# **CSE3111: Parallel Computing: Advances**

Programme: B.Tech. (CSE) Year: III Semester: I Course: Program Elective Credits: 3 Hours: 40

# **Course Context and Overview:**

Parallel computers provides a platform to solve a problem with multiple computers or computer with multiple processing element in order to obtain faster results. This course provides overview of design, engineering and analysis of modern parallel computers.

Prerequisites Courses: Computer Organization and Architecture, CSE216

## **Course outcomes(COs):**

| On completion of this course, the students will have the ability to: |
|----------------------------------------------------------------------|
| CO1: Understands parallel hardware constructs                        |
| CO2: Understands design and performance issues in parallel computer  |
| CO3: Understands different programming model for parallel computer   |
| CO4: Understands memory and cache architecture for parallel computer |
| CO5: Understands recent trends in the area of parallel computer      |

# **Course Topics:**

| Topics                                                                  | <b>Lecture Hours</b> |
|-------------------------------------------------------------------------|----------------------|
| UNIT – I: Introduction                                                  |                      |
| Flynn's taxonomy, Sequential performance, Performance metrics for       | 4                    |
| parallel architecture, Scalability, Performance versus efficiency       |                      |
| UNIT - II: Parallel Architecture and Programming Models                 |                      |
| Challenges; Instruction, data and thread-level parallelism; Classes of  |                      |
| parallel computers, Communication models: Shared memory and             | 12                   |
| Message passing; High-level parallel programming models: Task-          |                      |
| parallel, Data-parallel, MapReduce, Pipeline-parallel                   |                      |
| UNIT – III : Memory Architecture and Synchronization                    |                      |
| Cache coherence: Snooping-Based, Directory-Based; Consistency           | 12                   |
| models; Cache Architecture; Memory Architecture; Thread-Level           | 12                   |
| Speculation and Transactional Memory                                    |                      |
| UNIT - IV : Specialized and Heterogeneous Architecture                  |                      |
| Vector processors and GPUs; Clusters, Specialized compute units; Multi- | 13                   |
| Core and Multi-Threading; Interconnections network; Many-Core           |                      |

### **Textbook references:**

#### **Text Book:**

- 1. David E. Culler and Jaswinder Pal Singh, with Anoop Gupta., "Parallel Computer Architecture": A Hardware/Software Approach. Morgan Kaufmann, 1998.
- 2. Kai Hwang, "Advanced Computer Architecture", Parallelism, Scalability, Programmability, 2<sup>nd</sup> edition, Mc Graw Hill, 2011.
- 3. Michael J. Quinn. "Parallel Programming in C with MPI and Open MP". McGraw Hill, 2003.
- 4. J.L. Hennessey & D.A. "Patterson Computer Architecture": a Quantitative Approach, 5th Edition, Morgan Kaufmann, 2011.

### **Evaluation Methods:**

| Item                         | Weightage |
|------------------------------|-----------|
| Continuous evaluation (Quiz, | 20%       |
| Assignment, Attendance etc.) |           |
| Term Paper                   | 10%       |
| Midterm                      | 25%       |
| Final Examination            | 45%       |

Prepared By:

Last Update: 8th April, 2015