

## **CS 705: PARALLEL PROCESSING: ARCHITECTURES AND ALGORITHMS (3-0-0: 3)**

**Introduction:** Parallelism in uniprocessor System, memory-interleaving, pipelining and vector processing, parallel computer structures, architectural classifications, parallel computer models: PRAM and VLSI complexity models, program properties: conditions of parallelism, program partitioning and scheduling, granularity and scalability.

**System interconnect architectures:** Static interconnection networks array, tree, mesh, pyramid, hypercube, cube-connected-cycles, butterfly, Cayley graphs; Dynamic interconnection networks crossbar, Clos network, multistage interconnection networks, blocking, non-blocking and rearrangeable operations, properties and routing. Networked computers as a multi-computer platform, basics of message-passing, computing using workstation clusters, Software tools.

### **Parallel algorithms and their mapping on different architectures:**

- i. Arithmetic computations: Addition, multiplication, FFT, DFT, Polynomial multiplication, convolution, evaluation and interpolation.
- ii. Matrix operations: Transposition, multiplication, inversion, eigen value computation.
- iii. Numerical applications: Solving systems of linear equations, finding roots of non-linear equations, solving partial differential equations.
- iv. Sorting: Theoretical bounds, sorting networks, Batcher's odd-even and bitonic sort, sorting on hypercubic networks, mesh and mesh-like architectures.
- v. Graph algorithms: All-pairs shortest-path (APSP) problem, finding connected components of a graph, minimum spanning tree.
- vi. Computational Geometry: Inclusion problem, intersection problem, proximity problem, construction problem.

### **References:**

1. K. Hwang and F. A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill
  2. K. Hwang, Advanced Computer Architecture, McGraw Hill, New York
  3. M. J. Quinn, Design of Efficient Algorithms for Parallel Computers, McGraw Hill, New York
  4. S. G. Akl, Design and Analysis of Parallel Algorithms, Prentice Hall, Englewood Cliffs
  5. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kauffmann Pub.
  6. S. Lakshmivarahan and Analysis and S. K. Dhall, Design of Parallel Algorithms, McGraw Hill, New York.
  7. J. Jaja, Introduction to Parallel Algorithms, Addison-Wesley, Reading, Mass.
- S. G. Akl, Parallel Sorting Algorithms, Academic Press, Orlando.