INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

PARALLEL DISTRIBUTED ALGORITHMS								
V Semester: CSE (DS)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACDD10	Elective	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: There are no prerequisites to take this course.								

I. COURSE OVERVIEW:

This course offers a thorough exposition of parallel computing, encompassing fundamental communication operations, the principles underlying the design of parallel algorithms, the motivations for parallelism, and programming on platforms that utilize shared address space and message passing. By acquiring an extensive knowledge of parallel computing techniques and concepts, pupils will be capable of creating effective parallel programs and capitalizing on the capabilities of contemporary parallel computing platforms.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals and scope of parallel computing, including architecture, memory systems, and communication mechanisms.
II. The parallel algorithm design, communication operations, and performance considerations in parallel systems.
III. The parallel programming paradigms, including message passing (MPI) and shared memory programming using threads (Pthreads).

III. COURSE OUTCOMES:

CO1 Explain the architecture and limitations of parallel computing systems, including communication costs and routing mechanisms.
CO2 Design parallel algorithms using decomposition and mapping techniques while considering task interaction and load balancing.
CO3 Implement and evaluate basic communication operations such as broadcast, reduction, scatter, and gather in parallel systems.
CO4 Analyze the performance of parallel programs, identifying overheads and optimizing for granularity.
CO5 Develop programs using the message passing paradigm (MPI) with emphasis on communication, synchronization, and process topology.
CO6 Implement multithreaded applications using shared memory (Pthreads) with proper synchronization, including a case study (e.g., chat server).

IV. COURSE CONTENT:

MODULE-1: INTRODUCTION TO PARALLEL COMPUTING (09)
Introduction to parallel computing, Motivating Parallelism, Scope of Parallel Computing, Parallel programming platforms, Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication costs in parallel machines, Routing mechanisms for inter connection network.

MODULE-2: PRINCIPLES OF PARALLEL ALGORITHM DESIGN (09)
Principles of parallel algorithm design -Preliminaries, Decomposition techniques, Characteristics of tasks and interactions, Mapping techniques for load balancing, Methods for containing interaction overheads, Parallel algorithm models.

MODULE-3: BASIC COMMUNICATION OPERATIONS (09)
Basic communication operations- One to all broadcast and all to one reduction, All to All broadcast and reduction, Scatter and gather.

Sources of overhead in parallel programs, Performance metrics for parallel systems, The effect of granularity on performance.

MODULE-4: PROGRAMMING USING MESSAGE PASSING PARADIGM (09)
Programming using message passing paradigm, building blocks, Message passing interface, Topologies and embedding, Overlapping computation with communication, Collective communication and computation operation.

MODULE-5: PROGRAMMING SHARED ADDRESS SPACE PLATFORMS (09)
Programming shared address space platforms, Thread basics Why threads? POSIX thread, Thread basics Synchronization primitives in Pthreads, Controlling thread and synchronization attributes, Composite synchronization constructs, Case Study: Implementation of Chat Server.

V. TEXTBOOKS:

1. Ananth Grama, Vipin Kumar, "Introduction to Parallel Computing", Second edition, 2007
2. Cameron Hughes,Tracey Hughes, "Parallel and Distributed Programming using C++", Pearson education, 2005
3. Alberty Zomaya, "Parallel and Distributed Computing Handbook", McGraw Hill Publications 2005.

VI. REFERENCE BOOKS:

1. Michael J Quinn, Parallel Computing, TMH
2. Joseph Jaja, An Introduction to Parallel Algorithms, Addison Wesley

VII. WEB REFERENCES

1. https://studio.code.org/s/csp6-2022/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I

8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)