Savitribai Phule Pune University
(Formerly University of Pune)

Four Year Degree Program
B.Sc.(Computer Science)

With

Major: Computer Science

(Faculty of Science and Technology)

Syllabi for
S.Y.B.Sc. (Computer Science)

(For Colleges Affiliated to Savitribai Phule Pune University)

Choice Based Credit System (CBCS) Syllabus
Under National Education Policy (NEP)
To be implemented from Academic Year 2025-2026

Title of the Course: B.Sc. (Computer Science)

Preamble:

The B. Sc. (Computer Science) and B. Sc. (Computer Science) (Honors) and (Research) course is a systematically designed program with Computer Science as a major subject under the faculty of Science and Technology. The objective of the course is to prepare students to undertake careers involving problem solving using computer science and technologies, or to pursue advanced studies and research in computer science. The syllabus which comprises of Computer Science (Major) subject along with that of the three allied subjects (Mathematics, Electronics and Statistics) (Minor) covers the foundational aspects of computing sciences and also develops the requisite professional skills and problem solving abilities using computing sciences.

Introduction:

At the first year of under-graduation, the basic foundations of two important skills required for software development are laid. A course in problem solving and programming along with a course in database fundamentals forms the preliminary skill set for solving computational problems. The practical courses are designed to supplement the theoretical training in the year. Along with Computer Science (Major), VSC and SEC courses help in building a strong technical foundation. Another aspect of this course is IKS which tells about the rich heritage and advancement of India in the field of computation.

In the second year of under-graduation, computational problem solving skills are further strengthened by a course in Data structures, C++ and python programming. Software engineering concepts that are required for project design are also introduced. Essential concepts of computer networking are also introduced this year. The practical course included in both semesters complements the theory courses. Field projects/ OJT are introduced so that students can implement the concept they have learnt in first year.

In Second Year, the "Subject 1: Computer Science" will be the Major Subject and the Minor subject will be chosen from "Subject 2 or Subject 3". Subject 2 and Subject 3 will not be available as Major Subjects in Second Year and Third Year

At the third year of under-graduation, all the subjects are designed to fulfill core Computer Science requirements as well as meet the needs of the software industry. Theory courses are adequately supplemented by hands-on practical courses. Major elective courses are taking care of recent advancement in the field of computer science. Minor and Skill Enhancement courses enable the students to acquire additional skills.

At the fourth year (honors) and (research) of under-graduation, all the subjects are designed to fulfill core Computer Science requirements as well as meet the needs of the software industry. Practical courses and field projects enable students to get hands-on training. Various learning tracks are open through Major elective courses. Research methodology course will create interest among the students to carry research in the field of computer science.

Objectives:

- To develop problem solving abilities using a computer.
- To build the necessary skill set and analytical abilities for developing computer based solutions for real life problems.
- To train students in professional skills related to the Software Industry.
- To prepare the necessary knowledge base for research and development in Computer Science.
- To help student's build-up a successful career in Computer Science and to produce entrepreneurs who can innovate and develop software products.

Eligibility

a)   H.S.C. (10 + 2) Science stream with Mathematics.

b)   Three years diploma course after S.S.C. (10th std.) of Board of Technical Education conducted by Government of Maharashtra or its equivalent.

Programme Out comes:

PO No.	Outcomes
PO1	Develop creative skills, critical thinking, analytical skills and research to address the real world problems using computational skills
PO2	Understand and apply mathematical foundation, computing and domain knowledge and develop computing models for defined problems
PO3	Understand software project management and computing principles with computing knowledge to manage projects in multidisciplinary environments
PO4	Illustrate the concepts of systems fundamentals, including architectures and organization, operating systems, networking and communication
PO5	Understand and apply the concepts of Digital Electronics, Computer Architecture, IoT etc.
PO6	Recognize the need for and develop the ability to engage in continuous learning as a Computing professional
PO7	Apply modern computing tools, skills and techniques necessary for innovative software solutions
PO8	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations
PO9	Gain Self Discipline and commit Professional Ethics in global economic environment
PO10	Individual & Team Work: Ability to work as a member or leader in diverse teams in multidisciplinary environment
PO11	Identify opportunities, entrepreneurship vision and use innovative ideas to create value and wealth for the betterment of the individual and society

Savitribai Phule Pune University
Structure of UG Program as per NEP-2020
Name of Program :- B.Sc. (Computer Science)
Major Course: - Computer Science

Level:- 4.5 (First Year)　　　Sem:-I

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Subject 1	CS-101-T	Problem Solving using 'C' Programming	2		2		15	35	50
	CS-102-P	Lab Course based on CS-101-T		2		4	15	35	50
Subject 2	MTC-101-T	Matrix Algebra	2		2		15	35	50
	MTC-102-P	Mathematics Practical I		2		4	15	35	50
Subject 3	ELC-101-T	Principles of Analog Electronics	2		2		15	35	50
	ELC-102-P	Electronics Practical Course I		2		4	15	35	50
IKS(2)	IKS-101-T	Generic IKS	2		2		15	35	50
GE/OE*(2)	OE-101-CS -T/ OE-102-CS -T/ OE-103-CS-T / OE-104-CS-T	Office Automation I / Introduction to Computers and Basics of Internet / Introduction to Google Apps I / Fundamentals of Computers I	2		2		15	35	50
SEC (2)	SEC-101-CS	Statistical Methods for Computer Science I		2		4	15	35	50
AEC(2)	AEC-101-ENG	English	2		2		15	35	50
VEC(2)	VEC-101-ENV	EVS-I	2		2		15	35	50
Total			14	08	14	16			550

The subjects offered to other faculty students under OE vertical are OE-101-CS -P/ OE-102-CS -T/OE-103-CS-P / OE-104-CS-T. The students of B.Sc. (Computer Science) will opt the subjects offered by other faculty given in University Basket.

Level:- 4.5 (First Year)　　　Sem:-II

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Subject 1	CS-151-T	Advanced C Programming	2		2		15	35	50
	CS-152-P	Lab Course Based on CS-151-T		2		4	15	35	50
Subject 2	MTC-151-T	Graph Theory	2		2		15	35	50
	MTC-152-P	Mathematics Practical II		2		4	15	35	50
Subject 3	ELC-151-T	Principles of Digital Electronics	2		2		15	35	50
	ELC-152-P	Electronics Practical Course II		2		4	15	35	50
GE/OE* (2)	OE-151-CS-T / OE-152-CS-T / OE-153-CS-T OE-154-CS-T	Office Automation II / Computer Fundamentals / Introduction to Google Apps II/ Fundamentals of Computers II	2		2		15	35	50
SEC(2)	SEC-151-CS-P	Statistical Methods for Computer Science II		2		4	15	35	50
AEC(2)	AEC-151-ENG	English	2		2		15	35	50
VEC(2)	VEC-151-ENV	EVS-II	2		2		15	35	50
CC(2)	CC-151-T	From University Basket	2		2		15	35	50
Total			14	08	14	16			550

* The subjects offered to other faculty students under OE vertical are OE-151-CS -P/ OE-152-CS -T/OE-153-CS-P / OE-154-CS-T. The students of B.Sc. (Computer Science) will opt the subjects offered by other faculty given in University Basket.

Exit option: *Award of UG Certificate in Major with 44 credits and an additional 4 credits core as per university guidelines OR Continue with Major and Minor*

Continue option: Student will select one subject among the (subject 2 and subject 3) as minor and subject 1 will be major subject

In Second Year, the "Subject 1: Computer Science" will be Major Subject and the Minor subject will be chosen from "Subject 2 or Subject 3". Subject 2 and Subject 3 will not be available as Major Subjects in Second Year and Third Year

Level:- 5.0 (Second Year)   Sem:-III

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (4+2)	CS-201-MJ-T	Data Structure -I	2		2		15	35	50
	CS-202-MJ-T	Database Management System I	2		2		15	35	50
	CS-203-MJ-P	Lab Course based on CS-201-MJ-T & CS-202-MJ-T		2		4	15	35	50
VSC(2)	CS-221-VSC-T	Software Engineering	2		2		15	35	50
IKS	CS-201-IKS-T	Indian Knowledge System in Computing	2		2		15	35	50
FP/OJT/ CEP(2)	CS-231-FP	Mini Project		2		4	15	35	50
Minor (2+2)	CS-241-MN-T	Mathematics or Electronics	2		2		15	35	50
	CS-242-MN-P	Mathematics or Electronics		2		4	15	35	50
GE/OE(2)	OE-201-CS-T OE -202-CS-T OE-203-CS-T OE-204-CS-T	E commerce I / Web Design I / Digital Marketing I/ AI for everyone I	2		2		15	35	50
AEC(2)	AEC-201-T	From University Basket	2		2		15	35	50
CC(2)	CC-201-T	From University Basket	2		2		15	35	50
Total			16	06	16	12			550

