Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs	Cr	MSE/LA1	ISE/LA2	ESE	Ext
Professional Core (Theory)												
01	PCC	1AI201	Searches & Logics in AI	3	0	0	3	3	30	20	50	
02	PCC	1AI202	Computer Architecture & Networking	3	0	0	3	3	30	20	50	
03	PCC	1AI203	Data Structures and Algorithms	3	0	0	3	3	30	20	50	
04	PCC	1AI204	Discrete Mathematics	3	0	0	3	3	30	20	50	
Professional Core (Lab)												
05	PCC	1AI251	Searches & Logics Lab	0	0	2	2	1	30	30	40	POE
06	PCC	1AI252	Data Structures Lab	0	0	2	2	1	30	30	40	POE
07	PCC	1AI253	Object Oriented Programming Lab	1	0	2	3	2	30	30	40	POE
Mandatory Courses												
08	VEC	7VE201	Value Education	2	0	0	2	2	30	30	40	
09	AEC	7EE201	Understanding Incubation and Entrepreneurship (NPTEL)	3	0	0	3	3				
10	CEP/FP	7CEAI201	Project Management and Technical Writing	1	0	0	1	1	30	20	50	
			Total	**19**	**0**	**6**	**25**	**22**				

Sr. No.	Category	Course Code	Course Name	L	T	P	Hrs	Cr	MSE/LA1	ISE/LA2	ESE	Ext
Professional Core (Theory)												
01	PCC	1AI221	Decision Modeling using AI	3	0	0	3	3	30	20	50	
02	PCC	1AI222	Mathematical Foundation For AI	3	0	0	3	3	30	20	50	
03	PCC	1AI223	Operating System	3	0	0	3	3	30	20	50	
04	PCC	1AI224	Computational Algorithms	3	0	0	3	3	30	20	50	
Professional Core (Lab)												
05	PCC	1AI271	Python Programming Lab	1	0	2	3	2	30	30	40	
06	PCC	1AI272	Decision Modeling Lab	0	0	2	2	1	30	30	40	POE
Multi-Disciplinary Minor (MDM)												
07	MDM	Refer List	MDM	3	0	0	3	3	30	20	50	
Mandatory Courses												
08	VSEC	1VSAI245	Frontend Technologies	0	0	2	2	1	30	30	40	OE
09	EEM	7AE201	Employability Skills	2	0	0	2	2	30	20	50	
10	IKS	Refer List	IKS Elective	2	0	0	2	2	30	20	50	
			Total	**20**	**0**	**6**	**26**	**23**				

Sem-III

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information

Programme		B.Tech. (Artificial intelligence and Machine Learning)			
Class, Semester		Second Year B. Tech., Sem III/IV			
Course Code		1AI201			
Course Name		Searches and Logics in AI			
Desired Requisites:		Mathematical Reasoning and Proofs			
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives

1	Understand and Apply Local Search Algorithms
2	Explore search algorithms used in game-playing AI
3	Develop logical agents capable of automated reasoning and decision-making in AI systems.

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	Understand and Explain Local Search Algorithms	2	Understand
CO2	Apply propositional logic to represent and solve AI reasoning problems.	3	Apply
CO3	Apply Search Techniques to Solve Optimization Problems	3	Apply
CO4	Analyze different reasoning approaches	4	Analysing

Module	Module Contents	Hours
I	**Search in Complex Environments:** Introduction to Local Search and Optimization, Advanced Local Search Techniques, Local Search in Continuous Spaces & Non Deterministic Actions, Search in Partially Observable Environments, Online Search Agents and Unknown Environments	6
II	**Game Theory and Search in Games:** Introduction to Game Theory, Optimal Decisions in Games, Alpha-Beta Pruning and Move Ordering, Heuristic Alpha-Beta Tree Search, Monte Carlo Tree Search (MCTS) & Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms	7
III	**Constraint Satisfaction Problems (CSPs):** Introduction to CSPs, Constraint Propagation & Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems, Applications	6
IV	**Logical Agents and Propositional Logic:** Knowledge-Based Agents ,Propositional Logic :Syntax, Semantics, Propositional Theorem Proving, Effective Propositional Model Checking: Complete backtracking algorithm, Local search algorithms , Agents Based on Propositional Logic: Hybrid agent model, Making plans using propositional	7

	inference	
V	**First-Order Logic (FOL) and Inference:** Syntax and Semantics of First-Order Logic, Using First-Order Logic: Assertions and queries, Kinship domain, Numbers, Sets, Lists, The Wumpus World, Inference in First-Order Logic : Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining and Backward Chaining	7
VI	**Knowledge Representation and Reasoning:** Ontological Engineering, Categories and Objects : Physical composition, Events and Time Representation: Fluents and Objects, Mental Objects and Modal Logic, Reasoning Systems for Categories : Semantic Networks, Description Logics	6

Textbooks	
1	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd/4th ed., Pearson Education, 2010/2021.

References	
1	S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd/4th ed., Pearson Education, 2010/2021.
2	R. Brachman and H. Levesque, Knowledge Representation and Reasoning, 1st ed., Morgan Kaufmann, 2004.

Useful Links	
1	https://nptel.ac.in/courses/106102220/
2	https://nptel.ac.in/courses/106105470/

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			1	1				3	2
CO2	3	3	3		3	2		2					2	3
CO3	3	3	3	3	3		2				2	1	3	3
CO4		3	3	3			2	2	3	3			3	3

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)
Note: Self-study content should be provided module wise and assessment should be carried by course faculty at the time of ISE, MSE, ESE.

