

CEN- 704: PARALLEL AND DISTRIBUTED COMPUTING

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Credits : 4

Duration of Exam : 3 Hours

Internal: 40 Marks

External: 60 Marks

Total: 100Marks

Course Outcomes:

1. Students will be able to understand architecture , dependency analysis and other issues of parallel Systems and performance laws to evaluate them
2. Students will be able to design and implement pipeline for solving real life problems.
3. Students will able to design parallel algorithm for solving a given problem and to parallelize sequential algorithms.
4. Students will be able to understand and write cluster program using MPI, multi core program using Open Mp and programming massive parallel processor GPU using CUDA.
5. Students will able to develop real life scalable distributed system and distributed applications

UNIT 1:

Parallel system , Parallel computing, architectural classification schemes, Evolution of computer Architecture ,Parallel architecture, superscalar processor, Vector processors, Principle of multithreading, latency-hiding techniques, multi core processors, GPU, massive parallel processors, Cache coherence and synchronization mechanism , Arithmetic mean performance, geometric performance, harmonic performance, Performance laws, Amdahl's law, Gustafson's law, Sun and Ni' law, Bernstein's criteria, dependency analysis, flow dependency, anti dependency, output dependency, dependency flow graph, Evaluating parallel programs, Debugging and evaluating parallel program empirically.

UNIT 2: *P = H + v * n*

Pipeline, Design and analysis of pipeline and system based on it, optimal no. of stages, Instruction scheduling, pipeline hazards and their solutions, Tomasulo algorithm, Branch predictions, pipeline and branch predictor of recent processors, Collision free scheduling, Reservation table and stations.

UNIT 3:

Design and analysis of parallel algorithms, Preliminaries, decomposition techniques, characteristics of tasks and interactions, mapping techniques for load balancing, methods for containing interaction overheads, parallel algorithm models, the task/channel model, Foster 's design methodology, boundary value problem, finding the maximum, n-body problem, sorting, searching, solving linear equations, matrix multiplication, Parallelizing sequential algorithms, SIMD algorithm for multiplication, PRAM and VLSI model


UNIT 4:

Parallel Programming, Cluster programming using MPI, Multi core programming using OPEN MP, Programming massive parallel processors using CUDA, GPU, OPENCL, OPENACC

UNIT 5:

Distributed system, distributed computing, distributed applications, paradigms of Distributed Computing, Cloud Computing, Distributed algorithms, Logical clocks, clock synchronization algorithms

Books:

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- Michael J. Quinn, "Parallel Computing theory and practice", TATA McGraw Hill
 - Ananth Gramma, Anshul gupta, George Karypis & Vipin Kumar, "Introduction to parallel computing", Pearson Education.
 - Michael J. Quinn, "Parallel Programming in with MPI and OpenMP", Pearson Education
 - Barry Wilkinson & Michael Allen, "Parallel Programming techniques and Applications using networked work stations and parallel computers", Pearson Education
 - Kai Hwang, "Advanced Computer architectures, Parallelism, Scalability & Programmability", McGraw Hill.
 - John L. Hennessey and David A. Patterson, "Computer Architecture – A quantitative approach", Morgan Kaufmann / Elsevier Publishers, 5th. Edition, 2012.
 - David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors, A hands on approach, Morgan Kaufman publishers, Elsevier.
 - Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011.
 - Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
 - 4. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kaufmann, 2010.
 - Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", Second Edition, Pearson Education Limited, 2003.
 - Shameem Akhter and Jason Roberts, "Multi-core Programming", Intel Press, 2006.
 - Ian Foster, "Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering", Addison Wesley Longman Publishing Co., USA, 1995.
 - David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A hardware/ Software approach", Morgan Kaufmann / Elsevier Publishers, 1999.
 - OpenMP Programmer's Manual.
 - MPI Programmer's Manual
 - Kai Hwang, Distributed and Cloud Computing, Elsevier
 - Raj kumar Buyya, Mastering Cloud Computing, TMH publications.