Level:- 5.0 (Second Year)   Sem:-IV

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (4+2)	CS-251-MJ-T	Data Structure - II	2		2		15	35	50
	CS-252-MJ-T	Database Management System II	2		2		15	35	50
	CS-253-MJ-P	Lab Course based on CS-251-MJ-T & CS-252-MJ-T		2		4	15	35	50
VSC(2)	CS-271-VSC-P	Advanced Python Programming		2		4	15	35	50
FP/OJT/ CEP(2)	CS-281-FP	Mini Project		2		4	15	35	50
Minor (2+2)	CS-291-MN-T	Mathematics or Electronics	2		2		15	35	50
	CS-292-MN-P	Mathematics or Electronics		2		4	15	35	50
GE/OE(2)	OE-251-CS-T / OE-252-CS-T / OE-253-CS-T / OE-254-CS-T	E commerce II/ Web Design II/ Digital Marketing II / AI for everyone - II	2		2		15	35	50
SEC(2)	SEC-251-CS-P / SEC-252-CS-P	Computer Networks / Statistical Analysis using R Software		2		4	15	35	50
AEC(2)	AEC251	From University Basket	2		2		15	35	50
CC(2)	CC-251-T	From University Basket	2		2		15	35	50
Total			12	10	12	20			550

Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core as per university guidelines OR Continue with Major and Minor

Level:- 5.5 (Third Year)   Sem:-V

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (8+4)	CS-301-MJ-T	Core Java	2		2		15	35	50
	CS-302-MJ-T	Operating Systems	2		2		15	35	50
	CS-303-MJ-T	Web Technology-I	2		2		15	35	50
	CS-304-MJ-T	Theory of Computer Science	2		2		15	35	50
	CS-305-MJ-P	Lab Course based on CS-302-MJ-T		2		4	15	35	50
	CS-306-MJ-P	Lab Course based on CS-301-MJ-T & CS-303-MJ-T		2		4	15	35	50
Major Elective (2+2)	CS-307-MJ-T	Data Science	2		2		15	35	50
	CS-308-MJ-P	Lab Course based on CS-307-MJ-T		2		4	15	35	50
	OR								
	CS-309-MJ-T	Database Technologies	2		2		15	35	50
	CS-3010-MJ-P	Lab Course on CS-309-MJ-T		2		4	15	35	50
	OR								
	CS-3011-MJ-T	Embedded Systems	2		2		15	35	50
	CS-3012-MJ-P	Lab Course on CS-3011-MJ-T		2		4	15	35	50
VSC(2)	CS-321-VSC-P	Advanced Python Programming		2		4	15	35	50
FP/OJT/ CEP(2)	CS-331-FP	Project		2		4	15	35	50
Minor (2)	CS-341-MN-T	Mathematics or Electronics	2		2		15	35	50
Total			12	10	12	20			550

Level:- 5.5 (Third Year)   Sem:-VI

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (8+4)	CS-351-MJ-T	Advanced Java	2		2		15	35	50
	CS-352-MJ-T	Design Framework	2		2		15	35	50
	CS-353-MJ-T	Web Technology-II	2		2		15	35	50
	CS-354-MJ-T	Compiler Construction	2		2		15	35	50
	CS-355-MJ-P	Lab Course based on CS-352-MJ-T		2		4	15	35	50
	CS-356-MJ-P	Lab Course based on CS-351-MJ-T & CS-353-MJ-T		2		4	15	35	50
Major Elective (2+2)	CS-357-MJ-T	Android Programming	2		2		15	35	50
	CS-358-MJ-P	Lab Course based on CS-357-MJ-T		2		4	15	35	50
	OR								
	CS-359-MJ-T	Software Testing Tools	2		2		15	35	50
	CS-3510-MJ-P	Lab Course based on CS-359-MJ-T		2		4	15	35	50
	OE								
	CS-3511-MJ-T	Internet of Things							
	CS-3512-MJ-P	Lab Course based on CS-3511-MJ-T							
VSC(2)	CS-321-VSC-P	Agile Processes		2		4	15	35	50
FP/OJT/ CEP(4)	CS-381-OJT	OJT		4		8	30	70	100
Total			10	12	10	24			550

Level:- 6.0 (Fourth Year)   Sem:-VII (Research)

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (6+4)	CS-401-MJ-T	Advanced Operating System	2		2		15	35	50
	CS-402-MJ-T	Artificial Intelligence	2		2		15	35	50
	CS-403-MJ-T	Principles of Programming Language	2		2		15	35	50
	CS-404-MJ-P	Lab Course based on CS-401-MJ-T		2		4	15	35	50
	CS-405-MJ-P	Lab Course based on CS-402-MJ-T		2		4	15	35	50
Major Elective (2+2)	CS-406-MJ-T	Advance Databases and Web Technologies	2		2		15	35	50
	CS-407-MJ-P	Lab Course on CS-406-MJ-T		2		4	15	35	50
	OR								
	CS-408-MJ-T	Cloud Computing	2		2		15	35	50
	CS-409-MJ-P	Lab Course on CS-408-MJ-T		2		4	15	35	50
	OR								
	CS-410-MJ-T	C# .NET Programming	2		2		15	35	50
	CS-411-MJ-P	Lab Course on CS-410-MJ-T		2		4	15	35	50
FP/OJT/ CEP/RP (4)	CS-431-RP	Research Project		4		8	30	70	100
	CS-451-MN	Research Methodology	4		4		30	70	100
Total			12	10	12	20			550

Level:- 6.0 (Fourth Year)   Sem:-VIII (Research)

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (6+4)	CS-451-MJ-T	Design and Analysis of Algorithms	2		2		15	35	50
	CS-452-MJ-T	Mobile App Development Technologies	2		2		15	35	50
	CS-453-MJ-T	Software Project Management	2		2		15	35	50
	CS-454-MJ-P	Lab Course based on CS-451-MJ-T		2		4	15	35	50
	CS-455-MJ-P	Lab Course based on CS-452-MJ-T		2		4	15	35	50
Major Elective (2+2)	CS-456-MJ-T	Full Stack Development I	2		2		15	35	50
	CS-457-MJ-P	Lab Course based on CS-456-MJ-T		2		4	15	35	50
	OR								
	CS-458-MJ-T	Web Services	2		2		15	35	50
	CS-459MJ-P	Lab Course based on CS-458-MJ-T		2		4	15	35	50
	OR								
	CS-460-MJ-T	ASP DOT Net Programming	2		2		15	35	50
	CS-461-MJ-P	Lab Course based on CS-460-MJ-T		2		4	15	35	50
FP/OJT/ CEP(8)	CS-481-FP	Research Project		8		16	60	140	200
Total			08	14	08	28			550

Level:- 6.0 (Fourth Year)   Sem:-VII (Honors)

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (10+4)	CS-401-MJ-T	Advanced Operating System	2		2		15	35	50
	CS-402-MJ-T	Artificial Intelligence	2		2		15	35	50
	CS403MJ-T	Principles of Programming Language	2		2		15	35	50
	CS-404-MJ-P	Lab Course based on CS401MJ		2		4	15	35	50
	CS-405-MJ-P	Lab Course based on CS402MJ		2		4	15	35	50
	CS-406-MJ-T	Advanced Networking	2		2		15	35	50
	CS-407-MJ-T	Digital Marketing	2		2		15	35	50
Major Elective (2+2)	CS-408-MJ-T	Advance Databases and Web Technologies	2		2		15	35	50
	CS-409-MJ-P	Lab Course on CS-408-MJ-T		2		4	15	35	50
	OR								
	CS-410-MJ-T	Cloud Computing	2		2		15	35	50
	CS-411-MJP-T	Lab Course on CS-410-MJ-T		2		4	15	35	50
	OR								
	CS-412-MJ-T	C# .NET Programming	2		2		15	35	50
	CS-413-MJ-P	Lab Course on CS-412-MJ-T		2		4	15	35	50
	CS-441-MN-T	Research Methodology	4		4		30	70	100
Total			16	06	16	12			

Level:- 6.0 (Fourth Year)   Sem:-VII (Honors)

Level:- 6.0 (Fourth Year)　　Sem:-VIII (Honors)

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (10+4)	CS-451-MJ-T	Design and Analysis of Algorithms	2		2		15	35	50
	CS-452-MJ-T	Mobile App Development Technologies	2		2		15	35	50
	CS-453-MJ-T	Software Project Management	2		2		15	35	50
	CS-454-MJ-P	Lab Course based on CS-451-MJ-T		2		4	15	35	50
	CS-455-MJ-P	Lab Course based on CS-452-MJ-T		2		4	15	35	50
	CS-456-MJ-T	Crypto Currency Technologies	2		2		15	35	50
	CS-457-MJ-T	Cyber Security	2		2		15	35	50
Major Elective (2+2)	CS-458-MJ-T	Full Stack Development I	2		2		15	35	50
	CS-459-MJ-P	Lab Course based on CS-458-MJ-T		2		4	15	35	50
	OR								
	CS-460-MJ-T	Web Services	2		2		15	35	50
	CS-461-MJ-P	Lab Course based on CS-460-MJ-T		2		4	15	35	50
	OR								
	CS-462-MJ-T	ASP DOT Net Programming	2		2		15	35	50
	CS-463-MJ-P	Lab Course based on CS-462-MJ-T		2		4	15	35	50
FP/OJT/ CEP(4)	CS-481-OJT	OJT		4		8	30	70	100
Total			12	10	12	20			

Semester III

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Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – III
Course Type: Major Core
Course Code: CS-201-MJ-T
Course Title: Data Structure I

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Teaching Scheme 02 Hrs/week	No. of Credits 2	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites
- Knowledge of C programming language
- Memory management and pointers concepts
- Basic data handling techniques

Course Objectives
- To analyze the efficiency of algorithm and solve the problem in systematic way.
- To understand the different methods of organizing large amount of data.
- To design and implement the different data structures.
- To implement solutions for the specific problems.
- To apply different data structures to solve real life problems.

