Suggested Teaching Guidelines for

HPC System Administration and Management – PG-DHPCSA
August 2019

Duration: 60 class room hours + 80 Lab hours

Objective: To introduce HPC System Administration and Management.

Prerequisites: Knowledge of Computer Networks

Evaluation method: CCEE Theory exam– 40% weightage

Lab exam (Case Study based) – 40% weightage

Internal exam – 20% weightage

List of Books / Other training material

Text Book:

- High Performance Cluster Computing: Architectures & Systems (Volume-1) by Rajkumar Buyya, Pearson

Reference:

1. An Introduction to Parallel Computing: Design and Analysis of Algorithms (Authors: Vipin Kumar, Ananth Grama, Anshul Gupta, George Karypis)
2. Parallel programming in C with MPI and OpenMP (Author: Michael J. Quinn)
3. Distributed Computing and Networking: 11th International Conference, ICDCN 2010, Kolkata, India, January 3-6, 2010, Proceedings (Lecture Notes in Computer ... Computer Science and General Issues) 1st Edition. Edition
4. Distributed Computing Author: Seema Shah, Sunita Mahajan, Oxford Publications

Note: Each session mentioned is for theory and of 2 hours duration. Lab assignments are indicatives, faculty need to assign more assignments for better practice.

Data Center: Design & Management (14 Hrs Theory)
Session 1 & 2
Lecture:

- Data center overview
- Design issues

Session 3 & 4
Lecture:

- HVAC
- Power sizing

Session 5
Lecture:

- Data center matrices and best practices
- Security & safety

Session 6 & 7
Lecture:

- Collection, rejection and reuse of heat
- Energy use systems
- Cabinet & cable Management

Assignment:

- Case study about Data Center and Visit of Data Center

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Ecosystem: Architecture of HPC Cluster (30 Hrs Theory + 44 Hrs Lab)

Session 8 & 9
Lecture:
- Requirement Analysis

Session 10 &11
Lecture:
- Building blocks of HPC

Session 12 & 13
Lecture:
- Hardware and software selection process
- Cluster Planning

Session 14 &15
Lecture:
- Design of HPC Cluster

Session 16 &17
Lecture:
- Architecture and Cluster software

Session 18 &19
Lecture:
- Cluster building tools

Session 20 & 21
Lecture:
- Multicore-architecture
- knights landing and pascal
- Accelerator cards
- Configuring & setting environment for accelerator cards (CUDA Library)

Session 22
Lecture:
- Latest trends and technologies in HPC
- **Case study:** Param Shavak and Use Cases of Param Shavak for HPC solutions

Assignment:
- Write Survey Paper on Multicore processor and latest advancement in this

HPC System Management and Monitoring (16 Hrs Theory + 36 Lab Hrs)
Session 23
Lecture: s
- IPMI
- HMC

Session 24
Lecture:
- Processor usage, memory usage
- Network monitoring, network usage
- XD mod monitoring tool.

- Gangila, Collectl, Graphite, Nagios
- Node resources

Session 25, 26, 27, 28, 29 & 30
Lecture:

- System Benchmarking
- Theoretical peak performance
- HPL bench mark, Tuning HPL, Problem size, Block size, process grid PxQ
- OSU Benchmark / IO Benchmark
- HPCG Benchmark
- DGEMM, STREAM, PTRANS, Random Access, FFT, Communication bandwidth and latency

Assignment:

- operate, maintain, integrate, upgrade, and manage all HPC resources including related hardware and software

Assignments –Lab:

- Data Centre visit
- Building a manual HPC Cluster
- Building an HPC Cluster using different Cluster building and management tools
- Monitoring tools installation & configuration
- Network monitoring using Nagios
- IPMI configuration
- System benchmarking using HPL and HPCG
- OSU Benchmarking / IO Benchmarking
- Testing of DGEMM, STREAM, PTRANS, Random Access, FFT, Communication bandwidth and latency
- Case study HPC Solution (PARAM Shavak)