

IT 705 Elective –II (IT- 722- High Performance Computing)

Unit I: Introduction to high performance computing: Aim, Architectures, Cluster, Grid, Meta-computing, Middleware, Examples of representative applications.

Programming models: Parallel programming paradigms, task partitioning and mapping, shared memory, message passing, peer-to-peer, broker-based. Introduction to PVM and MPI.

Unit II: Architecture of cluster-based systems, Issues in cluster design: performance, single-system-image, fault tolerance, manageability, programmability, load balancing, security, storage.

High performance sequential computing: Effects of the memory hierarchy, Out-of-order execution, superscalar processors, Vector processing.

Unit III: Shared-memory processing: Architectures (extensions of the memory hierarchy), Programming paradigms, OpenMP.

Distributed-memory processing: Architectural issues (networks and interconnects), Programming paradigms, MPI (+MPI2).

Unit IV: Grids: Computational grids, Data grids, Architecture of Grid systems, Grid security infrastructure. Examples of Grids: Globus.

The productivity crisis & future directions: Development overheads, Petaflops programming, New parallel languages: UPC, Titanium, Co-Array FORTRAN.

Unit V: Performance Issues and Techniques: Cost and Frequency Models for I/O, paging, and caching. Notion of Cacheing; temporal and spatial locality models for instruction and data accesses; Intra-process parallelism and pipelining.

Typical Compiler Optimizations of Programs; Improving Performance: Identifying program bottlenecks - profiling, tracing; simple high-level-language optimizations - locality enhancement, memory disambiguation, moving loop-invariants.

References:-

- Charles Severance, Kevin Dowd, O'reilly, "High Performance Computing", Second Edition July 1998
- David j. Kuck, "High Performance Computing", Oxford Univ Pr, 1996
- Gary W. Sabot, "High Performance Computing ", Addison-Wesley, 1995
- Dowd K, "High Performance Computing", O' Reilly Series, 1993.
- R.E. Bryant and D. O'Hallaron, "Computer Systems:A Programmer's Perspective", Pearson Education, 2003.