Course Outcomes

On completion of the course, student will be able to–

CO1: Understand basics of data structure and algorithm analysis

CO2: Apply working strategy for different data Structures to solve related problems

CO3: Implement Data Structure and its Applications

CO4: Develop real words application based on data structure like array, link list, stack and queue

CO5: Design data structure to solve problems using appropriate algorithmic techniques.

Course Contents

Chapter 1	Introduction to Data Structures and Algorithm Analysis	03 Hours

1.1   Introduction
   1.1.1 Need of Data Structure
   1.1.2 Definitions - Data and Information, Data type, Data object, ADT, Data Structure
   1.1.3 Types of Data Structures
1.2   Algorithm Analysis
   1.2.1 Space and Time Complexity
   1.2.2 Best, Worst, Average case analysis, Asymptotic notations (Big-O (O) , Omega Ω, Theta (Θ)), Problems on time complexity calculation.

Chapter 2	Array as a Data Structure	08 Hours
2.1	ADT of array, Operations and Applications of Array	
2.2	Searching Techniques	
	2.2.1 Sequential / Linear search	
	2.2.2 Binary Search	
	2.2.3 Comparison of Searching Techniques	
2.3	Sorting Techniques	
	2.3.1 Terminology- Internal, External, Stable, In-place Sorting	
	2.3.2 Comparison Based Sorting Techniques - Bubble Sort, Insertion Sort, Selection Sort	
	2.3.3 Algorithm design strategies -Divide and Conquer strategy, Merge Sort, Quick Sort	
	2.3.4 Non Comparison Based Sorting: Counting Sort, Radix Sort	
	2.3.5 Analysis of sorting techniques.	
	2.3.6 Comparison of sorting Techniques.	
Chapter 3	**Linked List**	**08 Hours**
3.1	Introduction to Linked List	
3.2	Implementation of Linked List – Static & Dynamic representation,	
3.3	Types of Linked List-– Singly, Doubly, Circular (Singly)	
3.4	Operations on Linked List - create, display, insert, delete, reverse, search, sort, concatenate and merge	
3.5	Applications of Linked List – Polynomial Representation, Addition of two polynomials	
	3.5.1 Generalized linked list – Concept, Representation	
Chapter 4	**Stack**	**06 Hours**
4.1	Introduction to Stack	
4.2	Operations – init(), push(), pop(), isEmpty(), isFull(), peek(), time complexity of operations.	
4.2	Representation - Static (Array) and Dynamic (Linked List)	
4.3	Applications of stack	
	4.3.1 Function call and recursion, String reversal, palindrome checking	
	4.3.2 Expression types - infix, prefix and postfix, expression conversion and evaluation (Implementation of infix to prefix , infix to postfix, evaluation of postfix)	
Chapter 5	**Queue**	**05 Hours**
5.1	Introduction to Queue	
5.2	Operations - init(), enqueue(), dequeue(), isEmpty(), isFull(), peek(),time complexity of operations, differences with stack.	
5.3	Implementation – Static (Array) and Dynamic (Linked List) with comparison	
5.4	Types of Queue - Linear Queue, Circular Queue, Priority Queue, Double Ended Queue (only Concept of Doubly Ended Queue)	
5.5	Applications of queue	

Reference Books :-
1. Data Structures Through C – Yashavant Kanetkar (BPB Publications)
2. Data Structures, Algorithms, and Applications in C – Sartaj Sahni (Universities Press)
3. C and Data Structures – Balagurusamy (McGraw Hill)
4. Data Structures Using C and C++ – Tanenbaum, Langsam, and Augenstein (Pearson Education

<table>
<tr><td colspan="3" align="center">Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – III
Course Type: Major Core
Course Code: CS-202-MJ-T
Course Title: Database Management System I</td></tr>
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Teaching Scheme 02 Hrs/ week	No. of Credits 2	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites
- Basic knowledge of computer architecture, storage and algorithm.
- Basic knowledge of programming language.

Course Objectives
- To learn the fundamental concepts of database using PostgreSQL.
- To understand user requirements and frame it in data model.
- To Execute Database Queries like creations, manipulation on database.

Course Outcomes

On completion of the course, student will be able to-

CO1: Solve real world problems using appropriate set, function, and relational models.

CO2: Design E-R Model for given requirements and convert the same into database tables.

CO3: Design and create relational database systems.

CO4: Evaluate and apply database management operations to use database systems.

Course Contents

Chapter 1	**Introduction to DBMS**	**3 Hours**

1.1   Introduction to Data, Database and DBMS.

1.2   File system vs DBMS

1.3   Levels of abstraction and data independence

1.4   Architectures of DBMS

1.5.   Users of DBMS

1.6   Advantages and Disadvantages of DBMS

1.7   Applications of DBMS

Chapter 2	**Conceptual Design**	**10 Hours**

2.1   Overview of DB design process.

2.2   Introduction to data models (E-R model, Relational model, Network model, Hierarchical model)

2.3   Conceptual design using ER data model (entities, attributes, entity sets, relations, relationship sets) and symbols.

2.4   Extended features–Specialization, Aggregation, Generalization (Pictorial representation).

2.5	Constraints (domain constraints, entity integrity constraints referential integrity constraints and key constraints).
2.6	Structure of Relational Databases (concepts of a table)
2.7	Case Studies on ER model

Chapter 3	**SQL**	**9 Hours**

3.1	Introduction to query languages
3.2	Basic structure
3.3	Commands in SQL
	3.3.1 DDL Commands
	3.3.2 DML Commands
	3.3.3 DCL Commands
	3.3.4 TCL Commands
3.4	Forms of a basic SQL query (Expression and strings in SQL)
3.5	SQL Operations
	3.5.1 Set operations
	3.5.2 Aggregate functions
	3.5.3 Date, Time functions
	3.5.4 Simple queries
	3.5.5 Nested queries
3.6	Joins in SQL (Cartesian Product, Inner joins, Outer joins and their types)
3.7	Views.
3.8	Examples on SQL (case studies)

Chapter 4	**Relational Database Design**	**8 Hours**

4.1	Introduction to Relational-Database Design
	4.1.1 Undesirable properties of a RDB design
4.2	Functional Dependency
	4.2.1 Basic concepts
	4.2.2 Closure of relation (F+)
	4.2.3 Closure of an Attribute set
	4.2.4 Armstrong's axioms
4.3	Concept of Decomposition
4.4	Desirable Properties of Decomposition
	4.4.1. Lossless and Lossy join Decomposition.
	4.4.2 Dependency Preserving Decomposition.
4.5.	Concept of Normalization
4.6	Normal Forms 1NF, 2NF ,3NF, BCNF and its Examples.
4.7	Keys Concept : Primary Key, Candidate Keys ,Composite Key, Alternate Key and Super Key.(Find out candidate key and super key with examples)

Reference Books:

1. Database System Concepts, Henry F. Korth, Abraham Silberschatz, S. Sudarshan, ISBN:9780071289597, Tata McGraw-Hill Education

2. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill Science/ Engineering/ Math; 3 edition, ISBN: 9780072465631

3. Database Systems, Shamkant B Navathe, Ramez Elmasri, ISBN:9780132144988, Pearson Higher Education

4. Beginning Databases with PostgreSQL: From Novice to Professional, Richard Stones, Neil Matthew, ISBN:9781590594780, Apress

5. PostgreSQL, Korry Douglas, ISBN:9780672327568, Sams

6. Practical Postgresql, By Joshua D. Drake, John C Worsley (O'Reilly publications)

7. "An introduction to Database systems", Bipin C Desai, Galgotia Publications

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – III
Course Type: Major Core
Course Code: CS-203-MJ-P
Course Title: Lab Course based on CS-201-MJ-T & CS-202-MJ-T

Teaching Scheme 4 Hrs / week	No. of Credits 2	Examination Scheme IE : 15 Marks UE: 35 Marks

Prerequisites
- Knowledge of computer architecture, storage and algorithms
- Knowledge of programming fundamentals, including concepts like loops, arrays, stacks, recursion, and basic mathematics concepts.

