Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information	
Programme	B.Tech. (Information Technology)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7IT302
Course Name	Computer Algorithms
Desired Requisites:	Data Structures

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 efficiency of algorithms
3	To comprehend parallel programming using MPI for designing scalable algorithm.

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	Illustrate divide-and-conquer, greedy, and dynamic programming algorithms.	III	Applying
CO2	Apply graph algorithms to solve real-world problems	III	Applying
CO3	Analyze and compare the efficiency of algorithms using asymptotic notation	IV	Analysing
CO4	Develop parallel algorithms using MPI for scalable performance.	VI	Creating

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, Intersecting Line segments	6
II	**Divide and Conquer Algorithms:** QuickSort, Convex Hull, Closest pair of points **Dynamic Programming:** Matrix chain multiplication, Longest Common Subsequence , 0/1 Knapsack, string matching, KMP algorithm	8
III	**Introduction to Parallel Computing**: Basics of parallelism, MPI basics, Parallel MergeSort, BFS, DFS, Prims, Matrix Multiplication	7
IV	**Shortest Path Algorithms:** Types, Bellman-Ford algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm, Johnson's algorithm.	8
V	**Algorithm Complexity classes:** Complexity theory, Introduction to P, NP, NP-Complete and NP Hard problems	7

VI	**Advanced Topics:** Approximation algorithms, Randomized algorithms	6

Textbooks

1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein"Introduction to Algorithms" MIT Press, 4th Edition 2022
2	Jon Kleinberg and Éva Tardos "Algorithm Design" Pearson Publication, 1st Edition, 2005
3	Michael J. Quinn "Parallel Programming in C with MPI and OpenMP" McGraw Hill Indian 1st Edition, 2005

References

1	Donald E. Knuth."The Art of Computer Programming" Addison-Wesley Professional, Vol 1-4 , 2011
2	Robert Sedgewick and Kevin Wayne "Algorithms" 4th Edition, (Online Available), 2011

Useful Links

1	GeeksforGeeks Algorithms (https://www.geeksforgeeks.org/fundamentals-of-algorithms/)
2	MPI Official Documentation (https://www.mpi-forum.org/docs/)
3	NPTEL Algorithms Course (https://nptel.ac.in/courses/106/106/106106131/)
4	https://algs4.cs.princeton.edu/31elementary/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											2	
CO2		3	1									2		
CO3	2	3	3		1								3	
CO4	2	1	2		2								3	2

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).
Self-study content should be provided to students and assessed during the In-Semester Evaluation (ISE).

LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. Modern tools are to be studied in self-mode for implementation laboratory assignment and will be evaluated in Laboratory Assessment (LA).

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B.Tech. (Information Technology)
Class, Semester	Third Year B. Tech., Sem V
Course Code	7IT352
Course Name	IT Practices lab 1
Desired Requisites:	Data Structures, Computer Networks

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To design and implement algorithms using both sequential and parallel computing paradigms
2	To enhance proficiency in applying algorithmic strategies to solve real-world problems
3	To introduce professional tools and techniques for cryptography, encryption, hashing, and data hiding
4	To explore network security monitoring and analysis of firewall, ethical hacking, and malware attack using standard tools

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 Description**
CO1	Apply sequential and parallel algorithmic techniques to implement computation problem	III	Applying
CO2	Demonstrate problem-solving skills by implementing algorithms and analyzing performance	IV	Analyzing

CO3	Identify algorithmic complexity and information authentication mechanisms	IV	Analysing
CO4	Select appropriate programming approaches and skills in domain specific applications	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Assignments: (Minimum 10)

Part A:Computer Algorithm

1. Implement QuickSort algorithms and use tools such as debugger, profiler.
2. Implement any problem based on Matrix Chain MultiplicationGreedy Algorithms:
3. Implement sequential and parallel (MPI) MergeSort algorithms and compare
4. Any algorithm based on Computational geometry
5. Problem based on Floyd Warshall Shortest Path Algorithms
6. Parallel (MPI) Matrix Multiplication and Shortest Path algorithm

- **Part B: Cryptography and n/w Security**

1. Implementation of classical encryption techniques: Hill cipher or similar
2. Design and analysis of affine Caesar cipher
3. Generation of hash code: RSA_hash or similar
4. Demonstration of Stego Tools: Case Stools or similar
5. Network Security Monitoring and Analysis: Case Wireshark or similar
6. Verification Engine: Case Comodo Verisign or similar
7. Configuration of firewalls: Case Cisco or similar
8. Ethical hacking and attack analysis: Case malware

