COURSE CONTENT

PARALLEL PROGRAMMING								
VI Semester: CSE | CSE (DS) VIII Semester: CSE(CS)								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACCD28	Elective	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 48		
Prerequisites: High-Performance Computing								

I. COURSE OVERVIEW:

This course introduces the fundamentals of parallel programming, exploring programming models, parallel algorithms, and optimization strategies. It emphasizes the development of scalable solutions for complex problems using modern parallel architectures, including multi-core processors and distributed systems.

II. COURSE OBJECTIVES:

The students will try to learn:

I The concepts of parallelism and its necessity in modern computing.

II The understanding of various programming models such as shared memory and distributed memory paradigm

III The implementation of parallel algorithms for data and task decomposition

IV The application of optimization techniques for improving parallel program performance.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1 Analyze the need for parallel computing in various applications.

CO2 Develop programs using shared and distributed memory paradigms.

CO3 Implement parallel algorithms for complex computations.

CO4 Optimize parallel code for performance and scalability.

CO5 Evaluate and debug parallel programs using appropriate tools.

CO6 Understand and address challenges in parallel programming, including synchronization and deadlock avoidance.

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO PARALLEL PROGRAMMING (10)

Parallel Computing Concepts, Flynn's Taxonomy, Need for Parallel Processing, Parallel Programming Models, Overview of Parallel Architectures, Amdahl's Law, and Gustafson's Law.

MODULE – II: SHARED MEMORY PROGRAMMING (09)

Introduction to OpenMP, Basic Constructs, Work Sharing Constructs, Synchronization, Nested Parallelism, Performance Considerations in Shared Memory Systems.

MODULE – III: DISTRIBUTED MEMORY PROGRAMMING (10)

Introduction to MPI, Message Passing Model, Point-to-Point Communication, Collective Communication, Non-blocking Communication, Parallel I/O.

MODULE - IV: PARALLEL ALGORITHMS AND APPLICATIONS (09)

Parallel Sorting and Searching Algorithms, Matrix Operations, Graph Algorithms, Divide and Conquer Techniques, Parallel Performance Metrics.

MODULE – V: TOOLS AND DEBUGGING (10)

Profiling and Debugging Tools: gprof, Valgrind, TAU. Performance Analysis Techniques, Synchronization Issues, Deadlock Detection and Avoidance, Scalability Testing.

V. TEXTBOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 1st Edition, 2011.
2. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-Hill, 1st Edition,2004.

VI. REFERENCE BOOKS:

1. Barry Wilkinson and Michael Allen, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Pearson, 2nd Edition, 2005.
2. David Culler and Jaswinder Pal Singh, "Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann, 1st Edition, 1999.

VII, ELECTRONIC REFERENCES:

1. https://computing.llnl.gov/tutorials/parallel_comp/
2. https://www.openmp.org/resources/
3. https://www.mpi-forum.org/docs/

VIII. MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech-talk topics
4. Definitions and terminology
5. Assignments
6. Model question paper – I
7. Model question paper – II
8. Lecture notes
9. PowerPoint presentation
10. E-Learning Readiness Videos (ELRV)