Course Objectives
- To understand design and implementation, and manipulation of databases
- To apply theoretical concepts to real-world scenarios.
- Understand and Implement Searching Techniques
- Apply Sorting Algorithms for Data Organization
- Implement and Utilize Data Structure
- Develop Problem-Solving and Analytical Skills

Course Outcomes: -

On completion of this course, students will be able to:

CO1: Apply Linear and Binary Search techniques to efficiently

CO2: Analyze and implement sorting techniques

CO3: Develop Singly and Doubly Linked Lists with operations such as insertion, deletion, searching, reversal, and concatenation.

CO4: Evaluate the performance of Circular and Doubly Circular Linked Lists for dynamic memory-based data handling.

CO5: To design and implement relational database systems, including creating tables, defining relationships, and implementing constraints.

CO6: To understand Entity-Relationship (ER) diagrams to model database structures and convert them into relational models.

Operating Environment:

For Data Structures I

     Operating system: Linux

     Editor: Any linux based editor like vi, gedit etc.

     Compiler: cc or gcc

For Database Management System

     Operating system: Linux

     Editor: Any linux based editor like vi, gedit etc.

Suggested List of Assignments:

A) Data Structures I

Assignment 1.:- Searching Algorithm

1. Topic name:- Implementation of Linear search algorithm

2. Topic name :- Implementation of Binary Search algorithm

Assignment 2:- Sorting Algorithm

1. Topic name:- Implementation of Bubble Sort algorithm

2. Topic name:- Implementation of Insertion sort algorithm

3. Topic Name:- Implementation of the Selection sort algorithm

4. Topic Name:- Implementation of Merge sort algorithm

5. Topic Name:- Implementation of Quick Sort Algorithm

6 Topic Name:- Implementation of Count Sort

Assignment 3.:- Singly Linked List

1. Topic name:- Implementation of Singly Linked List

    Create, Insert, Delete, Display, Search, Sort, Reverse

2. Topic name - Merging of two linked list.

3. Topic name:- Concatenation of two singly linked list

4. Topic name:- Implementation of Singly Circular Linked List

    Create, Insert, Delete, Display, Search

Assignment 4:- Doubly Linked List

1 . Topic name:- Implementation of Doubly Linked List Create, Insert, Delete,

    Display, Search operation

2. Topic name:- Implementation of Doubly Circular Linked List

    Create, Insert, Delete, Display, Search

Assignment 5:- Stack

1 . Topic name:- Static and Dynamic implementation of Stack

2. Topic name:- Infix to Postfix conversion

3. Topic Name:- Evaluation of postfix expression

Assignment 6:- Queue

1. Topic name:- Static and Dynamic implementation of linear Queue

2. Topic name:- Implementation of circular queue

B.   Database Management Systems

Assignment 1.

Create simple tables including all data types.

a.   Primary key constraint (as a table level constraint & as a column level constraint)

b.   Check constraint (All types)

c.   Unique constraint

d.   Null/Not null constraint

Assignment 2.

  Create more than one table, with referential integrity constraint.

Assignment 3.

  Drop a table, Alter schema of a table.

  Insert / Update / Delete records using tables created in previous Assignments.

Assignment 4.

-   Write queries on the tables using simple form of select statement.

  Select <field-list> from table [where <condition> order by <field list>], Select <field-list, aggregate functions> from table [where <condition> group by <> having <> order by <>]

-   To create views

Assignment 5.

  Write queries on the table, using set operations (minus operation, union, union all, intersect, intersect all)

Assignment 6.

  Write nested queries on the tables (Use of Except, Except, all , Exists, Not exists)

Note: Laboratory handbook prepared by the University

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – III
Course Type: VSC
Course Code: CS 221-VSC-T
Course Title : Software Engineering

Teaching Scheme	No. of Credits	Examination Scheme
2 Hours /Week	**2**	IE : 15 marks UE: 35 marks

Prerequisites

   ER Modeling

Course Objectives

1.   To get knowledge and understanding of software engineering discipline.
2.   To learn analysis and design principles for software project development.
3.   Implement Agile Development Methodologies in real life Software Projects.

Course Outcomes

On completion of the course, student will be able to-

CO1: Identify data requirements, analyze and prepare data models.

CO2: Understand basic software engineering concepts and Process models.

CO3: Compare and chose a process model for a software project development.

CO4: Design different UML Diagrams.

Course Contents

Chapter 1	**Introduction to Software Engineering**	**5 Hours**

1.1   Definition of Software
1.2   Nature of Software Engineering
1.3   Changing nature of software
1.4   Mc Call's Quality factors
1.5   Software Process
1.6   The Process Framework
1.7   Umbrella Activities
1.8   Process Adaptation

Chapter 2	Software Development Life Cycle	5 Hours

2.1 Introduction, Activities of SDLC

2.2   Preliminary Investigation and its activities.

2.3 Requirements engineering tasks (Inception, Elicitation, Elaboration, Negotiation, Specification, Validation, Requirements Management)

2.4 Fact finding techniques (Interview, Questionnaire, Record Review, Observation)

2.5 Determination of system requirements

2.6 Design of a system

2.7 Development of software

2.8 System testing (Unit Testing, Integration Testing, System Testing, Acceptance Testing)

2.9 System Implementation and Evaluation

2.10 System maintenance

Chapter 3	Process Models	7 Hours

3.1 Generic Process Model

3.2 Prescriptive Process Models

    3.2.1. The Waterfall Model

    3.2.2   V-model

3.3 Incremental and Iterative Process Models

3.4 Evolutionary Process Models- Prototyping, Spiral Model

3.5 Rapid Application Development(RAD)

3.6 Concurrent Models

3.7 The Unified Process

Chapter 4	Requirements Modeling-UML	8 Hours

4.1 Introduction to UML

4.2 Structural Modeling

    4.2.1   Class Model

    4.2.2   Object Model

    4.2.3   Deployment Model

    4.2.4   Component Model

4.3 Behavioral Modeling

    4.3.1   Use case model

    4.3.2   Activity model

    4.3.3   State Chart Model

    4.3.4   Sequence model

4.4 Interaction Model-

    4.4.1 Sequence Model

    4.4.2 Collaboration Model

Chapter 5	Agile Development	5	Hours

5.1   Agility: Introduction, use, purpose

5.2   Agile Process

    5.2.1   Agility Principles

    5.2.2   Human Factors

5.3   Extreme Programming(XP)

    4.3.4   XP Values

    4.3.5   XP Process

    4.3.6   Industrial XP Agile

4.4   Adaptive Software Development(ASD)

    4.4.1   Scrum

    4.4.2   Dynamic System Development Model (DSDM)

    5.4.3   Agile Unified Process (AUP)

Reference Books:

1.   Software Engineering: A Practitioner's Approach - Roger S. Pressman, McGraw hill (Eighth Edition) ISBN-13: 978-0-07-802212-8, ISBN-10: 0-07-802212-6

2.   A Concise Introduction to Software Engineering - Pankaj Jalote, Springer ISBN: 978-1-84800-301-9

3.   The Unified Modeling Language Reference Manual - James Rambaugh, Ivar Jacobson, Grady Booch ISBN 0-201-30998-X

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – III
Course Type: IKS
Course Code: CS-201-IKS-T
Course Title : Indian Knowledge System in Computing

Teaching Scheme	No. of Credits	Examination Scheme
2 Hours /Week	**2**	IE : 15 marks
		UE: 35 marks

Course Objective:

1. To introduce Vedic mathematical techniques and their relevance to modern computational methods.
2. To understand Nyaya's logical framework and its application in reasoning and AI.
3. To explore the algorithmic structure of Panini's grammar and Chandasastra's binary system in computational linguistics and mathematics.
4. To explore real-world applications of IKS concepts in computational sciences

Course Outcomes

On Completion of this course, student will be able to –

CO1: Understand the computational foundations of Indian Knowledge Systems by applying Vedic mathematical techniques in problem-solving.

CO2: Use Nyaya's logical reasoning in AI and decision-making.

