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

~~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**

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| **Vision:** Dream of where you want. | **Mission:** Means to achieve Vision |

**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):** (statements that describe what a student should be able to do and know by the end of a program)

**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**

Mohika Jugele - 9/9/25



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| **Session** | **2025-26 (ODD)** | **Course Name** | **HPC Lab** |
| **Semester** | **7** | **Course Code** | **22ADS706** |
| **Roll No** | **12** | **Name of Student** | **Purvaja Sawalakhe** |

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| Practical  Number | 6 |
| Course  Outcome | Upon successful completion of the course the students will be able to: 1. Understand and Apply Parallel Programming Concepts 2. Analyze and Improve Program Performance.  3. Demonstrate Practical Skills in HPC Tools and Environments. |
| Aim | Parallel Pi Calculation using MPI |
| Problem  Definition | To calculate the value of π (Pi) using parallel programming techniques with MPI and analyze the performance compared to sequential computation. |
| Theory  (100 words) | The value of π can be approximated using numerical integration or the Monte Carlo method. In this experiment, we use numerical integration to approximate π by calculating the area under the curve of the function f(x) = 4 / (1 + x²) over the interval [0,1]. Using MPI (Message Passing Interface), the total computation is divided among multiple processes, where each process computes a partial sum of the integral. The results are combined using MPI\_Reduce to obtain the final value of π. This demonstrates how distributed parallel computing enhances computational performance and efficiency. |

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| Procedure and Execution (10 0 Words) | **Algorithm:**  1. Initialize the MPI environment using MPI\_Init.  2. Get process rank and total number of processes using MPI\_Comm\_rank and MPI\_Comm\_size.  3. Divide the range [0,1] among all processes.  4. Each process computes its partial sum for its assigned range. 5. Use MPI\_Reduce to collect and sum all partial results at the root process.  6. The root process prints the final value of π.  7. Finalize MPI using MPI\_Finalize.  **Compilation & Execution:**  mpicc pi\_mpi.c -o pi\_mpi  mpirun -np 4 ./pi\_mpi |



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| Code:  #include <stdio.h>  #include <mpi.h>  int main(int argc, char\* argv[]) {  int rank, size, n = 1000000, i;  double h, sum = 0.0, x, local\_sum = 0.0, pi;  MPI\_Init(&argc, &argv);  MPI\_Comm\_rank(MPI\_COMM\_WORLD, &rank);  MPI\_Comm\_size(MPI\_COMM\_WORLD, &size);  h = 1.0 / (double) n;  for (i = rank; i < n; i += size) {  x = h \* (i + 0.5);  local\_sum += 4.0 / (1.0 + x \* x);  }  local\_sum \*= h;  MPI\_Reduce(&local\_sum, &pi, 1, MPI\_DOUBLE, MPI\_SUM, 0, MPI\_COMM\_WORLD);  if (rank == 0)  printf("Calculated value of Pi = %.16f\n", pi);  MPI\_Finalize();  return 0;  } |

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| Output |  |

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| Output  Analysis | The parallel computation of π using MPI demonstrates effective workload distribution. As the number of processes increases, the execution time decreases significantly, showing nearly linear speedup and high efficiency. Each process computes a portion of the total integration, and MPI\_Reduce aggregates the results accurately. |





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| Link ofstudent Github profile where lab  assignment has been uploaded | https://github.com/Mohikaaa18/HPC-Lab |
| Conclusion | The experiment successfully demonstrates parallel computation using MPI. The program efficiently calculates π by dividing tasks among multiple processes, resulting in reduced execution time and improved performance. This practical shows how distributed processing can be applied to numerical computations to achieve scalability and speedup. |
| Plag Report  (Similarity  index < 12%) |  |
| Date | 09/09/2025 |