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Course Information

Programme	B.Tech. (Artificial intelligence and Machine Learning)
Class, Semester	Second Year B. Tech., Sem V/VI
Course Code	1AI202
Course Name	Computer Architecture & Networking
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives

1	Introduce the basic components of a computer system
2	Explore the concepts of memory hierarchy, multi-core processing, and cache optimization techniques
3	Describe concepts of networking, protocols, and technologies for AI systems

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	Comprehend the architecture of CPU, memory and instruction set	II	Understanding
CO2	Study the integration of parallel processing, multi-core processor, and GPU	IV	Analysing
CO3	Explain concepts of communication models, network topologies, and protocols for AI systems	IV	Analysing
CO4	Analyze impact of transport layer, application layer protocol in deployment, operations and access in AI enabled services	IV	Analysing

Module	Module Contents	Hours
I	**Computer Architecture Fundamentals** Introduction to Computer Architecture, CPU Architecture: Structure, components and limitations for large workloads, Instruction Cycle, Memory hierarchy: Memory hierarchy and role in AI model training	7
II	**Pipelining, Accelerators, and I/O Systems:** Instruction pipelining, I/O devices: Types and interfacing with the CPU, Bus systems: Data, address, and control buses, Specialized hardware accelerators: TPUs, NPUs, FPGAs for AI, Interrupts: Types, Interrupt handling in AI systems, Modern Computer Architectures: RISC vs. CISC architectures	7
III	**Parallel Processing, GPU, and Multi-Core Architecture** Introduction to Parallel Processing, Types of Parallelism, Multi-Core Architecture, GPU Architecture, Case study on: Parallel Processing, GPUs, and Multi-Core processor	6
IV	**High-Performance Networking for AI Systems:** OSI and TCP/IP models in computing clusters, Distributed AI Network Protocols: RDMA, InfiniBand, IPv4, IPv6 addressing in data centers, Internet Control Protocols (SPF, BGP), Data transfer and IP operations in AI data	7

	centers	
V	**Transport Layer and Data Transmission in AI Systems:** TCP segment header, TCP Port, and Sockets in AI systems, Socket Programming for AI model deployment and inference, TCP connection and cloud AI services, UDP: Use cases in real-time AI data streaming	6
VI	**Application Layer for Intelligent Web Service:** World Wide Web: Architecture of AI-powered web applications, DNS: Fast resolution for AI service endpoints, HTTP/HTTPS: REST APIs for AI services, FTP: Large dataset transfers, SMTP: Automated AI-driven email systems	6

Textbooks	
1	David A. Patterson, John L. Hennessy, *"Computer Organization and Design: The Hardware/Software Interface"*, Morgan Kaufmann, 5th Edition, 2017
2	Anath Grama, Ansul Gupta, George Karypis, Vipin Kumar, *"Introduction to parallel computing"*, Second Edition, Pearson Education, 2003
3	Larry Peterson and Bruce Davie, *"Computer Networks: A Systems Approach"*, Morgan Kaufmann, 6th Edition, October 2020
4	M. Omar Faruque Sarker, "Python Network Programming Cookbook" Packt Pub Ltd, 1st edition., 2014
References	
1	David Culler, Jaswinder Pal Singh, Anoop Gupta, *"Parallel Computer Architecture: A Hardware/Software Approach"*, Morgan Kaufmann, 1st Edition, 1999
2	James F. Kurose, Keith W. Ross, *"Computer Networking: A Top-Down Approach"*, 7 th Edition, Pearson Publication, 2016
Useful Links	
1	https://archive.nptel.ac.in/courses/106/105/106105163/
2	https://archive.nptel.ac.in/courses/106/105/106105183/

CO-PO Mapping

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

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).

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Course Information					
Programme		B.Tech. (Artificial Intelligence and Machine Learning)			
Class, Semester		Second Year B. Tech., Sem III			
Course Code		1AI203			
Course Name		Data Structures and Algorithms			
Desired Requisites:					
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 the fundamentals of data structures and algorithms
2	To explain linear, non-linear data structures and algorithms
3	To introduce parallel programming concepts using OpenMP and applications in data structures.

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	Understand and apply fundamental data structure concepts	II, III	Understanding , Applying
CO2	Design and analyze efficient algorithms for AI scenarios	III, IV	Applying, Analyzing
CO3	Integrate appropriate data structures in the design of AI applications	IV	Analyzing
CO4	Evaluate parallel programming techniques using OpenMP to optimize data structure operations.	V	Evaluate

Module	Module Contents	Hours
I	**Basic Concepts:** Algorithm, Bubble, Merge, Quick sort, Pseudo-code, ADT, Data Structure, Algorithmic Efficiency, And Recursion, Dynamic Memory allocation, Pointers to Arrays, functions and Structures.	5
II	**Linked Lists:** Concept of linked organization, Singly linked list, doubly linked list and dynamic storage management, circular linked list, Operations, traversal on linked list, Linked data organization in AI systems, Circular Linked Lists for implementing cyclic neural networks	7
III	**Stacks and Queues:** Fundamentals stack and queue as ADT, Representation and Implementation of stack and queue using linked organization, Circular queue: representation and implementation, Expression evaluation and conversion for interpreters in ML frameworks, Backtracking for AI search algorithms, Use of recursion in neural network traversal	7
IV	**Trees:** Basic terminology, binary trees and its representation, binary tree traversals	8

	(recursive and nonrecursive), operations such as copy, equal on binary tree, expression trees, General Trees, Binary Search Tree-optimization in AI systems, B+, AVL Graphs: Representation: Adjacency Matrix vs. Adjacency List, Graph Traversals: BFS and DFS,MST,	
V	**Introduction to Parallel Computing:** Basics of parallelism, shared memory, distributed memory, OpenMP basics (`#pragma omp parallel`). Parallel Linked List Operations	6
VI	**Design and Analysis of Parallel Algorithms:** Parallel traversal and search using OpenMP.Parallel Tree Traversals, Parallel Merge Sort, Quick Sort, hash table operations	6

Textbooks	
1	Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures, A Pseudocode Approach With C", Cengage Learning, 2nd Edition, 2007
2	S. Lipschutz, "Data Structures with C", Schaum's Outlines Series, Tata McGraw-Hill, 2nd Edition, 2017
3	Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP" McGraw-Hill Science Engineering, 1st Edition, 2003

References	
1	Yashavant Kanetkar, "Understanding pointers in C", BPB Publication, 6th edition, 2019
2	OpenMP API Specification by OpenMP Architecture Review Board

Useful Links	
1	https://nptel.ac.in/courses/106102064
2	https://www.openmp.org/wp-content/uploads/OpenMP-API-Specification-5.0.pdf

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	2	3			2								3	
CO3	2	2	1		1								2	
CO4	3	1	2		2									1

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).

