**Session 2025-2026**

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| **Vision:** To help businesses uncover crucial  insights | **Mission:** To be a good data scientist |

**Program Educational Objectives of the program (PEO):** (broad statements that describe the professional and career accomplishments)

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| PEO1 | **Preparation** | **P: Preparation** | **Pep-CL abbreviation**  **pronounce as Pep-si-lL easy to recall** |
| PEO2 | **Core Competence** | **E: Environment (Learning Environment)** |
| PEO3 | **Breadth** | **P: Professionalism** |
| PEO4 | **Professionalism** | **C: Core Competence** |
| PEO5 | **Learning Environment** | **L: Breadth (Learning in diverse areas)** |

**Program Outcomes (PO):** 1. Understand and Apply Parallel Programming Concepts

2. Analyse and Improve Program Performance.

3. Demonstrate Practical Skills in HPC Tools and Environments.

**Keywords of POs:**

Engineering knowledge, Problem analysis, Design/development of solutions, Conduct Investigations of Complex Problems, Engineering Tool Usage, The Engineer and The World, Ethics, Individual and Collaborative Team work, Communication, Project Management and Finance, Life-Long Learning

**PSO Keywords:** Cutting edge technologies, Research

“I am an engineer, and I know how to apply engineering knowledge to investigate, analyse and design solutions to complex problems using tools for entire world following all ethics in a collaborative way with proper management skills throughout my life.” *to contribute to the development of cutting-edge technologies and Research*.

**Integrity:** I will adhere to the Laboratory Code of Conduct and ethics in its entirety.

**Name and Signature of Student and Date**

Sujal Kumeriya – 01/09/2025

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| **Session** | **2025-26 (ODD)** | | **Course Name** | **HPC Lab** | |
| **Semester** | **7** | | **Course Code** | 22ADS706 | |
| **Roll No** | 64 | | **Name of Student** | Sujal Kumeriya | |
|  |  | |  |  |  |
| Practical Number | | 1 | | | |
| Course Outcome | | 1. Understand and Apply Parallel Programming Concepts 2. Analyse and Improve Program Performance | | | |
| Aim | | Introduction to Linux and HPC Environment | | | |
| Problem Definition | | Introduction to Linux and HPC Environment | | | |
| Theory  (100 words) | | **Definition:**  High Performance Computing (HPC) refers to the use of  supercomputers and parallel processing techniques to  solve complex computational problems faster and more  efficiently than traditional systems.  **Purpose:**  To Solve large-scale scientific, engineering, and  data-intensive problems.  To Reduce processing time.  To Improve simulation accuracy.  **Key Components of HPC Systems:**  Compute Nodes (Processors/CPUs/GPUs)  Memory (RAM)  Storage (Disks/SSDs)  Interconnect (High-speed Network)  Software Stack (Compilers, Libraries, Tools)  **Parallel Computing – The Core of HPC**  **Types of Parallelism:**  **Data Parallelism:** Same operation on different data  **Task Parallelism:** Different tasks executed simultaneously  **Parallel Architectures:**  Shared Memory Architecture  Multiple cores sharing the same RAM  Easy programming but limited scalability  **2. Distributed Memory Architecture**  Each processor has its own memory  Requires message passing (MPI)  **Parallel Programming:**  It is a programming technique where multiple tasks or  computations are performed simultaneously to solve a  problem faster and more efficiently.  **Purpose:**  Speed up execution time  Utilize multi-core and multi-processor hardware  Handle large data sets  Perform complex scientific simulations  **Why is Parallel Programming Needed in HPC?**  To Solve Large Problems Faster  To Make Full Use of Modern Hardware  To Handle Big Data and Complex Simulations  To Achieve Better Performance and Scalability  Energy and Cost Efficiency  **Why is Parallel Programming Needed in HPC?**  To Solve Large Problems Faster  To Make Full Use of Modern Hardware  To Handle Big Data and Complex Simulations  To Achieve Better Performance and Scalability  Energy and Cost Efficiency  **Parallel Programming Models:**  **Shared Memory (OpenMP, Threads):** Tasks share  the same memory space  **Distributed Memory (MPI):** Tasks run on different  machines and exchange messages  **Hybrid**: Mix of shared and distributed (used in  modern HPC)  **GPU-based (CUDA, OpenCL):** Thousands of  lightweight threads run in parallel on GPUs  **Programming Models in HPC:**  **Message Passing Interface (MPI)**  Used in distributed memory systems  **OpenMP**  Shared memory parallelism using compiler directives  **CUDA/OpenCL**  Programming for GPUs  **Hybrid Models**  MPI + OpenMP or MPI + CUDA  **Why Linux in HPC?**  Linux is the standard OS for HPC clusters  Open-source, customizable, lightweight  Robust support for networking, process control,  and file systems  Widely supported by HPC software libraries and  tools | | | |
| Code: | | * ls * cd Downloads * pwd * mkdir MyDocuments * rm -rf MyDocuments * top * man dnf * touch text.txt * nano text.txt | | | |
| Output | |  | | | |
| Output Analysis | | We have taken a brief overview of the main concepts of HPC and have practices working on a live Linux environment running CentOS Stream 10. | | | |
| Link of student Github profile where lab assignment has been uploaded | | **https://github.com/sujalkumeriya59/HPC\_LAB** | | | |
| Conclusion | | We have taken a brief overview of the main concepts of HPC and have practices working on a live Linux environment running CentOS Stream 10. | | | |
| Plag Report (Similarity index < 12%) | | **A screenshot of a computer  AI-generated content may be incorrect.** | | | |
| Date | | 01/09/2025 | | | |