## PARALLEL COMPUTING (Major Elective-III)

**Semester III (Computer Engineering)**
**SUB CODE: MECE303-A**

**Teaching Scheme (Credits and Hours)**

| Teaching scheme | | | | Total Credit | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L | T | P | Total | | Theory | | Mid Sem Exam | CIA | Pract. | Total |
| Hrs | Hrs | Hrs | Hrs | | Hrs | Marks | Marks | Marks | Marks | Marks |
| 04 | 00 | 02 | 06 | 05 | 3 | 70 | 30 | 20 | 30 | 150 |

**LEARNING OBJECTIVES:**

This course provides students with knowledge of the fundamental concepts of parallel computing as well as hands-on experience of the core technology in the field. By the end of the course, students will be proficient in performance analysis and performance tuning for sequential programs, parallel programs on shared-memory architectures, parallel programs on distributed-memory architecture, and parallel programs on hybrid architectures.

**OUTLINE OF THE COURSE:**

| Unit No | Topics |
|---|---|
| 1. | Introduction |
| 2. | Hardware taxonomy and Software taxonomy |
| 3. | Abstract parallel computational models |
| 4. | Performance Metrices |
| 5. | Parallel Processors |
| 6. | Parallel Programming |
| 7. | Scheduling and Parallelization |

**Total hours (Theory): 60**

**Total hours (Practical): 30**

**Total hours: 90**

**DETAILED SYLLABUS:**

| Sr. No | Topic | Lecture Hours | Weight age (%) |
|---|---|---|---|
| 1 | **Introduction:** Paradigms of parallel computing: Synchronous - vector/array, SIMD, Systolic; Asynchronous -MIMD, reduction paradigm. | 4 | 10 |
| 2 | **Hardware taxonomy:** Flynn's classifications, Handler's classifications. **Software taxonomy:** Kung's taxonomy, SPMD. | 8 | 15 |
| 3 | **Abstract parallel computational models:** Combinational circuits, Sorting network, PRAM models, Interconnection RAMs. Parallelism approaches - data parallelism, control parallelism | 10 | 15 |
| 4 | **Performance Metrices:** Laws governing performance measurements. Metrices - speedups, efficiency, utilization, communication overheads, single/multiple program performances, bench marks. | 10 | 15 |
| 5 | **Parallel Processors:** Taxonomy and topology - shared memory multiprocessors, distributed memory networks. Processor organization - Static and dynamic interconnections. Embeddings and simulations. | 10 | 15 |
| 6 | **Parallel Programming:** Shared memory programming, distributed memory programming, object oriented programming, data parallel programming, functional and dataflow programming. | 10 | 15 |
| 7 | **Scheduling and Parallelization:** Scheduling parallel programs. Loop scheduling. Parallelization of sequential programs. Parallel programming support environments. | 8 | 15 |

**INSTRUCTIONAL METHOD AND PEDAGOGY** (Continuous Internal Assessment (CIA) Scheme)

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lecture and laboratory which carries 10 marks in overall evaluation.
- One internal exam will be conducted as a part of internal theory evaluation.
- Assignments based on the course content will be given to the students for each unit and will be evaluated at regular interval evaluation.
- Surprise tests/Quizzes/Seminar/tutorial will be conducted having a share of five marks in the overall internal evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments shall be performed in the laboratory related to course contents.

**STUDENTS LEARNING OUTCOMES:**

On successful completion of the course, the student will:

- Understand the concepts and terminology of parallel computing.
- Can write and analyze the behavior of high performance parallel programs for distributed memory architectures.
- Can write and analyze the behavior of high performance parallel programs for shared memory architectures.
- Can independently study, learn about, and present some aspect of parallel computing.

**REFERENCE BOOKS:**


1. M. J. Quinn. *Parallel Computing: Theory and Practice* , McGraw Hill, New York, 1994.
2. Introduction to Parallel Computing, Second Edition by Ananth Grama, Anshul Gupta, Vipin Kumar, Pearson
3. Scalable Parallel Computing, Kai Hawang, Zhiwei Xu, TMH
4. Steven Brawer, Introduction To Parallel Programming
5. T. G. Lewis and H. El-Rewini. *Introduction to Parallel Computing* , Prentice Hall, New Jersey, 1992.
6. T. G. Lewis. *Parallel Programming: A Machine-Independent Approach* , IEEE Computer Society Press.