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Course Information

Programme	B.Tech. (Artificial intelligence and Machine Learning)
Class, Semester	Second Year B. Tech., Sem III
Course Code	1AI204
Course Name	Discrete Mathematics
Desired Requisites:	Basics of Mathematics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives

1	To discuss logic along with mathematics and its computer applications
2	To explain set theory, relations, functions, lattices and algebraic structures
3	To describe graph theoretic approaches for problem solving

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	Summarize fundamental concepts of discrete Mathematics that includes s sets, relations, functions, logic, and proof techniques	II	Understanding
CO2	Solve problems based on mathematical proofs, logical reasoning and graphs	III	Applying
CO3	Identify domain specific applications by studying appropriate concepts and algorithms	IV	Analyzing
CO4	Discuss combinatorial principles, counting techniques, permutations, combinations, and their applications	V	Evaluating

Module	Module Contents	Hours
I	**Logic:** Proposition and Predicate Logic, Theory of Inference for Statement Calculus, Predicate Calculus, Proof of Techniques, Induction	6
II	**Set Theory:** Definitions and notation, Set operations, Venn diagrams, Cartesian products and power sets, Cardinality theory, countable and uncountable sets, multisets, ordered pairs	6
III	**Relations and Functions:** Representing Relations in Matrices, Directed graphs. Properties of relations: Equivalence relations and partitions, Partial orderings, Partially Ordered Sets and Hasse Diagram Types of Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions	7
IV	**Combinatorics:** The rule of sum and the rule of product, Permutations and combinations, Pigeonhole principle, Inclusion-exclusion principle, recurrence relations, generating functions	6

V	**Graph and Trees:** Types of graphs, Graph Isomorphism, Connectivity in graphs. Planar graphs and graph coloring. Euler and Hamiltonian paths, Trees and its properties, Rooted trees, , Spanning trees, Domain Applications	7
VI	**Algebraic Structures and Lattices:** Properties of Algebraic Structures, Semi- Groups, Monoids, Groups, subgroups, Homomorphism, Properties and Types of Lattices	7

Textbooks	
1	C. L. Liu, D P Mohapatra, "Elements of Discrete Mathematics: A Computer Oriented Approach", TMG, 4th Edition, 2017
2	Kenneth H. Rosen," Discrete Mathematics and Its Application", TMG, 7th Edition, 2011
3	J.P. Tremblay &R. Manohar,"Discrete Mathematical structure with applications to computer",TMG, 1st Edition, (1997) Re-print 2017.
References	
1	K.D. Joshi, "Foundation of Discrete Mathematics", 2019
2	Lipschutz, Marc Lipson ,"Discrete mathematics", Schaum'soutline series,3rd Edition, 2007
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc25_cs26/preview,Swayam Course Coordinated by IIT Ropar
2	https://onlinecourses.nptel.ac.in/noc25_cs27/preview Swayam Course Coordinated by IIT Kanpur

CO-PO Mapping

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

Note: Few Self learning contents should be decided by faculty.

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Course Information

Programme	B.Tech. (AIML)
Class, Semester	Second Year B. Tech., Sem III
Course Code	1AI251
Course Name	Searches & Logics Lab
Desired Requisites:	Python, Prolog Programming

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

Credits: 1

Course Objectives

1	Analyze the effectiveness of local search in different problem domains.
2	Implement AI Agents for Game Playing and Decision-Making
3	Design an AI agent that infers facts using Propositional Logic.

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 Local Search and Optimization Techniques	3	Apply
CO2	Develop AI Agents for Game Playing and Decision-Making	4	Analyse
CO3	Utilize First-Order Logic (FOL) for Knowledge Representation and Planning	3	Apply
CO4	Develop AI Models for Intelligent Problem Solving	6	Create

List of Experiments / Lab Activities/Topics

List of Lab Assignments: (Minimum 10)

1. Optimization Using the Hill Climbing Algorithm
   tasks:
   - Game playing,
   - Planning
   - scheduling, Path finding

2. Implement the Simulated Annealing algorithm to overcome local optima
   task:
   - Travelling Salesman Problem (TSP)
   - Knapsack Problem
   - Job-shop scheduling
   - Vehicle routing

3. Implement the Minimax Algorithm to enable an AI agent
   tasks:
   - Tic-Tac-Toe
   - Chess
   - Connect Four

4. Implement Monte Carlo Tree Search: Analyzing Its Effectiveness in Game AI tasks:
   - Sudoku, Sliding puzzles
   - Knapsack problems
   - Traveling Salesman Problem (TSP)

5. Implementing Backtracking Search for Constraint Satisfaction tasks:
   - Sudoku Puzzle Solving
   - N-Queens Problem:
   - Graph Coloring

6. Implementing and Analyzing the AC-3 Algorithm tasks:
   - Map Coloring Problem
   - 3x3 Sudoku Puzzle
   - Unary and Ternary Constraints

7. Designing a Knowledge-Based Agent for Fact Inference Using Logic and Rules Tasks:
   - Inference with Propositional Logic
   - Forward Chaining in First-Order Logic
   - Rule-Based Decision System

8. Exploring the Use of Backtracking Search in Problem Solving Tasks:
   - Implement Backtracking Search for N-Queens Problem
   - Sudoku Solver using Backtracking
   - Analyze Backtracking with and without Forward Checking in a simple map-coloring problem.

