CP455: PARALLEL PROCESSING
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:
To expose students to basic techniques of parallel algorithm development and programming on different parallel platform

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Marks Distribution				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	5	70	30	30	20	150

Course Contents:

Sr. No.	Topics	Teaching Hours
1	**Parallel Programming Platforms:** Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.	06
2	**Principles of Parallel Algorithm Design algorithms:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.	07
3	**Basic Communication Operations, algorithms:** One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.	08

4	**Analytical Modelling of Parallel Programs:** Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity and Data Mapping on Performance, Amdahl's law, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.	06
5	**Programming Using the Message Passing Paradigm:** Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Collective Communication and Computation Operations, Groups and Communicators.	06
6	**Programming Shared Address Space Platforms Thread Basics:** Why Threads? The POSIX Thread Application Programme Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, OPENMP.	06
7	**Applications:** Parallel algorithm development for Matrix multiplication, Sorting and Graph**.**	06
	TOTAL	**45**

List of references:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, “Introduction to Parallel Computing”, Pearson Publication
2. M. SasiKumar, Dinesh Shikhare, P.Raviprakash, “Introduction to Parallel Processing”, PHI Publication
3. Steven Brawer, “Introduction to Parallel Programming”, Academic Press
4. M.Sasikumar, Dinesh Shikhare and P. Ravi Prakash, “Introduction to Parallel Processing”, PHI
5. V. Rajaraman and C. Siva Ram Murthy, “Parallel Computers – Architecture and Programming”, PHI.

Course Outcomes (COs):

After learning the course students will be able to

1. Understand implicit and explicit parallel platform
2. Decompose given problem into many sub problems using different decomposition techniques
3. Use different performance metrics for analysis of parallel algorithms
4. Use message passing library for communication among process running on parallel platform
5. Develop parallel algorithms for shared address space platform using multithreading
6. Develop parallel algorithms for tightly coupled and loosely coupled parallel systems for various applications.