CO3: Explore the connection between Panini's grammar and NLP technologies. CO4: Recognize the applications of IKS in modern computing fields

Course Contents

Chapter 1	**Vedic Mathematics & Computational Thinking**	**8 hours**

1.1	Introduction to Vedic Mathematics: Origins and importance in ancient India, Sutras and their logical foundation
1.2	Basic Arithmetic using Vedic Methods: Addition, subtraction, multiplication, and division tricks
1.3	Algebraic Applications of Vedic Mathematics: Squaring, square roots, cube roots, and factorization

Chapter 2	**Introduction to Nyaya (Indian Logic)**	**8 hours**

2.1	Introduction to Nyaya Philosophy: Introduction to Nyaya (Indian Logic), Overview of Indian philosophical schools, Importance of Nyaya in logical reasoning, Types of reasoning (Anumana, Pramana, etc.)
2.2	Nyaya's Four Sources of Knowledge (Pramaṇa): Perception, inference, comparison, verbal Testimony
2.3	Types of Argumentations in Nyaya Vada (truth-based), Jalpa (debate-focused), Vitanda (criticism) Applications in AI & Machine Learning**:** Logical reasoning models, expert systems, and rule-based AI

Chapter 3	Panini's Astadhyayi & Chandasāstra	8 hours
3.1	Introduction to Panini's Astadhyayi: Historical background and linguistic importance	
3.2	Rule-Based System of Sanskrit Grammar: Sutras, meta-rules, recursion, and transformations	
3.3	Chandasastra's Binary logic and combinatorial techniques	

Chapter 4	Applications of IKS in Computer Science	6 hours
4.1	Mind and cognition in Samkhya and Yoga: AI insights	
4.2	Machine Learning and Indian philosophies: Understanding of human cognition in Indian philosophical schools (Advaita, Samkhya and Yoga)	
4.3	Cryptography and Security: Ancient cryptographic methods in Kautilya's Arthashastra, protecting information: analogies from Indian traditions	

Reference Books

1. Vedic Mathematics, Jagadguru Swami Bharati Krishna Tirtha, Motilal Banarsidass Publishing House, New Delhi.
2. "The Power of Vedic Maths" – Atul Gupta, JAICO publishing
3. Nyaya Theory of Knowledge" – S.C. Vidyabhusana
4. "A Primer of Indian Logic" – Kuppuswami Sastri, Hassell Street Press.2021
5. "Indian Logic: A Reader" – Jonardon Ganeri
6. "Aṣṭādhyāyī of Pāṇini" (Volumes 1 & 2) – Rama Nath Sharma, Munshirm Manoharlal publication
7. "Panini: His Work and Its Traditions" – George Cardona, Motilal Banarsidass Publishing House
8. "The Mathematics of Metre" – Satyanarayana Das
9. "Samkhya and Science" – Debabrata Sen Sharma
10. Explores the cognitive science aspects of Samkhya and Yoga in AI research.
11. "AI and Indian Philosophy" – Sangeet Kedia
12. "Kautilya's Arthashastra" – R. Shamasastry (Translation)
13. "History of Indian Cryptography" – Subhash Kak
14. Discusses coded messages, steganography, and security concepts in ancient India.
15. Saubhagya Vardhan, AI in Land of Vedas, Notion Press, 2023

Savitribai Phule Pune University **S.Y.B.Sc. (Computer Science) - Sem – III** **Course Type: FP/OJT/CEP** **Course Code: CS-231-FP** **Course Title : Mini Project**		
Teaching Scheme 4 Hours /Week	No. of Credits 2	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites
  ER Modeling

Course Objectives

1. To get knowledge and understanding of software engineering discipline.
2. To learn analysis and design principles for software project development.
3. Implement Agile Development Methodologies in real life Software Projects.

Course Outcomes

On completion of the course, student will be able to-

CO1: Identify requirements, analyze and prepare models.

CO2: Understand basic SW engineering concepts and Process models.

CO3: Compare and chose a process model for a software project development.

CO4: Design different UML Diagrams.

Course Contents

Assignment No	**Title**	**No of hours**
1	Preliminary Investigation and its activities	2 Slots
2	Requirement Specification	2 Slots
3	Database Design	3 Slots
4	Design of a system	4 Slots
5	Input Form Design and Output Screen layout	1 Slot

Note: 1 slot = 4 Hours

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem –III
Course Type:GE/OE.   Course Code: OE-201-CS-T
Course Title: Ecommerce I

Teaching Scheme 02 Hours /Week	No. of Credits 2	Examination Scheme IE :15 Marks UE:35Marks

Prerequisites
- Basic Computer and Internet Knowledge
- Fundamentals of Business, Commerce and Digital Marketing Basics
- Financial and Payment Systems

Course Objectives
- To understand basic concepts about e-Commerce.
- To understand the applications of e-Commerce.
- To learn Business model knowledge.
- To enable knowledge about E-payment system.
- To get a general idea of M-commerce

Course Outcomes

On completion of the course, student will be able to–

CO1: Learn and implement basic concepts and applications of e-Commerce.

CO2: Understand operations of electronic payment system.

CO3: Compare and analyze various business models.

CO4: Understand regulatory framework for E-Commerce.

Course Contents

Chapter1	**E- Commerce and Business Model Concepts**	**7 Hours**

1.1. Introduction to E Commerce: Definition, Goals, Technical Components, Functions, Status, Prospects, Significance, Advantages, Disadvantages E-Commerce

1.2. Business Models: Major Business to Consumer (B2C) Business Model Portal, E-tailor, Major Business to Business (B2B) Business Mode, E Distributor, E-Procurement, Exchanges

1.3 Business models in Emerging E-Commerce Areas - C2C, P2P, and B2G.,case studies.

Chapter2	**E-Marketing and E- Commerce Application**	**7 Hours**

2.1. Introduction, Identifying Goals, Definition

2.2. Browsing Behavior Model

2.3. Online Marketing

    2.3.1   e-Commerce and retailing

    2.3.2   e-Commerce and banking,

2.4. E-Advertising –Introduction, Purpose, Goals, advantages, disadvantages.

2.5.	Internet Marketing Trends	
2.6.	Target Markets	
2.7.	E-Branding	
2.8.	Marketing Strategies	
2.9.	Consumer Online: The Internet Audience and Consumer Behaviors	
2.10.	E-cycle of Internet Marketing	

Chapter 3	**E-commerce Payment Method**	**6 Hours**

3.1.	The requirements of an electronic payment system
3.2.	Traditional payment system, Electronic payment technology.
3.3.	Electronic payment gateways.
3.4.	B2B electronic payments.
3.5.	Third-party payment processing, electronic or digital currency, characteristics, operation.
3.6.	Online credit card payments and smart cards.

Chapter 4	**E-Commerce Laws & Regulations**	**5 Hours**

4.1.	Introduction to E-Commerce Laws
4.2.	Information Technology (IT) Act, 2000 (India).
4.3.	GDPR (General Data Protection Regulation) – EU.
4.4.	Other Global E-Commerce Laws.

Chapter 5	**Future Trends in E-Commerce**	**5 Hours**

5.1.	AI & Chatbots in E-Commerce.
5.2.	AR/VR Shopping Experiences.
5.3.	Personalization & Data Analytics.
5.4.	The Role of IoT in E-Commerce.

Reference Books:

1. Kenneth C. Laudon, E-Commerce: Business, Technology, Society, 4th Edition, Pearson
2. S. J. Joseph, E-Commerce: An Indian perspective, PHI
3. E-Commerce Law: National and Transnational Topics– Alan Davidson
4. Artificial Intelligence in E-Commerce– Richard Boire

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – III
Course Type: GE/OE   Course Code: OE-202-CS-T
Course Title :Web Design I

Teaching Scheme 02 Hrs/ week	No. of Credits 2	Examination Scheme IE :15 marks UE: 35 marks

Prerequisites
- Basic computer knowledge and the ability to work with files.
- Knowledge and understanding of Internet.

Course Objectives
- To learn HTML tags and programming concepts and techniques.
- To develop the ability to logically plan and develop web pages.
- To learn writing and debugging HTML code.
- To learn to design table, frames etc.

Course Outcomes

On completion of the course, student will be able to–
- Learn and use the HTML Tags.
- Understand and resolves errors in HTML codes.
- Design and develop the page using HTML codes.
- Implement and develop Web pages

Course Contents

Chapter 1	**Introduction to Web Design**	**8 hours**

1.1   Introduction

1.2   Working of the Internet.

1.3   Role of Web Servers, Clients(Communication)

1.4   Web Browsers

1.5   Working of the Internet, Intranet and WWW

1.6   E-Mail Servers and Protocols

1.7   E-mail Clients and Web Based Mail Access using Browser

1.8   Messenger Services and Clients(Chat)

1.9   Advantages and Disadvantages of Internet

1.10   Concept of effective Web Design (Web site, classification of website, Advantages and Disadvantages. Of website)

1.11   Fundamental Principles of Web page design and issues

Chapter 2	Getting Started with HTML	6 hours

2.1   Introduction to scripting Languages
2.2   HTML Editing Tools
2.3   WYSISYG Authoring Tools
     2.3.1   HTML Script
     2.3.2   Basic HTML Document Structure
     2.3.3   Common HTML Tags and its attributes
     2.3.4   Design HTML Tags
     2.3.5   Text Formatting and Styles
     2.3.6   Images and Graphics
     2.3.7   Button, Formatting and Style
     2.3.8   Lists
     2.3.9   Hyperlinks
2.4   Multimedia
2.5   Frames
2.6   HTML Forms
2.7   Linking Web pages
2.8   Publishing Web Pages

Chapter 3	Tables	6 hours

3.1   Table Structure
3.2   Table tags
3.3   Affecting table appearance
3.4   Table troubleshooting
3.5   Tips and tricks
3.6   Standard table templates
3.7   Multipart images in tables

Chapter 4	Frame / Forms	6 hours

4.1.   Introduction to frames
4.2.   Basic frameset structure
4.3.   The frame function, appearance and Targeting frames.
4.4.   The Inline (Floating) frames and Frame design tips and tricks
4.5.   Forms: FORM elements, FORM attributes, Unconventional use of FORM elements
4.8.   Demystifying CGI
4.9.   Retrieving parameter value using getParameter () method

Case Studies	4 hours
Case study 1: Creation of forms, small case study to create HTML pages using all the above learnt techniques. **Case study 2:** Creation of Forms layout designing by using div element with CSS property **Case study 3:** Create Multiple Web pages link them to publish a small website.	
Reference Books:	

1. Computer Programming For Beginners:Learn The Basics Of HTML5-Joseph Connor
2. The Complete Reference HTML & CSS-Fifth Edition-Thomas A.Powell
3. Learning Web Design: A beginner's Guide to HTML, CSS, Javascript, and Web Graphics - Jennifer Robbins
4. HTML5: The Missing Manual - Matthew MacDonald.