9. Exploring First-Order Logic for Representing Relationships and Entities
   - Represent a Family Tree Using FOL
   - University Knowledge Base Using FOL
   - Knowledge Representation in a Smart Home System

10. Implementing FOL-Based Planning for Intelligent Agents: Tasks:
    - A robot in a room can pick up a key and unlock a door.
    - Enable an agent to plan a sequence of actions to deliver a package using FOL.
    - An agent needs to turn on a heater, but it works only if power is available.

Textbooks	
1	Pattern Recognition and Machine Learning –BY Christopher M. Bishop
2	Artificial Intelligence: A Modern Approach (AIMA)-by Stuart Russell & Peter Norvig **Edition**: 4th Edition (2020)
3	Artificial Intelligence: Structures and Strategies for Complex Problem Solving- George F. Luger

References	
1	Russell, S., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson. *(Chapter on Local Search and Optimization)*
2	Van Laarhoven, P. J., & Aarts, E. H. (1987). *Simulated Annealing: Theory and Applications*. Springer.

Useful Links	
1	https://www.geeksforgeeks.org/
2	https://www.swi-prolog.org/
3	https://onlinecourses.nptel.ac.in/noc21_cs79/preview
4	https://www.redblobgames.com/pathfinding/a-star/introduction.html
5	https://developers.google.com/optimization/routing/tsp

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2		2				2			2	2	2
CO2	3	3	3		3			2	3	1			3	3
CO3	3	3	3	3	3		2		3		1		3	3
CO4	2	2	2	2	2	2			2				2	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.
Self-assessment Content should be provided by course faculty and Evaluation should be done in LA1,LA2,ESE

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Course Information

Programme	B.Tech. (Artificial intelligence and Machine Learning)
Class, Semester	Second Year B. Tech., Sem III
Course Code	1AI252
Course Name	Data structure and Algorithms Lab
Desired Requisites:	computer Programming

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

Course Objectives

1	To provide hands-on experience in implementing data structures and algorithms.
2	To develop skills in analyzing and optimizing data structure operations.
3	To introduce parallel programming using OpenMP for performance enhancement.

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	Implement and analyze linear and non-linear data structures.	III	Applying
CO2	Demonstrate various searching, sorting and hashing algorithms	III	Applying
CO3	Optimize data structure operations using parallel programming techniques.	V	Evaluating
CO4	Solve real-world problems using appropriate data structures and algorithms.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Lab Assignments: (Minimum 10)

1. Linked List Operations:
   Implement a singly linked list with insertion, deletion, and traversal operations.
2. Stack and Queue Operations:
   Implement stack and queue operations (push, pop, enqueue, dequeue) using arrays and linked lists.
3. Binary Search Tree (BST) Operations:
   Implement insertion, deletion, and traversal in a BST.
   Parallelize the traversal operation using OpenMP.
4. Heap Operations:
   Implement a min-heap and max-heap with insertion and deletion operations.
5. Parallelization of Link List, BST, Heap algorithm
6. Graph Traversal (DFS and BFS):
   Implement DFS and BFS for a graph represented using an adjacency list.
7. Sorting Algorithms:

Implement QuickSort and MergeSort.

8. Searching Algorithms
   Implement linear and binary searching
9. Hashing with OpenMP:
   Implement a hash table with chaining for collision resolution.
10. Parallelization of sorting, searching and hashing algorithms

Textbooks

1	Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures, A Pseudocode Approach With C", Cengage Learning, 2nd Edition, 2007
2	S. Lipschutz, "Data Structures with C", Schaum's Outlines Series, Tata McGraw-Hill, 2nd Edition, 2017
3	Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP" McGraw-Hill Science Engineering, 1st Edition, 2003

References

1	Yashavant Kanetkar, "Understanding pointers in C", BPB Publication, 6th edition, 2019
2	OpenMP API Specification by OpenMP Architecture Review Board

Useful Links

1	https://nptel.ac.in/courses/106102064
2	https://www.openmp.org/wp-content/uploads/OpenMP-API-Specification-5.0.pdf
3	NPTEL Data Structures Course (https://nptel.ac.in/courses/106/103/106103069/)

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

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%

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

Self-assessment Content should be provided by course faculty and Evaluation should be done in LA1,LA2,ESE

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B.Tech. (AIML)
Class, Semester	Second Year B. Tech., Sem III/IV
Course Code	1AI253
Course Name	OOP-I (CPP Programming) Lab
Desired Requisites:	C Programming or Any Procedural programming Language

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

Course Objectives

1	To learn the fundamental programming concepts and methodologies which are essential to
2	building good C/C++ programs

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

Course Outcome Statement/s		**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Describe Object Oriented real time applications Programming (OOP) concepts for	I	Understanding
CO2	Implement simple C++ programs using classes and objects	III	Applying
CO3	Compare procedural and approaches object-oriented programming	IV	Analysing
CO4	Assess the advantages and and objects in C++disadvantages of using classes	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to OOP and Basics of C++:** Introduction to Object-Oriented Programming concepts, Understanding classesand objects, Basic syntax and structure of C++ programming language, Data types, variables, and operators in C++.	2
II	**Object and Classes:** Creating classes and objects in C++ , Member functions and data members, Access specifiers: public, private, and protected, Constructors and destructors	2
III	**Polymorphism:** Polymorphism and its types: compile-time and runtime	2

	polymorphism.Overloading unary operations. Overloading binary operators, data conversion, pitfalls of operators overloading and conversion keywords. Explicit and Mutable.	
IV	**Inheritance-I:** Understanding inheritance and its types: single, multiple, multilevel, and hierarchical inheritance, Implementing inheritance in C++ using base and derived classes, ,Virtual functions and function overriding in C++	2
V	**Advanced OOP Concepts:** Abstract classes and pure virtual functions, Interface classes and their usage, Friend functions and friend classes	2
VI	**Exception Handling and Templates:** Understanding exceptions and exception handling in C++, Try-catch blocks and exception specifications, Introduction to C++ templates for generic programming, Writing and using class templates and function templates	2

