



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

PARALLEL AND DISTRIBUTED COMPUTING								
II Semester: CSE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
BCSE31	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes:48	Total Tutorials: Nil	Total Practical Classes: Nil			Total Classes: 45			
Prerequisites: Operating system, computer networking, and computer Organization								

### I. COURSE OVERVIEW:

This course covers a broad range of topics related to parallel and distributed computing. It covers general introductory concepts in the design and implementation of parallel and distributed systems including parallel and distributed architectures and systems, parallel and distributed programming paradigms, parallel algorithms, and scientific and other applications of parallel and distributed computing.

### II. COURSE OBJECTIVES:

#### The students will try to learn:

- The basic design, architecture and design principles of cyber physical systems.
- The fundamental concepts of cryptography for ensuring security of cyber- physical systems
- The sources of vulnerability in a cyber physical system systematically via attack surfaces.
- The various modeling formalisms for CPS, such as hybrid automata, state-space methods, etc.

### III. COURSE OUTCOMES;

- CO1 Apply the fundamentals of parallel and distributed computing including parallel architectures and paradigms
- CO2 Analyze the various design principles of parallel algorithms
- CO3 Learn the intricacies of parallel and distributed programming
- CO4 Develop and execute basic parallel and distributed applications using basic programming models and tools.
- CO5 Apply design, development, and performance analysis of parallel and distributed applications.

#### **IV. COURSE SYLLABUS:**

##### **MODULE – I: INTRODUCTION TO PARALLEL COMPUTING (09)**

The Idea of Parallelism, Power and potential of parallelism, examining sequential and parallel programs, Scope and issues of parallel and distributed computing, Goals of parallelism, Parallelism and concurrency using multiple instructions streams

##### **MODULE – II: PARALLEL ARCHITECTURE (09)**

Pipeline architecture, Array processor, Multi processor architecture, Systolic architecture, Dataflow architecture, Architectural classification schemes, Memory access classification, Memory Issues : Shared vs. distributed, Symmetric multiprocessing (SMP), SIMD, Vector processing, GPU co-processing, Flynn’s Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).

##### **MODULE – III: PARALLEL ALGORITHM DESIGN PRINCIPLES AND PROGRAMMING (10)**

Need for communication and coordination/synchronization, Scheduling and contention, Independence and partitioning, Task- Based Decomposition, Data Parallel Decomposition, Characteristics of task and interaction, Load balancing.

Data Management, parallel algorithm models, Sources of overhead in parallel programs, Performance metrics for parallel algorithm implementations, Parallel algorithmic patterns like divide and conquer, Map and Reduce, Specific algorithms like parallel Merge Sort, Parallel graph Algorithms.

##### **MODULE - IV: INTRODUCTION TO DISTRIBUTED SYSTEMS (10)**

Goals of the Distributed Systems, Relation to parallel systems, synchronous versus asynchronous execution, design issues and challenges, Types of Distributed Systems, Distributed System Models, Hardware and software concepts related to distributed systems, middleware models.

##### **MODULE – V: DISTRIBUTED COMPUTING AND COMMUNICATION DESIGN PRINCIPLES (10)**

A Model of distributed executions, Models of communication networks, Global state of distributed system, Models of process communication. Communication and Coordination: Shared Memory, Consistency, Atomicity, Message- Passing, Consensus, Conditional Actions, Critical Paths, Scalability, and cache coherence in multiprocessor systems, synchronization mechanism.

##### **Parallel and Distributed Programming Frameworks:**

Overview of CUDA, OpenMP, POSIX Threads, Apache Hadoop (DFS), and current trends in parallel and distributed computing

#### **V. TEXT BOOKS:**

1. Ananth Grama, Anshul Gupta, and George Karypis, Vipin Kumar, “Introduction to Parallel Computing”, Addition Wesley, 2<sup>nd</sup> edition 2012.
2. Arun Kulkarni, Nupur Prasad Giri, Nikhilesh Joshi, “Parallel and Distributed Systems”, 2<sup>nd</sup> edition, 2019.

#### **VI. REFERENCE BOOKS:**

1. Ian Foster, “Designing and Building Parallel Programs – Concepts and tools for Parallel Software Engineering”, Pearson Publisher, 1<sup>st</sup> edition, 2019.
2. Michael J.Quinn, “Parallel Programming in C with MPI and OpenMP” McGrawHill Higher Education.