



Department of Computer Technology

Vision of the Department

To be a well-known centre for pursuing computer education through innovative pedagogy, value-based education and industry collaboration.

Mission of the Department

To establish learning ambience for ushering in computer engineering professionals in core and multidisciplinary area by developing Problem solving skills through emerging technologies.

Session 2025-2026

Vision: To help businesses uncover crucial insights	Mission: To be a good data scientist
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Program Educational Objectives of the program (PEO): (broad statements that describe the professional and career accomplishments)

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

Soham pimplagaonkar – 28/10/2025

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Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Hingna Road, Wanadongri, Nagpur - 441 110

NAAC A++

Ph.: 07104-237919, 234623, 329249, 329250 Fax: 07104-232376, Website: www.ycce.edu



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Session	2025-26 (ODD)	Course Name	HPC Lab
Semester	7	Course Code	23030146
Roll No	62	Name of Student	Soham pimpalgaonkar

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)	<p>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.</p> <p>Purpose: To Solve large-scale scientific, engineering, and data-intensive problems. To Reduce processing time. To Improve simulation accuracy.</p> <p>Key Components of HPC Systems: Compute Nodes (Processors/CPUs/GPUs) Memory (RAM) Storage (Disks/SSDs) Interconnect (High-speed Network) Software Stack (Compilers, Libraries, Tools)</p> <p>Parallel Computing – The Core of HPC</p> <p>Types of Parallelism:</p> <p>Data Parallelism: Same operation on different data</p>



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	<p>Task Parallelism: Different tasks executed simultaneously</p> <p>Parallel Architectures:</p> <ul style="list-style-type: none">Shared Memory ArchitectureMultiple cores sharing the same RAMEasy programming but limited scalability <p>2. Distributed Memory Architecture</p> <ul style="list-style-type: none">Each processor has its own memoryRequires message passing (MPI) <p>Parallel Programming:</p> <p>It is a programming technique where multiple tasks or computations are performed simultaneously to solve a problem faster and more efficiently.</p> <p>Purpose:</p> <ul style="list-style-type: none">Speed up execution timeUtilize multi-core and multi-processor hardwareHandle large data setsPerform complex scientific simulations <p>Why is Parallel Programming Needed in HPC?</p> <ul style="list-style-type: none">To Solve Large Problems FasterTo Make Full Use of Modern HardwareTo Handle Big Data and Complex SimulationsTo Achieve Better Performance and Scalability
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Energy and Cost Efficiency	<p>Why is Parallel Programming Needed in HPC?</p> <ul style="list-style-type: none">To Solve Large Problems FasterTo Make Full Use of Modern HardwareTo Handle Big Data and Complex SimulationsTo Achieve Better Performance and Scalability <p>Energy and Cost Efficiency</p> <p>Parallel Programming Models:</p> <p>Shared Memory (OpenMP, Threads): Tasks share the same memory space</p> <p>Distributed Memory (MPI): Tasks run on different machines and exchange messages</p> <p>Hybrid: Mix of shared and distributed (used in modern HPC)</p> <p>GPU-based (CUDA, OpenCL): Thousands of lightweight threads run in parallel on GPUs</p> <p>Programming Models in HPC:</p> <p>Message Passing Interface (MPI)</p> <p>Used in distributed memory systems</p> <p>OpenMP</p> <p>Shared memory parallelism using compiler directives</p> <p>CUDA/OpenCL</p> <p>Programming for GPUs</p>
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	<p>Hybrid Models</p> <p>MPI + OpenMP or MPI + CUDA</p> <p>Why Linux in HPC?</p> <p>Linux is the standard OS for HPC clusters</p> <p>Open-source, customizable, lightweight</p> <p>Robust support for networking, process control, and file systems</p> <p>Widely supported by HPC software libraries and tools</p>
Code:	<ul style="list-style-type: none">➤ ls➤ cd Downloads➤ pwd➤ mkdir MyDocuments➤ rm -rf MyDocuments➤ top➤ man dnf➤ touch text.txt➤ nano text.txt