List of Experiments / Lab Activities/Topics

List of Lab Activities:

List of Lab Activities:

1. Program on input/output stream
2. Program on class and objects.
3. Program on Inline/Friend functions.
4. Program on Constructor/Destructors.
5. Program static variables/class/functions.
6. Program on polymorphism.
7. Program on different types of inheritance.
8. Program on operator overloading.
9. Program on File Operations.
10. Standard Template Library (STL):
11. Containers (vectors, lists, maps, sets)
12. Algorithms (sort, find, transform)

Textbooks

1	E.Balguruswamy, "Object Oriented Programming C++", Tata McGraw Hill, 3rd Edition, 2006.
2	Bjarne Stroustrup, "The C++ Programming language", Third edition, Pearson Education.

References

1	Robert Laffore, "Object Oriented Programming in c++", SAMS publication, 4thEdition,2008.

Useful Links

1	https://nptel.ac.in/courses/106/105/106105151

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	
CO2			2										3	
CO3		2											2	
CO4												2	1	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 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.
Self-assessment Content should be provided by course faculty and Evaluation should be done in LA1,LA2,ESE

Sem-IV

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	1AI221				
Course Name	Decision Modelling in AI				
Desired Requisites:	Artificial Intelligence Concepts				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
		Credits: 3			

Course Objectives	
1	Analyze different algorithms for state-space search in planning
2	Understand the principles of knowledge representation in uncertain domains
3	Explain the concepts of utility functions and human decision-making.

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	Implement state-space search algorithms like forward and backward search	3	Applying
CO2	Explain the semantics of Bayesian Networks and their applications in AI.	2	Understanding
CO3	Analyze the value of information in AI-based decision processes.	4	Analyzing
CO4	Define the core principles of multiagent environments in AI.	1	Remembering

Module	**Module Contents**	**Hours**
I	**Classical Planning and AI-Based Decision Making:** Introduction to Classical Planning, Algorithms for Classical Planning, Heuristics and Hierarchical Planning, Planning in Nondeterministic Domains, Time, Scheduling, and Planning Analysis	6
II	**Probabilistic Reasoning and Decision Making Under Uncertainty** Introduction to Uncertainty in AI, Foundations of Probability Theory, Probabilistic Inference, Bayes' Theorem and Its Applications, Naïve Bayes and Its Real-World Applications, Case Study - The Wumpus World	7
III	**Bayesian Networks and Temporal Probabilistic Models in AI** Knowledge Representation in Uncertain Domains, Bayesian Network Semantics and Inference, Approximate Inference in Bayesian Networks, Time and Uncertainty in AI, Hidden Markov Models and Kalman Filters, Dynamic Bayesian Networks	7
IV	**Advanced Probabilistic Models and AI Reasoning** Introduction to Advanced Probabilistic Models, Inference in Relational	6

	and Open-Universe Models, Tracking and Monitoring in Dynamic Environments, Probabilistic Programs and AI Decision Making, Generative Models and Markov Processes, Advanced Inference Techniques and Applications	
V	**Decision Making Under Uncertainty and Sequential Decision** Fundamentals of Decision Making Under Uncertainty, Utility Functions and Human Decision-Making, Multi-attribute Utility and Decision Networks, The Value of Information in AI, Handling Unknown Preferences in AI, Sequential Decision Problems and MDPs, Advanced Decision-Making: POMDPs and Bandit Problems	7
VI	**Multiagent Systems and Game Theory** Introduction to Multiagent Environments, Fundamentals of Non-Cooperative Game Theory, Sequential and Uncertain Games, Cooperative Game Theory and Strategic Interaction, Collective Decision Making, Bargaining and Negotiation in AI	6

Textbooks

1	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., Pearson, 2020.

References

1	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., Pearson, 2020.
2	D. Koller and N. Friedman, *Probabilistic Graphical Models: Principles and Techniques*, MIT Press, 2009.
3	M. Ghallab, D. Nau, and P. Traverso, *Automated Planning: Theory and Practice*, Morgan Kaufmann, 2004.

Useful Links

1	https://aima.cs.berkeley.edu/
2	https://mitpress.mit.edu/9780262013192/probabilistic-graphical-models/
3	https://www.sciencedirect.com/book/9781558608566/automated-planning
4	https://nptel.ac.in/courses/106106201
5	https://nptel.ac.in/courses/106105077

CO-PO Mapping

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

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)
Note: Self Study content should be provided to students and Evaluation should be carried out at time of ISE

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information

Programme	B.Tech.
Class, Semester	Second Year (AIML), Sem IV
Course Code	1AI222
Course Name	Mathematical foundation for AI
Desired Requisites:	Mathematics course at Higher Secondary Level

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 03			

Course Objectives

1	Familiarize the students with techniques in probability and statistics.
2	Develop knowledge of standard probability distributions such as Binomial, Poisson, Normal, and Exponential.
3	Design a statistical hypothesis about the real world problem and conduct appropriate test for drawing valid inference about the population characteristics.
4	Introduce the fundamental concepts of interpolation, numerical differentiation and integration.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to

CO	**Course Outcome Statements**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	**Understand** probability distributions for discrete and continuous random variable.	II	Understanding
CO2	**Apply** various discrete & continuous distributions to solve real life problems.	III	Applying
CO3	**Test** hypothesis particularly about mean and proportion and goodness of fit to make decisions in real life problems using concepts of Sampling distribution.	III	Applying
CO4	**Apply** interpolation techniques for estimating unknown data points within a given range.	III	Applying
CO5	**Apply** numerical methods for differentiation and integration to solve engineering problems.	III	Applying