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem –III
Course Type:GE/OE.   Course Code: OE-203-CS-T
Course Title: Digital Marketing I

Teaching Scheme 02 Hours /Week	No. of Credits 2	Examination Scheme IE :15 Marks UE:35Marks

Prerequisites

- Creative & Logical thinking ability,
- Digital devices operational skills and Knowledge

Course Objectives

- To understand Digital Marketing as the most powerful marketing tool.
- Learn to create digital marketing artworks.
- Learn how to use email campaigns, blogging to produce worthwhile, pertinent material that draws in and engages a target audience.

Course Outcomes

On completion of the course, student will be able to–

CO1: Learn and visualize power to explore new ideas.

CO2: Analyze and develop their Marketing skills.

CO3: Analyze and understand tacts with corporate objectives and produce quantifiable outcomes from e-payment mechanisms.

CO4: Identify and apply target demographics and company objectives, increasing

brand awareness and boosting conversions.

Course Contents

Chapter1	**History of Digital Marketing**	**8 Hours**

1.1. Introduction

1.2. Offline digital marketing - Electronic billboards, Radio marketing, T.V. marketing, Phone marketing

1.3. Online marketing - Search Engine Optimization (SEO), Social media marketing, E-mail marketing

1.4. Difference between conventional marketing and online marketing.

Chapter2	**Internet Marketing**	**8 Hours**

2.1. Structure of Website - Team

2.2. Types of website - Static Website, Dynamic website, Personal, Commercial, Governmental, Non-profit organization

2.3. Web Portals - Type of Portals

Chapter3	Classification of e-Commerce	8 Hours
3.1. Business to Business (B2B) Model		
3.2. Business to Consumer(B2C) Model		
3.3. Consumer to Consumer(C2C) Model		
3.4. Consumer to Business (B2B) Model		

Case Study	6 Hours
Case Study 1: Digital Platform like subscription-based streaming service that offers a vast library of TV shows, movies, documentaries, and original content. (eg. Prime Video, Netfix etc)	
Case Study 2: Any Private sector bank in India–Digital Transformation and Customer Engagement, Retail banking, corporate banking, credit cards, loans, digital banking, etc.	
Case Study 3: Multispecialty Hospital in 2- Tier city -Cardiology and Orthopedic Departments	
Case Study 4: Content Marketing - like HupSpots Content Marketing creates valuable content like blog posts, e-books and infographics that address their target audience and establishing themselves as though leaders and attracting potential customers.	
Case Study 5: Any Newspaper like The New York Times – Digital Subscription Growth- Transition from print to digital revenue through subscriptions	

Reference Books:	
1	SEO 2025: Learn Search Engine Optimization with Smart Internet Marketing Strategies" by Adam Clarke
2	Digital Marketing: Nitin Kamat, Chinmay Kamat (Himalaya Publishing House)"Made to Stick: Why Some Ideas Survive and Others Die" by Chip Heath and Dan Heath
3	"Digital Marketing: Strategy, Implementation, and Practice" by Dave Chaffey and Fiona Ellis-Chadwick

Savitribai Phule Pune University
S.Y.B.Sc. (Cyber and Digital Science)
Subject Code: OE-204-CS-T
Subject Name:AI for Everyone - I

Teaching Scheme: 2 hours / week	No. of Credits: **2**	Examination Scheme: CA:15 Marks UA: 35Marks

Course Objectives: -

1. Understand the basics of artificial intelligence and its subfields.
2. Explore real-world applications of AI across different industries.
3. Gain insights into the ethical, social, and economic implications of AI.
4. Develop an appreciation for the potential of AI to drive innovation and transformation.

Course Outcomes: -On completion of the course, student will be able to–

CO1: Learn and analyse the fundamental concepts and subfields of AI.

CO2: Understand the potential of AI to drive innovation and transformation in different domains.

CO3: Identify and apply AI tools across various industries.

CO4: Analyse and apply the ethical, social, and economic implications of AI.

Course Contents

Unit 1	**Introduction to Artificial Intelligence**	**8 hours**

1.1   Definition and scope of AI
1.2   Historical overview and key milestones
1.3   Differentiating AI from human intelligence
1.4   Types of AI tools: Text, image, audio, video, coding, and automation.
1.5   Where to find free AI tools? (Google AI, Open AI, Hugging Face, etc.)

Unit2	**AI Subfields**	**6 hours**

2.1   Machine learning: Supervised, unsupervised, and reinforcement learning
2.2   Deep learning and neural networks
2.3   Natural language processing (NLP) and computer vision

Unit3	**Applications of AI**	**8 hours**

3.1   AI in healthcare: Diagnosis, treatment, and medical imaging
3.2   AI in finance: Fraud detection, algorithmic trading, and risk assessment
3.3   AI in transportation: Autonomous vehicles and traffic optimization
3.4   AI in customer service and chatbots
3.5   AI in education: Personalized learning and intelligent tutoring systems

Unit4	Ethical and Social Implications of AI	8 hours
4.1	Bias and fairness in AI systems.	
4.2	Privacy and data protection concerns	
4.3	Impact of AI on employment and the workforce	
4.4	AI and social inequality	
Reference Books:		
1.	Artificial Intelligence: A Guide for Thinking Humans" – Melanie Mitchell	
2.	The AI Revolution in Medicine: GPT-4 and Beyond" – Peter Lee, Carey Goldberg, Isaac Kohane	
3.	AI 2041: Ten Visions for Our Future" – Kai-Fu Lee, Chen Qiufan	
4.	The Business of AI: AI Technologies and How to Leverage Them for Business Success" – Anirudh Koul	
5.	AI-Powered Marketing: Harness the Future of Marketing with AI" – Peter Gentsch	
6.	The AI Marketing Handbook" – Ryan McKenzie	

Semester IV

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – IV
Course Type: Major
Course Code: CS-251-MJ-T
Course Title : Data Structure II

Teaching Scheme 02 Hrs/ week	No. of Credits 2	Examination Scheme IE: 15 marks UE: 35 marks

Prerequisites
- Understanding of Fundamentals of Data Structures
- Proficiency in Memory Management and Pointers
- knowledge of Algorithmic Concepts.

Course Objectives
- Understand the fundamental concepts of trees, search trees, graphs, and hash tables to analyze their structure and properties.
- Apply appropriate tree and graph traversal techniques to solve real-world computational problems.
- Analyze the efficiency of various searching, graph algorithms, and hashing techniques for optimized data retrieval.
- Design and implement tree, graph, and hash-based data structures to develop efficient algorithmic solutions.

Course Outcomes

On completion of the course, student will be able to–

CO1: Learn traversal algorithms to solve computational problems efficiently.

CO2: Analyze the performance of different data structures.

CO3: Design graph-based solutions using representations techniques

CO4: Evaluate the efficiency of different strategies of data storage and retrieval.

Course Contents

Chapter 1	**Tree**	**10 Hours**

1.1 Concept and Terminologies

1.2 Types of Binary Trees - Binary Tree, Skewed Tree, Strictly Binary Tree, Full Binary Tree, Complete Binary Tree, Expression Tree, Binary Search Tree.

1.3 Representation – Static and Dynamic

1.4 Implementation and Operations on Binary Search Tree - Create, Insert, Delete, Search,

1.5 Tree traversals– preorder, inorder, postorder (recursive implementation), Level-order traversal using queue, Counting leaf, non-leaf and Total nodes, Copy, Mirror.

