NIRMA UNIVERSITY
Institute of Technology
B. Tech. Computer Science and Engineering
Semester –VI
Department Elective-I

L	T	P	C
2	0	2	3

Course Code	2CSDE58
Course Title	High Performance Computing

Course Outcomes :

At the end of the course, students will be able to –

1. analyse the functionality of Modern Processor.
2. comprehend and implement various optimization techniques for serial code.
3. design the concept of parallel computing paradigm.

Syllabus:

Teaching Hours:30

Unit I **06**

Modern Processors: Stored Program Computer Architecture, Architecture of microprocessor based on cache- Performance based metrics and benchmarks, Moore's Law, Pipelining, Super scalarity, SIMD, Different classes of Memory- cache, mapping, pre-fetch ,Introduction to different types of processor such as Multicore processors, Multithreaded processors, Vector Processors

Unit II **10**

Requirements and General Issues: Scalable parallel computer Architectures, A cluster computer and its Architecture, clusters classifications, Commodity components for clusters, Network services/Communication SW, Cluster middleware and single system Image(SSI),Resource Management and Scheduling(RMS),Programming environments and Tools, Representative cluster Systems. **High speed Networks:** Design issues, Fast Ethernet, High Performance parallel interface (HPPI), Asynchronous transfer mode (ATM), Myrinet.

Unit III **04**

Parallel Computers: Taxonomy of parallel computing paradigm, Different types of memory computers such as Shared memory computers, Distributed-memory computers, Hierarchical systems, Basics of parallelization.

Unit IV **05**

Parallel Scalability- Factors that limit parallel execution- Scalability metrics- Simple scalability laws- parallel efficiency - serial performance Vs Strong scalability- Refined performance models- Choosing the right scaling baseline- Case Study: Can slow processors compute faster- Load balance

Unit V **05**

Distributed memory parallel programming with MPI: Brief introduction to MPI such as messages and point-to-point communication - collective communication – Non blocking point-to-point communication- virtual topologies ,MPI parallelization of Jacobi solver- MPI implementation - performance properties .MPI performance tools, communication parameters, Synchronization, serialization.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on the above syllabus with minimum 7 experiments to be incorporated.

Suggested Readings^:

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series
2. Gene Wagenbreth and John Levesque, High performance Computing: Programming and Application,CRC press, Taylor and francis group
3. MaciejBrodowicz, Matthew Anderson, and Thomas Sterling, High Performance Computing: Modern Systems and Practices,Morgankaufmann publishers

L=Lecture, T=Tutorial, P=Practical, C=Credit

^this is not an exhaustive list