Module	Module Contents	Hours
I	**Random Variable:** Definition, Discrete random variable, Continuous random variable, Probability mass function, Probability density function, cumulative distribution function for discrete random variable and continuous random variable, bivariate discrete random variable, joint probability distribution, joint distribution function of two dimensional discrete random variables.	**6**
II	**Probability Distribution:** Binomial distribution, Poisson distribution, Gaussian (Normal) distribution, Exponential distribution, Examples.	**5**
III	**Interpolation and Approximation:** Lagrange's interpolation formula, forward and backward difference interpolation formula, Newton's divided difference interpolation formula, Hermite interpolation formula.	**8**
IV	**Sampling Distribution:** Population, Sample, Random samples, Methods of sampling, large sample, small sample, parameter, statistic, standard error of Statistic, sampling distribution of mean, sampling distribution of proportion, Examples. Hypothesis, null and alternative hypothesis, critical region, level of significance, Types of error, one tailed test, two tailed test.	**6**
V	**Applied Statistics:** Test of significance for large samples, Hypothesis testing for single population proportion, hypothesis testing for single population mean, Examples, Test of significance for small samples, degrees of freedom, student t distribution: Definition and its properties, Test the significance of mean of random sample, Examples, Chi-square distribution: Definitions and its properties, chi square test, chi square test of goodness of fit, Examples.	**6**
VI	**Numerical Differentiation and Integration:** Numerical differentiation, methods based on interpolation, Error analysis, numerical integration, methods based on interpolation, Newton cotes methods, Error estimates for trapezoidal and Simpson's rule.	**7**

Textbooks	
1	*"An Introduction to probability and Statistics"*, V.K. Rohatgi, Wiley Publication, 2nd Edition, 2008.
2	*"Introductory Methods of Numerical Analysis"*, S.S. Sastry, 3rd edition, Prentice Hall of India, 1999.

References	
1	*"Introduction to Probability and Statistics for Engineers and Scientists"*, Sheldon M. Ross, Academic Press, (2009).
2	"*Probability and Statistics"*, Dr. Hari Arora, S.K.Kataria & Sons , 4th Edition , 2020.
3	*"Numerical methods for scientific and Engineering Computation", M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International Limited Publishers.*
4	*"Numerical Analysis"*, E Balguruswamy. Tata McGraw Hill Publications.

5	*"Numerical method for Engineers"* - S.C. Chapra, R.P. Canale (Tata McGraw Hill Publications)
6	*"Computer oriented Numerical methods"*, A. B. Auti Tech-max publications.

Useful Links

1.	https://nptel.ac.in/courses/111106525
2.	https://nptel.ac.in/courses/122102009
3.	https://nptel.ac.in/courses/122102009
4.	https://nptel.ac.in/courses/111105041

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							2	2	2
CO2	3	3	2	2	2	1						2	3	3
CO3	3	3	2	3	2	1		1		1		3	3	3
CO4	2	2	2	2	2							2	2	2
CO5	3	3	2	3	3						1	3	3	3

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)
Note: Self Study content should be provided to students and Evaluation should be carried out at time of ISE

Walchand College of Engineering, Sangli

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AY 2025-26

Course Information

Programme	B.Tech. (AI-ML)
Class, Semester	Second Year B. Tech., Sem V/VI
Course Code	1AI223
Course Name	Operating System
Desired Requisites:	Computer Architecture

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 concepts, functions and services of operating systems.
2	To inculcate the concepts of inter-process communication techniques.
3	To compare various memory management techniques of operating systems.
4	To explore file system structures and storage management

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	Examine the basic concepts, functions and services provided by operating systems.	II	Understanding
CO2	Explore and compare CPU scheduling, process scheduling/ synchronization.	III/IV	Applying /Analyzing
CO3	Compare process management, threads and its applications.	IV	Analyzing
CO4	Analyze/Compare different memory management systems and various file systems of operating systems.	IV	Analyzing

Module	Module Contents	Hours
I	**Introduction:** Introduction to Assembler and Linker and its Types, Loader and its types, Introduction to Compiler, Aspects of Compilation, Phases of a Compiler. **System Structure** - Structure of OS, interface of OS, system calls, nature of computation, Classes of OS, Batch processing and Multiprogramming systems, time sharing system, Introduction to various types of OS	6
II	**Process** Process Concept, Process Scheduling, Operation on process, Cooperating process, Threads, Inter-process Communication. **Process Scheduling:** Basic concept, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF, RR, Priority, Multilevel Queue Scheduling), Multiple processor and Real time scheduling.	8
III	**Inter-process Synchronization** Classical problems of synchronization, Critical Region, The critical section problem, Peterson's Solution, Monitors, Semaphores.	5

IV	**Deadlocks** System modes, Deadlock characterization, Methods for handling deadlocks Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.	6
V	**Memory Management** Background, Logical Versus Physical Address space, Swapping ,Contiguous Allocation, Introduction to Paging, Segmentation, Segmentation with paging. **Virtual Memory:** Background, Demand paging, Page replacement, Page Replacement Algorithms (FIFO, LRU, Optimal)	8
VI	**Virtual Memory:** Allocation of frames, Introduction to thrashing, Demand segmentation concepts, Memory Management in Various OS **File System Management** Introduction to File system structure, file indexing, file-system implementation, directory implementation, Basics of Allocation Method- Contiguous, Linked, Indexed.	6

Textbooks	
1	D.M Dhamdhere "Systems Programming Paperback" TMGH,1st Edition July 2011(Unit I)
2	James. L. Peterson and A. Silberchatz ,"Operating System Concepts", Addison Westley Publication, 9th Edition,2018
2	Milan Milenkovic ,"Operating System – Concept and Design", TMGH,1st Edition,2001

References	
1	William Stallings," Operating Systems : Internals and Design Principles",Peterson Publication,7th Edition,2013
2	Crowley Charles ," Operating Systems : A Design-Oriented Approach",Mc Graw Hill Publication,1st Edition,2017

Useful Links	
1	https://onlinecourses.swayam2.ac.in/cec20_cs06/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs108/preview

CO-PO Mapping

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

Examine the basic concepts, functions and services provided by operating systems.
Explore and compare CPU scheduling, process scheduling/ synchronization.
Compare process management, threads and its applications.
Analyze/Compare different memory management systems and various file systems of operating systems.

