MPI programming for distributed memory systems: MPI basic communication routines (Introduction to MPI and basic calls, MPI calls to send and receive data, MPI call for broadcasting data, MPI Non-blocking calls, Introduction to MPI Collectives, Types of interconnects (Characterization of interconnects, Linear arrays, 2D mesh and torus, cliques)

Unit 4

Applications: Matrix-matrix multiply, Odd-Even sorting, distributed histogram, Breadth First search, Dijkstra's algorithm.

References

1. Grama, A., Gupta, A., Karypis, G., Kumar, V., *Introduction to Parallel Computing*, 2nd edition, Addison-Wesley, 2003.
2. Quinn, M., *Parallel Programming in C with MPI and OpenMP*, 1st Edition, McGraw-Hill, 2017.
3. Revdikar, L., Mittal, A., Sharma, A., Gupta, S., *A Naïve Breadth First Search Approach Incorporating Parallel Processing Technique For Optimal Network Traversal*, International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 5, May 2016

Additional references

(i) B. Parhami, Introduction to Parallel Processing: Algorithms and Architectures, Plenum, 1999, Springer.

Suggested Practical List

1. Implement Matrix-Matrix Multiplication in parallel using OpenMP
2. Implement distributed histogram Sorting in parallel using OpenMP
3. Implement Breadth First Search in parallel using OpenMP
4. Implement Dijkstra's Algorithm in parallel using OpenMP

DSC17/GE7d/DSE8e: CLOUD COMPUTING

Credit distribution, Eligibility and Pre-requisites of the Course

	Credits	Credit distribution of the course		

Course title & Code		Lecture	Tutorial	Practical/ Practice	Eligibility criteria	Pre-requisite of the course
Cloud Computing	4	3	0	1	Pass in Class XII	NIL

Course Objective:

The objective of an undergraduate cloud computing course is to provide students with a comprehensive understanding of cloud computing technologies, services, and applications.

Course Learning Outcomes:

Learning outcomes for an undergraduate course on cloud computing may include:

1. Knowledge of the fundamental concepts and principles of cloud computing, including virtualization, scalability, reliability, and security.
2. Ability to design, develop, and deploy cloud-based applications using popular cloud platforms and services.
3. Familiarity with cloud computing architectures, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
4. Visualize the economic, legal, and ethical implications of cloud computing, including issues related to data privacy, ownership, and security.
5. Ability to evaluate and select cloud-based solutions based on their technical, economic, and business requirements.
6. Understanding of the broader societal and environmental impacts of cloud-based services and applications.

Syllabus:

Unit 1: Overview of Computing Paradigm
Recent trends in Computing : Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing,

Unit 2: Introduction to Cloud Computing
Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing,

Unit 3: Cloud Computing Architecture

Comparison with traditional computing architecture (client/server), Services provided at various levels, Service Models- Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), How Cloud Computing Works, Deployment Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Case study of NIST architecture.

Unit 4: Case Studies

Case study of Service model using Google Cloud Platform (GCP), Amazon Web Services (AWS), Microsoft Azure, Eucalyptus.

Unit 5: Cloud Computing Management

Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling.

Unit 6: Cloud Computing Security

Infrastructure Security- Network level security, Host level security, Application level security, Data security and Storage- Data privacy and security Issues, Jurisdictional issues raised by Data location, Authentication in cloud computing.

References:

1. Thomas Erl, Ricardo Puttini and Zaigham Mahmood, Cloud Computing: Concepts, Technology and Architecture, Publisher: PHI, 2013.
2. Rajkumar Buyya, James Broberg, and Andrzej Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2013.
3. Boris Scholl, Trent Swanson, and Peter Jausovec, Cloud Native: Using Containers, Functions, and Data to Build Next-Generation Applications, Publisher : Shroff/O'Reilly, 2019.

Additional References:

1. *Cloud Computing Bible,* Barrie Sosinsky, *Wiley-India,* 2010
2. *Cloud Computing: Principles and Paradigms,* Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, *Wile,* 2011

3. *Cloud Computing: Principles, Systems and Applications, Editors:* Nikos Antonopoulos, Lee Gillam, *Springer*, 2012

4. *Cloud Security: A Comprehensive Guide to Secure Cloud Computing*, Ronald L. Krutz, Russell Dean Vines, *Wiley-India*, 2010

Suggested Practical List:

1. Create virtual machines that access different programs on same platform.

2. Create virtual machines that access different programs on different platforms .

3. Working on tools used in cloud computing online-

    a) Storage

    b) Sharing of data

    c) manage your calendar, to-do lists,

    d) a document editing tool

4. Exploring Google cloud

5. Exploring microsoft cloud

6. Exploring amazon cloud