

| Walchand College of Engineering, Sangli                 |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----|------------------------|-----------------------------|-------|
| (Government Aided Autonomous Institute)                 |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
| AY 2025-26                                              |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
| Course Information                                      |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
| Programme                                               |                                                                                                                                                                                                   | B.Tech. (Artificial intelligence and Machine Learning) |     |                        |                             |       |
| Class, Semester                                         |                                                                                                                                                                                                   | Second Year B. Tech., Sem IV                           |     |                        |                             |       |
| Course Code                                             |                                                                                                                                                                                                   | 1AI224                                                 |     |                        |                             |       |
| Course Name                                             |                                                                                                                                                                                                   | Computational Algorithms                               |     |                        |                             |       |
| Desired Requisites:                                     |                                                                                                                                                                                                   | Data Structures and Algorithms                         |     |                        |                             |       |
| Teaching Scheme                                         |                                                                                                                                                                                                   | Examination Scheme (Marks)                             |     |                        |                             |       |
| Lecture                                                 | 3 Hrs/week                                                                                                                                                                                        | ISE                                                    | MSE | ESE                    | Total                       |       |
| Tutorial                                                |                                                                                                                                                                                                   | 20                                                     | 30  | 50                     | 100                         |       |
|                                                         |                                                                                                                                                                                                   | Credits: 3                                             |     |                        |                             |       |
| Course Objectives                                       |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
| 1                                                       | To introduce fundamental algorithmic techniques and their applications in problem-solving.                                                                                                        |                                                        |     |                        |                             |       |
| 2                                                       | To develop skills in designing and analyzing algorithms for efficiency.                                                                                                                           |                                                        |     |                        |                             |       |
| 3                                                       | To introduce parallel programming concepts using MPI for scalable algorithm design.                                                                                                               |                                                        |     |                        |                             |       |
| Course Outcomes (CO) with Bloom's Taxonomy Level        |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
| At the end of the course, the students will be able to, |                                                                                                                                                                                                   |                                                        |     |                        |                             |       |
| CO                                                      | Course Outcome Statement/s                                                                                                                                                                        |                                                        |     | Bloom's Taxonomy Level | Bloom's Taxonomy Descriptor |       |
| CO1                                                     | Analyze and compare the efficiency of algorithms using asymptotic notation.                                                                                                                       |                                                        |     | 4                      | Analyze                     |       |
| CO2                                                     | Design and implement divide-and-conquer, greedy, and dynamic programming algorithms                                                                                                               |                                                        |     | 6                      | Create                      |       |
| CO3                                                     | Apply graph algorithms to solve real-world problems.                                                                                                                                              |                                                        |     | 5                      | Evaluate                    |       |
| CO4                                                     | Develop parallel algorithms using MPI for scalable performance.                                                                                                                                   |                                                        |     | 6                      | Create                      |       |
| Module                                                  | Module Contents                                                                                                                                                                                   |                                                        |     |                        |                             | Hours |
| I                                                       | Introduction to Algorithms: Algorithm analysis, Asymptotic notation (Big-O, Big-Ω, Big-Θ), Time and space complexity. Greedy Algorithms: Activity selection, Fractional Knapsack, Huffman coding. |                                                        |     |                        |                             | 7     |
| II                                                      | Divide and Conquer Algorithms: QuickSort, Binary Search<br>Dynamic Programming: Matrix chain multiplication, Longest Common Subsequence (LCS), Matrix Chain multiplication, 0/1 Knapsack.         |                                                        |     |                        |                             | 7     |
| III                                                     | Introduction to Parallel Computing: Basics of parallelism, MPI basics, Distributed memory Architecture, Parallel matrix multiplication, Parallel MergeSort                                        |                                                        |     |                        |                             | 7     |
| IV                                                      | Graph based shortest path Algorithm: Bellman-Ford algorithm, topological sorting of vertices, Dijkstra's algorithm                                                                                |                                                        |     |                        |                             | 7     |
| V                                                       | Other Shortest Path Algorithms: All-pairs shortest paths, Matrix-multiplication, Floyd-Warshall algorithm, Johnson's algorithm, Max Flow, Complexity classes                                      |                                                        |     |                        |                             | 7     |
| VI                                                      | Advanced Topics: Randomized algorithms, Approximation algorithms. Parallel BFS and DFS, Parallel Prim's algorithm                                                                                 |                                                        |     |                        |                             | 7     |

## Textbooks

| Textbooks |                                                                                                             |
|-----------|-------------------------------------------------------------------------------------------------------------|
| 1         | Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. |
| 2         | Algorithm Design by Jon Kleinberg and Éva Tardos.                                                           |
| 3         | Parallel Programming in C with MPI and OpenMP by Michael J. Quinn                                           |

## References

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|---|--------------------------------------------------------|
| 1 | The Art of Computer Programming*** by Donald E. Knuth. |
| 2 | Algorithms by Robert Sedgewick and Kevin Wayne.        |

## Useful Links

| Useful Links |                                                                                                                                                                |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | GeeksforGeeks Algorithms ( <a href="https://www.geeksforgeeks.org/fundamentals-of-algorithms/">https://www.geeksforgeeks.org/fundamentals-of-algorithms/</a> ) |
| 2            | MPI Official Documentation ( <a href="https://www.mpi-forum.org/docs/">https://www.mpi-forum.org/docs/</a> )                                                   |
| 3            | NPTEL Algorithms Course ( <a href="https://nptel.ac.in/courses/106/106/106106131/">https://nptel.ac.in/courses/106/106/106106131/</a> )                        |

## CO-PO Mapping

[illegible]

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High  
Each CO of the course must map to at least one PO.

## Assessment

The assessment is based on MSE, ISE and ESE.

MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)