Task Mapping**	**7 hours**
Mesh Networks - Binary Tree - Hyper Tree – Pyramid – Butterfly – Hypercube - Cube Connected Cycles and Shuffle Exchange Networks - De Brujin networks - Mapping Data to Processors: Embedding, Dilation, Ring to 2D mesh, 2D mesh to 2D mesh, Binary tree to 2D mesh, Binomial tree to 2D mesh - Embedding Graphs to Hypercubes: Binary Tree to Hypercubes, Binomial Tree to Hypercubes, Rings and Mesh to Hypercubes.		
Module:3	**Summation Algorithms**	**6 hours**
Hypercube SIMD Model – Shuffle Exchange SIMD Summation Algorithm - 2D Mesh SIMD Summation Algorithm - UMA Summation Model – Broadcast - Binomial Tree Communication Pattern.		
Module:4	**Matrix Multiplication Algorithms**	**6 hours**
Matrix Multiplication on 2D Mesh SIMD Model - Hypercube SIMD Model – Shuffle-Exchange SIMD Model - UMA Multiprocessor - Block Matrix Multiplication - Algorithms for Multicomputer - Row-column and Block-oriented Algorithms.		
Module:5	**Sorting**	**6 hours**
Enumeration Sort - Lower Bounds on Parallel Sorting - Odd Even		

Transposition Sort - Bitonic Merge - Sequence, Bitonic Merge on Shuffle Exchange Network - Two-dimensional Mesh Network - Hypercube Network - Parallel Quicksort - Hyperquick Sort.		
Module:6	**Graph and Search Algorithms**	**6 hours**
Minimum-spanning Tree - Single-source Shortest Path - All-pairs Shortest Path - Sequential Search Algorithms - Parallel Depth-First Search - Parallel Breadth-First Search.		
Module:7	**Parallel Computing Platforms**	**6 hours**
Programming Shared-Memory Multiprocessors with OpenMP - Programming Distributed-Memory Multiprocessors with MPI - Programming Massively Parallel Processors with CUDA.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**
Text Book		
1.	Michael Quinn, Parallel Computing: Theory and Practice, 2017, 2nd Edition, McGraw Hill Education.	
Reference Book		
1.	David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, 2012, 2nd Edition, Morgan Kaufmann.	
Mode of Evaluation: Continuous Assessment Tests, Assignment, Quiz, Final Assessment Test		
Recommended by Board of Studies	12-10-2022	
Approved by Academic Council	No. 68	Date 19-12-2022