Textbooks

1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein"Introduction to Algorithms" MIT Press, 4th Edition 2022
2	William Stallings, "*Cryptography and Network Security, Principles and Practices*", Pearson Publication, 8th Edition 2023

References

1	Victor Eijkhout, "Parallel Programming in MPI and OpenMP" Google book Lulu.com 2017
2	Menezes, A. J., P. C. Van Oarschot, and S. A. Vanstone, "*Handbook of Applied Cryptography*", CRC Press, 2nd Edition, 2018

Useful Links

1	https://www.open-mpi.org/
2	https://archive.nptel.ac.in/courses/106/106/106106129/ : Nptel course coordinated by IIT Madras

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3			2								2	
CO2		2	3		3									2
CO3	3				2								3	
CO4	3	2			3								1	2

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)	
AY 2025-26	
Course Information	
Programme	B.Tech. (Information technology)
Class, Semester	ThirdYear B. Tech., Sem VI
Course Code	7IT373
Course Name	Parallel Computing Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	1 Hrs/week	**LA1**	**LA2**	**Lab ESE**	**Total**
Practical	2 Hrs/Week	30	30	40	100
		Credits: 2			

Course Objectives	
1	To introduce parallel computing concepts with a focus on Manycore GPGPU programming.
2	To equip students with CUDA programming and GPU acceleration skills for solving high-performance computational problems
3	To provide hands-on experience with parallel programming tools and libraries.

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 Description**
CO1	Develop hands-on skills in using GPU acceleration techniques to efficiently solve computational problems	III	Applying
CO2	Analyze and evaluate the performance and scalability of parallel algorithms implemented on GPUs	IV	Analyzing
CO3	Apply advanced optimization strategies to enhance the efficiency of GPU programs.	V	Evaluating
CO4	Implement GPU-accelerated solutions across various application domains	VI	Creating

Module	**Module Contents**	Hours
I	**Introduction to GPGPU Computing:** GPU architecture vs CPU, Parallel computing paradigms,Applications in HPC/AI	2
II	**CUDA Programming:** CUDA execution model, Memory hierarchy, Kernel programming	3
III	**SYCL/OpenCL:** Intel oneAPI ecosystem, Cross-platform abstraction, Unified shared memory	2
IV	**ROCm & HIP:** AMD GPU architecture ,HIP portability layer , ROCm libraries	2
V	**Directive-Based (OpenACC):** Pragmas for acceleration , Data management , Multi-GPU programming	2
VI	**Performance Optimization:** arp scheduling , Occupancy tuning, Benchmarking tools	2

List of Experiments / Lab Activities/Topics

List of Lab Assignments: (Minimum 10)

1. CUDA Hello World: Write first CUDA program with device queries
2. Vector Addition: Compare CPU/GPU performance with CUDA
3. Matrix Multiplication: Optimize with shared memory (CUDA)
4. Image Filter: Implement Sobel edge detection (CUDA)
5. SYCL Vector Ops: Cross-platform vector addition (Intel DevCloud)
6. HIP Porting: Convert CUDA code to HIP for AMD GPUs
7. OpenACC Stencil: Heat diffusion simulation with pragmas
8. ROCm Reduction: Parallel sum with ROCm libraries
9. Unified Memory: Implement with SYCL/CUDA
10. Occupancy Calculator: Analyze kernel performance
11. Multi-GPU: Domain decomposition with MPI+CUDA
12. Final Project: Optimize real-world algorithm (e.g., CNN layer)

Textbooks

1	David Kirk, "Programming Massively Parallel Processors: A Hands-on Approach" Morgan Kaufmann, 1st Edition, 2012
2	Jason Sanders, Edward Kandrot,"CUDA by Example: An Introduction to General-Purpose GPU Programming" Addison-Wesley, 1st Edition, 2010

References

1	Wen-mei W. Hwu "GPU Computing Gems", Morgan Kaufmann, 1st Edition ,2011

Useful Links

1	NVIDIA Developer Resources – http://www.developer.nvidia.com
2	Website URL http://www.leetgpu.com

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		2		3								2	
CO2	1	3	2		2							2	3	
CO3		2			2							1		2
CO4	1	2	1									3	2	

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, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30

Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates the starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. Modern tools are to be studied in self-mode for implementation laboratory assignment and will be evaluated in Laboratory Assessment (LA).