1.6 Applications of trees - Heap Sort.(Max heap and Min Heap)

Chapter 2	Search Trees	4 Hours

2.1	Basic Terminology: Balanced tree - AVL Tree, Red Black tree
2.2	AVL Tree- Rotations (LL, LR, RL, RR)
2.3	Red Black tree – Operation (Insertion, Deletion)
2.4	Multi-way search tree -
	2.4.1 B tree and B+ tree - Concept, Operation (Insertion)

Chapter 3	Graph	11 Hours

3.1	Concept and terminologies
3.2	Graph Representation –Adjacency Matrix, Adjacency List, Inverse Adjacency list, Adjacency Multi List.
3.3	Graph Traversals – Breadth First Search and Depth First Search (with implementation)
3.4	Applications of graph
	3.4.1 Topological sorting
	3.4.2 Use of Greedy Strategy in Minimal Spanning Trees (Prims and Kruskals algorithm)
	3.4.3 Single Source Shortest Path - Dijkstra's algorithm
	3.4.4 Dynamic Programming Strategy - All Pair Shortest Path - Floyd Warshall algorithm
	3.4.5 Use of graphs in social networks

Chapter 4	Hash Table	5 Hours

4.1	Concept of Hashing
4.2	Terminologies – Hash table, Hash function, Bucket, Hash address, Collision, Overflow
4.3	Hash Function -
	4.3.1 Properties
	4.3.2 Methods/ Functions (Division, MID Square, Folding etc.)
4.4	Collision resolution techniques
	4.4.1 Open Addressing - Linear probing, Quadratic probing, Rehashing
	4.4.2 Chaining - Coalesced , Separate Chaining

Reference Books:

1. Fundamentals of Data Structures in C- Ellis Horowitz, Sartaj Sahni,Susan Anderson-Freed, 2nd Edition, Universities Press.
2. Data Structures Using C – Reema Thareja
3. Introduction to Algorithms – Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
4. Data Structures, Algorithms, and Applications in C++ – Sartaj Sahni

Savitribai Phule Pune University	
S.Y.B.Sc. (Computer Science) - Sem – IV	
Course Type: Major	
Course Code: CS-252-MJ-T	
Course Title : Database Management System-II	

Teaching Scheme 02 Hrs/ week	No. of Credits 2	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites
- Basic Knowledge of DBMS
- Knowledge of SQL Queries
- Basics concepts of Relational Database Design and ER models

Course Objectives
- To teach fundamental concepts of RDBMS (PL/PGSQL)
- To teach database management operations
- Be familiar with the basic issues of transaction processing and concurrency control
- To teach data security and its importance

Course Outcomes

On completion of the course, student will be able to–

CO1: Understand PL/PGSQL database techniques and its programming skill.

CO2: Apply and relate the concepts of database transaction management.

CO3: Implement the concurrency control mechanism and recovery techniques in the databases.

CO4: Inculcate concepts of modern databases.

CO5: Apply the database security concepts in real life situation.

Course Contents

Chapter 1	**Relational Database Design Using PL/PGSQL**	**12 Hours**

1.1   Introduction

1.2   PL/PGSQL: Data types, Language Structure

1.3   Controlling the program flow.

     1.3.1   Conditional Statements

     1.3.2   Loops

1.4   Stored Procedures

1.5   Functions

1.6   Handling Errors and Exceptions

1.7   Cursors

1.8   Triggers

Chapter 2	**Transaction Concepts and concurrency control**	**8 Hours**

2.1   Transaction - Concept, Properties of transaction, States of transaction

2.2   Transaction Execution

      2.2.1   Types of Execution

      2.2.2   Associated Problem in Concurrent execution.

2.3   Schedules – Concept

      2.3.1   Types of Schedule

      2.3.2   Concept of Serializability

      2.3.3   Precedence Graph for Serializability.

2.4   Ensuring Serializability by Locks,

      2.4.1   Different Lock Modes

      2.4.2   2PL and its variations.

2.5   Basic timestamp method for concurrency, Thomas Write Rule.

2.6   Locks with Multiple Granularity, Dynamic Database Concurrency (Phantom Problem).

2.7   Timestamps vs Locking.

2.8   Deadlock and Deadlock Handling –

      2.8.1   Deadlock Avoidance (Wait-Die, Wound-Wait),

      2.8.2   Deadlock Detection (Wait for Graph).

      2.8.3   Deadlock Recovery

Chapter 3	**Database Integrity and Security Concepts**	**4 Hours**

3.1   Constraints

      3.1.1   Domain Constraints

      3.1.2   Referential Integrity Constraint

3.2   Database Security Concepts.

3.3   Methods for Database Security

      3.3.1.   Discretionary Access Control (DAC)

      3.3.2.   Mandatory Access Control (MAC)

      3.3.3.   Role Base Access Control for Multilevel Security.

3.4   Use of views in Security Enforcement.

3.5   Overview of Encryption Technique for Security.

3.6   Statistical Database Security.

Chapter 4	**Crash Recovery**	4 **Hours**

4.1   Concepts of failure, Failure Classification

4.2   Recovery Concepts

4.3   Log Base Recovery Techniques

      4.3.1   Deferred

      4.3.2   Immediate Update

4.4   Checkpoints, Relationship between Database Manager and Buffer Cache

4.5   Aries Recovery Algorithm.

4.6	Recovery with Concurrent Transactions (Rollback, Checkpoints, Commit)	
4.7	Database Backup and Recovery from Catastrophic Failure	
Chapter 5	**Other Databases**	**2 Hours**
5.1	Introduction to Parallel and Distributed Databases	
5.2	Object Based Databases	
5.3	XML Databases	
5.4	NoSQL Database	
5.5	Multimedia Databases	
5.6	Big Data Databases	

Reference Books:

1. Database System Concepts, By Silberschatz A., Korth H., Sudarshan S., 6ᵗʰ Edition, McGraw Hill Education
2. Database Management Systems, Raghu Ramakrishnan, Mcgraw-Hill Education
3. Database Systems, Shamkant B. Navathe, Ramez Elmasri, PEARSON HIGHER EDUCATION
4. Fundamentals of Database Systems, By: Elmasri and Navathe, 4ᵗʰ Edition Practical PostgreSQL O'REILLY
5. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill Science/Engineering/Math; 3 edition, ISBN: 9780072465631
6. NoSQL Distilled, Pramod J. Sadalage and Martin Fowler, Addison Wesley
7. An Introduction to Database Systems", C J Date, Addison-Wesley
8. Database Systems: Concepts, Design and Application", S.K.Singh, Pearson, Education
9. MongoDB: The Definitive Guide, Kristina Chodorow, Michael Dirolf, O'Reilly Publication

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – IV
Course Type: Major
Course Code: CS-253-MJ-P
Course Title : Lab Course based on CS-251-MJ-T & CS-252-MJ-T

Teaching Scheme 04 Hrs/ week	No. of Credits 2	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites
- Fundamentals concepts of Pointers, Data Structures,
- knowledge of Algorithm and proficiency in memory management
- Basic Knowledge of DBMS and SQL Queries.
- Basics concepts of Relational Database Design and ER model.

Course Objectives
- Apply tree-based data structures by implementing Binary Search Trees (BST) and traversal techniques.
- Analyze graph representations and perform fundamental graph operations, including traversal, topological sorting, and spanning tree algorithms.
- Evaluate shortest path algorithms and their efficiency in solving real-world pathfinding problems.
- Design and implement hash table techniques for efficient data storage and retrieval.

Course Outcomes: -

On completion of this course, students will be able to:

CO1: Understand the basic concepts of data structures.

CO2: Choose the appropriate data structure for a given problem.

CO3: Design and implement database applications to solve real-world problems.

CO4: Implement database security concept and access control mechanism.

Operating Environment:

For Data Structures II

       Operating system: Linux

       Editor: Any linux based editor like vi, gedit etc.

       Compiler: cc or gcc

For Database Management System II

       Operating system: Linux

       Editor: Any linux based editor like vi, gedit etc.

Suggested List of Assignments:

A)   Data Structures II

Assignment 1. Binary Search Tree and Traversals

1. Implementation of Binary Search Tree (BST) to perform Create, Search, Insert, Copy operation on BST
2. Implementation of Traversal Techniques: Inorder, Preorder and Postorder

Assignment 2. Binary Search Tree Operations and Applications

1. Implement Binary Search Tree (BST) to perform following operations on BST–copy and mirror image of BST, counting leaf, non-leaf and total nodes.
2. Level-order traversal of binary search tree using queue.
3. Heap sort

Assignment 3. Graph implementation

1. Implement Graph as adjacency matrix and adjacency list
2. Calculate indegree and outdegree of vertices
3. Graph traversals: BFS and DFS.

Assignment 4. Graph Applications - I

1. Implementation of Topological sorting
2. Implementation of Prims/Kruskals Minimum spanning tree algorithm

Assignment 5. Graph Applications - II

1. Implementation of Dijkstra's shortest path algorithm for finding Shortest Path from a given source vertex using adjacency cost matrix.
2. Implementation of Floyd Warshall algorithm for all pairs shortest path.

Assignment 6. Hash Table

1. Implementation of static hash table with Linear Probing.
2. Implementation of static hash table with chaining.
3. Implementation of linked hash table with chaining.

B)   Database Management Systems II:

Lab Book:

Assignment 1: Stored Procedure

1. A Simple Stored Procedure
2. A Stored Procedure with IN, OUT and IN/OUT parameter

Assignment 2: Function

1. A Simple Stored Function
2. A Stored Function that returns
3. A Stored Function recursive

Assignment 3: Cursors

1. A Simple Cursor
2. A Parameterize Cursor

Assignment 4: Exception Handling
1. Simple Exception- Raise Debug Level Messages
2. Simple Exception- Raise Notice Level Messages
3. Simple Exception- Raise Exception Level Messages

Assignment 5: Triggers
1. Before Triggers (insert, update, delete)
2. After Triggers (insert, update, delete)

Note: Laboratory handbook prepared by the University.