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Output

```
shreyyoo@localhost:~/Downloads - top
~/Downloads

top - 16:35:44 up 5 min, 2 users, load average: 0.45, 1.02, 0.54
Tasks: 263 total, 1 running, 262 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.7 us, 1.7 sy, 0.0 ni, 94.8 id, 0.0 wa, 2.4 hi, 0.3 si, 0.0 st
MiB Mem : 3604.9 total, 1589.4 free, 1313.5 used, 933.8 buff/cache
MiB Swap: 3992.0 total, 3992.0 free, 0.0 used. 2291.5 avail Mem

 PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM TIME+ COMMAND
2509 shreyyoo  20   0 4912464 354308 125132 S  5.6  9.6  1:21.54 gnome-s+
4246 shreyyoo  20   0 3045684 250168 101464 S  5.6  6.8  0:03.21 ptyxris
 42 root      20   0     0     0     0 I   1.7  0.0  0:00.20 kworker+
1216 root      20   0     0     0     0 I   1.0  0.0  0:01.26 kworker+
34 root      20   0     0     0     0 I   0.7  0.0  0:00.34 kworker+
18 root      20   0     0     0     0 I   0.3  0.0  0:00.48 rcu_prc+
 1 root      20   0  50012  41840  10524 S  0.0  1.1  0:03.10 systemd
 2 root      20   0     0     0     0 S  0.0  0.0  0:00.03 kthreaddd
 3 root      20   0     0     0     0 S  0.0  0.0  0:00.00 pool_w+
 4 root      0 -20    0     0     0 I  0.0  0.0  0:00.00 kworker+
 5 root      0 -20    0     0     0 I  0.0  0.0  0:00.00 kworker+
 6 root      0 -20    0     0     0 I  0.0  0.0  0:00.00 kworker+
 7 root      0 -20    0     0     0 I  0.0  0.0  0:00.00 kworker+
 8 root      20   0     0     0     0 I  0.0  0.0  0:00.23 kworker+
 9 root      20   0     0     0     0 I  0.0  0.0  0:00.00 kworker+
10 root      0 -20    0     0     0 I  0.0  0.0  0:00.05 kworker+
11 root      20   0     0     0     0 I  0.0  0.0  0:00.00 kworker+
```



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The image shows two screenshots of a terminal window against a dark background with a purple and blue abstract pattern. The top screenshot shows a terminal session with the following commands:

```
shreywoo@localhost:~$ ls
Desktop Documents Downloads Music Pictures Public Templates Videos
shreywoo@localhost:~$ cd Downloads/
shreywoo@localhost:~/Downloads$ mkdir MyDocs
shreywoo@localhost:~/Downloads$ ls
matmul_openmp.c matmul_serial.c MyDocs openmp.c
shreywoo@localhost:~/Downloads$ rm -rf MyDocs/; ls
matmul_openmp.c matmul_serial.c openmp.c
shreywoo@localhost:~/Downloads$
```

The bottom screenshot shows a terminal session with the command `man dnf` running, displaying the manual page for DNF version 4.8. The page includes sections for NAME, SYNOPSIS, DESCRIPTION, and Return values.

```
shreywoo@localhost:~/Downloads – man dnf
DNF4(8) DNF DNF4(8)

NAME
dnf – DNF Command Reference

SYNOPSIS
dnf [options] <command> [<args>...]

DESCRIPTION
DNF is the next upcoming major version of YUM, a package manager for
RPM-based Linux distributions. It roughly maintains CLI compatibility
with YUM and defines a strict API for extensions and plugins.

Plugins can modify or extend features of DNF or provide additional CLI
commands on top of those mentioned below. If you know the name of such
a command (including commands mentioned below), you may find/install
the package which provides it using the appropriate virtual provide in
the form of dnf-command(<alias>), where <alias> is the name of the com-
mand; e.g. ``dnf install 'dnf-command(versionlock)''' installs a ver-
sionlock plugin. This approach also applies to specifying dependencies
of packages that require a particular DNF command.

Return values:
Manual page dnf(8) line 1 (press h for help or q to quit)
```

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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	https://github.com/Sohampimpalgaonkar/HPC



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student Github profile where lab assignment has been uploaded							
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%)	<div style="text-align: center;"> Check Plagiarism Deep Plagiarism Checker <input type="checkbox"/> No Words Limit <input type="checkbox"/> Plagiarism API <input type="checkbox"/> User Seats <input type="checkbox"/> No Ads <input type="checkbox"/> Accurate Result Starting from \$9.80 <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 5px;">Result</th> <th style="text-align: left; padding: 5px;">Citation</th> <th style="text-align: left; padding: 5px;">Word Statistics</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">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.</td> <td style="padding: 5px;">Purpose: To Solve large-scale scientific, engineering, and data-intensive problems. To Reduce processing time. To Improve simulation accuracy.</td> <td style="padding: 5px;">9% Plagiarism 91% Unique <input type="radio"/> Exact Match 5% <input type="radio"/> Partial Match 4% Remove Plagiarism Download Report Source(s) 2 matches from 2 Source(s) 1 / 2 > 1. High Performance Computing (HPC) refers to the use of https://nzcloud.com/blog/high-performance-computing 5% Exclude Cite Source 2. https://sathee.iitk.ac.in/article/oper... 4% Exclude Cite Source </td> </tr> </tbody> </table> </div>	Result	Citation	Word Statistics	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.	9% Plagiarism 91% Unique <input type="radio"/> Exact Match 5% <input type="radio"/> Partial Match 4% Remove Plagiarism Download Report Source(s) 2 matches from 2 Source(s) 1 / 2 > 1. High Performance Computing (HPC) refers to the use of https://nzcloud.com/blog/high-performance-computing 5% Exclude Cite Source 2. https://sathee.iitk.ac.in/article/oper... 4% Exclude Cite Source
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