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. **ISE assignments should focus on teamwork. Self-study Contents related to subject need to be**

handled by faculty and evaluation has to be done in ISE.

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)

Walchand College of Engineering, Sangli

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

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/)

CO-PO Mapping

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

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B.Tech. (AI ML)
Class, Semester	Second Year B. Tech., Sem V/VI
Course Code	1AI271
Course Name	Python Programming Lab
Desired Requisites:	Computer Programming

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

Course Objectives

1	To understand Python programming basics.
2	To learn how to design and program Python applications.
3	To make use of the different libraries of Python.
4	To implement python code and add visualization using various 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 Descriptor
CO1	Explain the importance of Python's data structures and use them to solve problems.	III	Applying
CO2	Learn and examine Python programming models and use its various libraries effectively.	IV	Analyzing
CO3	Implement, test and debug the code written in Python.	VI	Creating
CO4	Draw various kinds of plots using various libraries.	VI	Creating

Module	Module Contents	Hours
I	**Introduction to Python:** Variables and Data Types: Introduction to different variables and data types (integers, floats, strings, lists, tuples, dictionaries) and variable assignment. Control Flow: Using conditional statements (if, else, elif) and loops (for, while) to control the execution flow of a program	2
II	**Functions, Modules and packaging:** Functions: Defining and calling functions, understanding scope (local and global variables), and using lambda functions (anonymous functions). Modules and Packages: Importing and using standard libraries and creating custom modules. Files, System Functions and Parameters, Strings, Tuples, Lists and Dictionaries, Lists and Mutability, Programming using functions, modules and external packages.	2
III	**File handling and Database Connectivity:** Python File Operations: Understanding file read and write functions, file	3

	pointer using seek Programming and file operations. Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database.	
IV	**Classes and Object-Oriented Programming:** Abstract Data Types and Classes, Information Hiding, Class in Python, Objects in Python, Polymorphism in Python, Encapsulation in Python, Inheritance in Python, Data Abstraction in Python.	2
V	**Python-Numpy and Pandas:** NumPy: Introduction, Numpy array, Numpy array indexing, Numpy operations. Pandas: Series, Data frames, managing missing data, group by, merging & concatenation, operations, data input and data output. NumPy and Pandas for data manipulation and analysis.	2
VI	**Python for Data Visualization:** Working with Graphs: Understanding Python graph algorithms, visualizing graphs using libraries -Matplotlib, Seaborn, Plotly and Cufflinks. Matplotlib: Creating various types of plots (line, bar, scatter, histogram) and customizing them. Seaborn: Generating advanced visualizations and integrating with Matplotlib for enhanced graphics	2

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Problem solving using core Python functionality like strings, variables, functions.
2. Problem solving using core Python functionality like tuples, dictionary, list, objects
3. Problem solving using Class & object concepts.
4. Problem statement on inheritance in classes
5. Problem based on encapsulation in classes
6. Problem statement on array
7. Problem statement on NumPy libraries with different operations
8. Problem statement on Pandas libraries with different operations
9. Problem statement on NumPy and Pandas use for data manipulation and analysis.
10. Problem statement on data visualization using Matplot Libraries.
11. Problem statement on data visualization using Seaborn Libraries.

Best Practices used for lab:

- Some assignments are in group of students to understand teamwork
- Writing clean and readable code
- Testing and debugging
- Documentation and comments
- Version control with Git

Textbooks

1	R. Nageswara Rao, Core Python Programming, Dreamtech Press, 2nd Edition, 2017
2	Eric Matthes - "Python Crash Course", "Automate the Boring Stuff with Python" 2nd Edition,2019

References

1	Barry, Paul, Head First Python, O Rielly,2nd Edition, 2010
2	Lutz, Mark, Learning Python, O Rielly, 4th Edition, 2009

Useful Links

1	https://onlinecourses.nptel.ac.in/noc19_mg47/preview https://onlinecourses.nptel.ac.in/noc22_cs32/preview

2	https://onlinecourses.nptel.ac.in/noc24_cs45/preview													
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								1	
CO2	1	2	2	3	2							1	2	1
CO3		3	3		3			2	2	2	2	1	1	2
CO4	2	2			3			2	2	2	2	2	2	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. **Self-study Contents related to subject need to be handled by faculty and evaluation has to be done in ISE**
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 4 Marks Submission at the end of Week 4	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 10 Marks Submission at the end of Week 10	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 10 to Week 13 Marks Submission at the end of Week 13	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.
Self-assessment Content should be provided by course faculty and Evaluation should be done in LA1,LA2,ESE

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2025-26

Course Information

Programme	B.Tech. (AIML)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	1AI272
Course Name	Decision Modelling Lab
Desired Requisites:	Computer Programming

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

Course Objectives

1	Understand fundamental concepts of classical planning and implement search algorithms
2	Analyze probabilistic models and simulate stochastic events
3	Explore game-theoretic strategies by implementing algorithms

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	Implement and Analyze Classical Search Algorithms	4	Analyze
CO2	Apply Advanced Heuristic Search Techniques in AI	3	Apply
CO3	Understand and Implement Probabilistic Models and Reasoning	2,4	Knowledge, analyze
CO4	Explore Decision-Making Models and Game Theory.	6	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Assignments: (Minimum 10)

1. Implementation of Classical Search Algorithms for AI Planning

Tasks:

- Robot Path Planning in a 2D Grid Using BFS and DFS
- Implement A* and Greedy Search for Optimal Pathfinding

2. Heuristic Generation and Analysis in Planning Problems.

Tasks:

- Implement Manhattan and Euclidean Heuristics in A*
- Design a Custom Heuristic for a Block Rearrangement Problem

3.To apply Bayes' theorem for probabilistic inference in uncertain real-world scenarios.

