3/3 MCA First Semester

CA5T4F **PARALLEL PROCESSING** **Credits : 4**

Lecture Hours : 4 periods / week Internal assessment : 30 Marks

Semester and Examination: 70 Marks

Course Description:

The objective of this course is to introduce the students to High-Performance Computing (HPC). Students will develop skills in writing message-passing parallel codes for solution of large-scale computational problems and assessing computational speedup and efficiency of the parallel algorithms. The course features detailed analysis of effective techniques for parallel processing of inherently parallel problems and provides foundation for critical analysis of current and future HPC solutions.

Course Objective:

It aims teaching basic models of parallel machines and tools to program them. It is an introduction to parallel programming, how to parallelize programs, and how to use basic tools like MPI and POSIX threads.

- Student will learn Parallel Programming Platforms.
- Student will learn Principles of Parallel Algorithm Design.
- Student will learn Analytical Modeling of Parallel Programs.
- Student will learn Parallel Programming Paradigms.
- Student will learn Programming Shared Address Space Platforms.
- Student will learn Programming Message Passing Platforms.
- Student will learn pthreads.

UNIT I:

Introductin: Overview of Machine Levels (Historical and Contemporary), Design trends and issues (RISC vs CISC, future).

UNIT II:

Computer Systems Organization: Overview, Processors, memory, I/O, classification, technology, Paradigms and Models.

UNIT III:

Performance: Metrics and Benchmarks, Speedup and Scalability.

UNIT IV:

Pipelining and Vector Processing: Principles, classification, reservation tables, buffers, prefetching, forwarding, hazards.

UNIT V:

Scalar Processing: Superscalar Processing, Functional structures, processes, tasks, threads, interconnection networks and buses, parallel memory, concurrency

UNIT VI :

Parallel Algorithms: Concepts, Terminology, Issues, Processes, Threading, Timing.

UNIT VII:

Parallel Algorithm Design: Models, Partition, Communication, Mapping MPI and OpenMP, Parallel Algorithms Examples and Implementation , Graphs, Matrices, Numeric and Non-numeric, MPI and OpenMP.

UNIT VIII:

Advanced Architectures: Overview, Data Flow, GRID, Biological, Optical Example systems

Learning Resources

Text Books:

1. Flynn, M., Computer Architecture, Jones and Bartlett, 1/e, 1995.
2. Hennessy, J., and Patterson, D., Computer Architecture A Quantitative Approach, 4/e, 2007.
3. Hwang, K and Z. Xu, Scalable Parallel Computing, McGraw-Hill, 1998.
4. Quinn, M. J., Parallel Programming in C with MPI and OpenMP, McGraw-Hill, 2004.

Reference Books:

1. Shiva, S. G., Advanced Computer Architectures, CRC Press (Taylor and Francis), 2006.
2. Tanenbaum, A. S. Structured Computer Organization, 5th Ed., Prentice Hall, 2006.
3. Vahid, F., and T. Givargis, Embedded System Design, Wiley, 2002.