ITE3003	Parallel Processing	L	T	P	J	C
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Pre-requisite	**ITE2001**	**Syllabus version**				
		1.0				

Course Objectives:

- To learn to develop parallel algorithms and map them with processor architectures
- To understand the parallelization of basic mathematical and engineering algorithms
- To learn the contemporary parallel architectures and their programming

Expected Course Outcome:

1) Parallelize basic algorithms and analyze their speedup and efficiency.
2) Understand the properties of various interconnection networks and suggest the suitable network based on performance requirements
3) Comprehend the mapping of data and scheduling of tasks to appropriate processors for better efficiency
4) Develop and analyze summation algorithms for different parallel processing architectures.
5) Design matrix multiplication algorithms for various SIMD and MIMD architectures.
6) Design an efficient sorting algorithm for a given parallel architecture.
7) Elaborate various searching techniques and sorting algorithms.
8) Design the applications for modern parallel architectures.

Student Learning Outcomes (SLO):	**1, 2, 9**

[1] Having an ability to apply knowledge of mathematics, science, and engineering

[2] Having a clear understanding of the subject related concepts and of contemporary issues

[9] Having problem-solving ability solving social issues and engineering problems

Module:1	**Pram Algorithms**	**9 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**	**4 hours**

Mesh Networks – binary tree – hyper tree – pyramid – butterfly – hypercube – cube connected cycles and Shuffle exchange networks – De Brujin networks.

Module:3	**Mapping and Scheduling**	**5 hours**

Mapping data to processors: Embedding – Dilation – Ring to 2D mesh -2D mesh to 2Dmesh – Binary tree to 2D mesh – Binomial tree to 2Dmesh –Embedding graphs to hypercubes- binary tree to hypercubes – Binomial tree to hypercubes – rings and mesh to hypercubes. Static scheduling on

UMA models. Grahams list scheduling algorithm. Coffman Grahams scheduling algorithm.		
Module:4	**Summation Algorithms**	**5 hours**
Hypercube SIMD model – shuffle exchange SIMD summation algorithm – 2D Mesh SIMD summation algorithm – UMA summation model – Broadcast – Binomial tree communication pattern.		
Module:5	**Matrix Multiplication Algorithms**	**6 hours**
Matrix multiplication on 2D Mesh SIMD model – Related theorems -Hypercube SIMD model – shuffle exchange SIMD model – UMA Multiprocessor – Block matrix multiplication – Algorithms for multicomputer – Row-column and block oriented algorithms.		
Module:6	**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 – Recurrence equation and analysis – Hyperquick sort.		
Module:7	**Searchiing and Graph Algorithms**	**7 hours**
Parallel search – Ellis's algorithm – Manber and Ladner's algorithms. P- Depth Search – Breadth Depth Search – Connected components –All pairs shortest path – single source shortest path – Minimum cost spanning tree – Sollin's algorithm – Kruskal's algorithm.		
Module:8	**Contemporary issues:**	**3 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Michael J. Quinn, Parallel computing theory and practice, McGraw Hill, Second Edition, 2012.
Reference Books	
1.	David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach, MK Publishers, 2010.
2.	Pavan Balaji, Programming Models for Parallel Computing (Scientific and Engineering Computation) , MIT Press, 2016
3.	Patrick Amestoy, Daniela di Serafino, Rob Bisseling, Quitana Orti E.S., Vajtersic M, Parallel Numerical Algorithms, Springer, 2010

Recommended by Board of Studies	05-03-2016		
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