Suggested Teaching Guidelines for
Upcoming Technology-PG-DAC August 2018

Duration: 20 class room hours

Objective: To acquire the knowledge of parallel computing
Students undergoing this course are expected to

- Have an understanding about parallel models, performance, metrics and measures.
- Discuss about advanced processor technology and memory hierarchy.
- Study in Parallelism and its architectures.
- Study the OpenMp Programming.

Prerequisites: Knowledge of Computer Architecture, Linux, C/C++, and Operating System.
Evaluation method: Theory exam– 40% weightage
Internal exam– 60% weightage
List of Books / Other training material
Reference Text Book:
1. An Introduction To Parallel Computing : Design And Analysis Of Algorithms 2ed 2ndediton Edition Author: Vipin Kumar, Ananth Grama, Anshul Gupta, George Karypis
2. Parallel Programming in C with MPI andOpenMP, Michael J, Quinn
3. Computer Organization & Architecture – Carl Hamacher Zvonko, Safwat G. Zaky
4. High Performance Cluster Computing: Architectures & Systems (Volume-1) by Rajkumar Buyya, Pearson

Session 1:
Lecture 1, 2 (2+2 hours)
Multiprocessor Architecture

- Basic concepts of computer organization
- Classes of computer architecture,
- Processor vs. System architecture
- Goals of computer architecture – performance, throughput, latency
- Trends in Microprocessor Architectures, Multicore Architectures

Assignment – Study about advancement in processors, Symmetric Multiprocessor and Multicore Architectures
Session 2:
Lecture 3, 4 (2+2 hours)
Parallel Programming Platforms

- Introduction Amdahl's law and Gustafson's law,
- Dependencies,
- Routing Mechanisms for Interconnection Networks
- Race conditions, mutual exclusion, synchronization, and parallel slowdown,
- Limitations of Memory System Performance
- Performance Metrics for Parallel Systems

Assignment – Divide and Conquer algorithms Implementation and use cases

Suggested Teaching Guidelines for
Upcoming Technology-PG-DAC August 2018

Session 3:
Lecture 5, 6 (2+2 hours)
Concepts of parallelism

- Concepts of parallelism
- Types of parallelism: Fine-grained, coarse- grained, and embarrassing parallelism, Bit-level parallelism, Instruction-level parallelism, Data parallelism, Task parallelism,
- Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms,
- Communication Costs in Parallel Machines,
- Impact of Process-Processor Mapping and Mapping Techniques.

Assignment – Case study for High performance Computing technology and trends, Multicore Computing with Intel TBB
Session 4:
Lecture 7, 8 (2+2 hours)
Principles of Parallel Algorithm Design algorithms

- Decomposition Techniques,
- Characteristics of Tasks and Interactions, Profiling
- Mapping Techniques for Load Balancing, Optimization
- Methods for Containing Interaction Overheads,
- Parallel Algorithm Models
- Principles of Message-Passing Programming

Assignment – Code Optimization and Profiling of program (using gprof, gdb, ddd)
Session 5:
Lecture 9, 10 (2+2 hours)
Programming Shared Address Space Platforms Thread Basics

- What is a thread,
- Strategies of Multi-Threading, Introduction to Pthread
- OpenMP Programming Model,
- OpenMP constructs

Assignment – Programming OpenMP, Ex: Dense Matrix Algorithms, Sorting