Tasks:

- Medical Diagnosis
- Email Spam Filtering
- Weather Forecast Interpretation

4. Build and evaluate a Naïve Bayes classifier on a simple dataset.

Tasks:

- Data Preparation
- Training Naïve Bayes Model
- Testing and Evaluation

5. Model uncertain relationships using Bayesian networks and perform inference.

Tasks:

- Design a Bayesian Network
- Perform Inference
- Use Python Tools

6. To implement Hidden Markov Models and Kalman Filters to model temporal uncertainty and perform state estimation.

Tasks:

- Define a simple weather model with hidden states (Sunny, Rainy) and observations (Dry, Wet).
- Implement the Forward Algorithm to compute the probability of an observation sequence.
- Understand the Kalman filter concept for continuous state estimation (e.g., tracking a moving object).

7.Constructing and Analyzing Bayesian Networks for Real-World Reasoning

Tasks:

- Student Exam Performance Prediction
- Medical Diagnosis System
- Car Starting Problem

8. Implementation of Particle Filters for Object Tracking in Noisy Environments

Tasks:

- Robot Tracking on a 1D Grid
- Person Tracking Using Noisy GPS in 2D
- Drone Altitude Estimation with Noisy Barometric Sensor

9. To represent uncertain outcomes and evaluate decision alternatives using utility theory.

Tasks:

- Medical Treatment Choice
- Investment Decision

10.Analysis of Strategic Interaction in Multiagent Environments Using Non-Cooperative Game Theory

Tasks:

- Prisoner's Dilemma
- Matching Pennies

Textbooks	
1	R. E. Fikes and N. J. Nilsson, *STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving*, Artificial Intelligence, vol. 2, no. 3-4, pp. 189-208, 1971.
2	S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Pearson, 2020.
3	C. M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
References	
1	Russell, S., & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson. *(Chapter on Local Search and Optimization)*
2	Van Laarhoven, P. J., & Aarts, E. H. (1987). *Simulated Annealing: Theory and Applications*. Springer.
Useful Links	
1	https://archive.nptel.ac.in/courses/110/105/110105082/

2	https://www.swi-prolog.org/
3	https://onlinecourses.nptel.ac.in/noc21_cs79/preview
4.	https://www.geeksforgeeks.org/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	2				2				2	2
CO2	3	3	3	3	3			1	3	2			3	3
CO3	3	3	3	3	3	3	3				1		3	3
CO4	2	2	2	2	2	2			2			1	2	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.
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AY 2025-26

Course Information

Programme	B.Tech. (Artificial intelligence and Machine Learning)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	1VSAI245
Course Name	Frontend Technologies
Desired Requisites:	

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

Course Objectives

1	Introduce foundational concepts of android and web user interface design
2	Demonstrate modern web and android development tools to build for interactive applications
3	Facilitate hand-on experience to develop responsive and adaptive user interfaces

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 Android lifecycle management principles to manage activities of mobile application	III	Applying
CO2	Use android development tools to build user interface for mobile application	IV	Analyzing
CO3	Design and develop responsive interfaces for web applications	VI	Creating
CO4	Create dynamic and responsive applications to work across both web and mobile platforms.	VI	Creating

Evaluate and apply cross-platform development techniques to build dynamic and responsive applications

List of Experiments / Lab Activities/Topics

List of Lab Assignments:

1. Installation of Android SDK, Emulator, Creating a Simple Project, and Understanding the Android Project Structure:
2. Design and implement various layouts, including a Login Form using both Linear and Relative Layouts.
3. Develop a program that explores Intents for navigating between activities, and design a Registration Activity along with its corresponding layout
4. Create and showcase UI elements such as Buttons, Text Fields, Checkboxes, Radio Buttons, and Toggle Buttons using Android SDK.
5. Develop a program to demonstrate the usage of Spinners, Touch Mode, Alerts, Popups, and Toasts, while handling their events appropriately.
6. Implement and showcase Touch Mode and Menus, while handling their respective events effectively.
7. Set Up a Web Development Environment and Create a Simple Web Page Using HTML, CSS, and JavaScript

8. Implement and demonstrate a responsive web layout using CSS and PHP
9. Create a Dynamic Web Page with Client-Side JavaScript and Fetch API to Display Data
10. Implement Navigation Menus, Modals, and Tooltips Using JavaScript and CSS

Textbooks

1	Bill Phillips, Chris Stewart, and Kristin Marsicano, *"Android Programming: The Big Nerd Ranch Guide"*, Big Nerd Ranch Guides, 7th Edition, 2023
2	Noel Rappin, *"Modern Front-End Development for Rails"*, Pragmatic Bookshelf, 2nd Edition, 2023

References

1	Dawn Griffiths, David Griffiths, ""Head First Android Development: A Brain-Friendly Guide" O'Reilly Media, 2nd Edition, 2021
2	Jon Duckett, "HTML and CSS: Design and Build Websites", Wiley, 3rd Edition, 2023

Useful Links

1	https://archive.nptel.ac.in/courses/106/106/106106156/
2	https://nptel.ac.in/courses/106106147

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							2	1	2
CO2		3	2		3					2		2	3	
CO3	1		3	3	1	2	3		3		2	1		2
CO4		2	1		3	1	2	2	3	3	2	2	2	

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