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| Devi Ahilya University, Indore, India Institute of Engineering & Technology | | | | IVYear B.E. (Computer Engg.) (Full Time) | | | |
| Subject Code & Name | Instructions Hours per Week | | | Credits | | | |
| CER8E4 | L | T | P | L | T | P | Total |
| Parallel Computing | 3 | 1 | 2 | 3 | 1 | 1 | 5 |
| Duration of Theory Paper:3 Hours | | | | | | | |

Learning Objectives:

Parallel programming is ubiquitous in today's multi-core era and solves many real-world scientific problems. Massive parallelism entails significant hardware and software challenges. The course is structured so that the participants understand challenges in efficient execution of large-scale parallel applications. The course will also involve a research-oriented component.

Pre requisites:

Exposure to Operating Systems, Computer Architecture and Computer Networks is desirable.

COURSE OF CONTENTS

Unit 1: Introduction and Message passing

Why parallel computing? Shared memory and distributed memory parallelism, Amdahl's law, speedup and efficiency, supercomputers. MPI basics, point-to-point communication, collective communication, synchronous/asynchronous send/recv, algorithms for gather, scatter, broadcast, reduce.

Unit 2: Parallel communication

Network topologies, network evaluation metrics, communication cost, routing in interconnection networks, static and adaptive routing, process-to-processor mapping.

Unit 3: Performance

Scalability, benchmarking, performance modeling, impact of network topologies, parallel code analysis and profiling.

Unit 4: Designing parallel codes

Domain decomposition, communication-to-computation ratio, loadbalancing, adaptivity, case studies: weather and material simulation codes.

Unit 5: Parallel I/O and Additional topics

MPI I/O algorithms, contemporary large-scale I/O architecture, I/O bottlenecks.

Job scheduling, RDMA, one-sided communication, NVM, extreme scale computing: issues and trends.

Learning Outcomes

After completing of this course, the students will learn theoretical/practical aspects of parallel computing, and they will be able to effectively use parallel machines. Also, students will gain exposure to perform research on parallel computing, and to learn programming multicore processors.

RECOMMENDED BOOKS:

- [1] Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
- [2] DE Culler, A Gupta and JP Singh, Parallel Computer Architecture: A Hardware/Software Approach Morgan-Kaufmann, 1998.
- [3] Marc Snir, Steve W. Otto, Steven Huss-Lederman, David W. Walker and Jack Dongarra, MPI - The Complete Reference, Second Edition, Volume 1, The MPI Core.
- [4] William Gropp, Ewing Lusk, Anthony Skjellum, Using MPI : portable parallel programming with the message-passing interface, 3rd Ed., Cambridge MIT Press, 2014.
- [5] A Grama, A Gupta, G Karypis, and V Kumar, Introduction to Parallel Computing. 2nd Ed., Addison-Wesley, 2003.
- [6] JL Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach, 4th Ed., Morgan Kaufmann/Els India, 2006.
- [7] MJ Quinn, Parallel Computing: Theory and Practice, Tata McGraw Hill, 2002.