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Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – IV
Course Type: VSC
Course Code: CS-271-VSC-P
Course Title : Advance Python Programming

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Teaching Scheme 04 Hrs/ week	No. of Credits 2	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites -
- Basic Python Programming Knowledge
- Basic Understanding of pattern matching and String operations
- Knowledge of file handling

Course Objectives
- Understand and manipulate operations on data in Python
- Develop the ability to write reusable functions to organize code better and improve efficiency.
- Learn to structure their programs using functions and modules to improve readability and maintainability.

Course Outcomes

On completion of the course, student will be able to–

CO1: Read and write data from & to files in Python.

CO2: Express proficiency in the handling of strings and functions

CO3: Identify the commonly used operations involving file systems and regular expressions.

CO4: Develop application using python.

Course Contents

Assignment 1	**Data Frame**	**1 Slot**

- Creating Data Frame - User define, using csv file
- View Data Frame
- Preprocessing on Data Frame - Null Values, Duplicate values
- Modify Data in DataFrame
- Grouping and Aggregating Data
- Merging and Joining DataFrames

Assignment 2	Functions in Python	2 Slots

- Creating user defined functions
- Calling a function
- Function Arguments
- Return Statement
- Functions returning multiple values
- Anonymous Functions
- Recursive Functions

Assignment 3	Iterators & Generators in Python	2 Slots

- Function ducktyping
- List comprehension
- Unpacking argument list
- Creating Iterator
- Creating Generator

Assignment 4	Modules	1 Slot

- Importing module
- Creating & exploring modules
- Math module
- Random module
- Time module

Assignment 5	Packages	1 Slot

- Importing package
- creating package

Assignment 6	Working with Files	2 Slots

- Creating files and Operations on files (open, close, read, write),
- File object attributes,
- file positions,
- Listing Files in a Directory,
- Testing File Types,
- Removing files and directories,
- copying and renaming files

-

Assignment 7	Regular Expression	2 Slots
• Concept of regular expression, • various types of regular expressions • function related to regular expressions.		
Assignment 8	Exception Handling	1 Slot
• Built-in Exceptions • Handling Exceptions • Exception with Arguments • User-defined Exceptions.		

Note: 1 Slot = 4 Hours

Savitribai Phule Pune University	

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – IV
Course Type: VSC
Course Code: CS-281-FP
Course Title : Mini Project

Teaching Scheme **4 Hours /Week**	No. of Credits **2**	Examination Scheme IE : 15 marks UE: 35 marks

Prerequisites
    ER Modeling

Course Objectives

1.   To get knowledge and understanding of software engineering discipline.
2.   To learn analysis and design principles for software project development.
3.   Implement Agile Development Methodologies in real life Software Projects.

Course Outcomes

On completion of the course, student will be able to-

CO1: Identify requirements, analyze and prepare models.

CO2: Understand basic SW engineering concepts and Process models.

CO3: Compare and chose a process model for a software project development.

CO4: Design different UML Diagrams.

Course Contents

Assignment No	**Title**	**No of hours**
1	Preliminary Investigation and Requirement Specification	2 Slots
2	Design of a system	2 Slots
3	Database Design	2 Slots
4	Input and Output Screen layout	1 Slots
5	Coding and Implementation	5 Slot

Note: 1 Slot = 4 Hours

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Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem – IV
Course Type: SEC
Course Code: SEC-251-CS-P
Course Title : Computer Networks

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Teaching Scheme **2 Hours /Week**	No. of Credits **2**	Examination Scheme IE: 15 marks UE: 35 marks

Prerequisites
- Understanding of computer hardware components.
- Understanding of basic data communication terminology.
- Knowledge of how data is transmitted over networks (packets, frames).

Course Objectives
- To learn basic concepts and terminology related to computer networks
- To understand cyber security principles and techniques to secure networks.
- To understand and analyze different network devices.
- To equip students with the knowledge and skills necessary to design, implement, manage, and secure computer networks in various environments.

Course Outcomes

On completion of the course, student will be able to–

CO1: Understand the principles of wireless networking.

    CO2: Configure wireless networks.

CO2: Demonstrate the ability to apply theoretical knowledge in practical lab settings.

CO3: Utilize troubleshooting techniques and tools to diagnose and resolve common network issues effectively.

CO4: Identify potential security threats to networks and apply appropriate security measures.

CO5: Apply security practices in real-world scenarios.

Course Contents

Assignment 1	**Study of Network Devices , Cables and Configuration**	1 Slot

- Identify various network cables (Ethernet, Coaxial, Fiber Optic).
- Use a crimping tool to create a straight-through and cross-over Ethernet cable.
- Test cable connectivity using a network tester or direct connection between two devices.

Assignment 2	Understanding IP Addressing	2 Slots

- Understand IP address classes (A, B, C, D, E) and their ranges.
- Perform subnetting and supernetting calculations.
- Configure IP addresses on different devices using Packet Tracer.

Assignment 3	Connecting Computers and Configuration Commands	2 Slots

Use network cables and switches to connect multiple computers.

- Assign IP addresses to each computer.
- Verify network connectivity using ping and tracert commands.
- Execute commands such as ping, tracert, nslookup, ifconfig/ipconfig.
- Configure a router using basic commands (show, enable, configure terminal, etc.).
- Save and restore router configurations.

Assignment 4	Initial Switch Configuration	2 Slot

- Configure hostname, console password, VTY password, and privileged EXEC mode password.
- Assign an IP address to VLAN1 and set up a default gateway.
- Verify the configuration using show running-config and ping commands.

Assignment 5	Router Configuration and Encryption	2 Slots

- Configure hostname, enable password, and encrypted secret password.
- Set up banner messages for security purposes.
- Configure console and VTY passwords and test access control.
- Set up a Linksys Wireless Router and configure SSID.
- Enable WEP encryption and configure a passkey.
- Connect a client device and verify secure connectivity.

Assignment 6	Network Address Translation (NAT) and Testing Static and Dynamic Routing	2 Slots

- Observe NAT behavior using Packet Tracer Simulation Mode.
- Identify inside local, inside global, outside local, and outside global addresses.
- Verify successful NAT translation using show NAT translations.
- Configure static routes between multiple networks.
- Set up dynamic routing protocols such as RIP, EIGRP, or OSPF.
- Compare routing performance using tracert and show ip route.

Assignment 7	Cyber Threats and Attacks	1 Slot

- Simulating a Phishing Attack (Ethical Demonstration)
- Detecting Malware Using Virtual Machines
- Password Cracking (Brute Force & Hash

Assignment 8	Cyber Security and Policies	1 Slot
• Password security and Hashing • Ethical Hacking • Network Scanning		
Reference Books: 1. "Computer Networking: A Top-Down Approach" - James Kurose and Keith Ross. 2. "Computer Networks" -Authors: Andrew S. Tanenbaum and David J. Wetherall 3. "TCP/IP Illustrated, Volume 1: The Protocols" - W. Richard Stevens 4. "Network Security Essentials: Applications and Standards"- William Stallings 5. "Applied Cryptography: Protocols, Algorithms, and Source Code in C"- Bruce Schneier		

Note: 1 Slot = 4 Hours

Savitribai Phule Pune University
Savitribai Phule Pune University **S.Y.B.Sc. (Computer Science) - Sem –IV** **Course Type:GE/OE. CourseCode: OE-251-CS-T** **Course Title: Ecommerce II**

Teaching Scheme 02Hours /Week	No. of Credits 2	Examination Scheme IE :15 Marks UE:35Marks

Prerequisites

- Knowledge of basic e-commerce concepts, business models and payment systems.
- Understanding of digital marketing, financial systems, and internet technologies

Course Objectives

- To understand the technical and security aspects of e-commerce.
- To explore data-driven decision-making and analytics in e-commerce.
- To study supply chain and logistics management in e-commerce.
- To gain insights into global e-commerce trends and challenges.
- To learn about the integration of AI, Blockchain, and Cloud Computing in e-commerce.

Course Outcomes

On completion of the course, student will be able to–

CO1: Implement secure e-commerce transactions and protect user data.

CO2: Apply analytics tools to track and enhance e-commerce performance.

CO3: Manage e-commerce logistics and understand global trends.

CO4: Use emerging technologies such as AI, Blockchain, and Cloud for e-commerce applications.

Course Contents

Chapter1	**E-Commerce Logistics and Supply Chain Management**	**6 Hours**

1.1. E-Commerce Supply Chain Overview
1.2. Inventory Management in E-Commerce
1.3. Role of Warehousing and Fulfillment Centers
1.4. Last-Mile Delivery Challenges
1.5. Reverse Logistics and Return Policies
1.6. Green and Sustainable Supply Chains

Chapter2	**Data Analytics and Consumer Behavior in E-Commerce**	**7 Hours**

2.1. Importance of Data Analytics in E-Commerce
2.2. Key Performance Indicators (KPIs) and Metrics
2.3. Web Analytics (Google Analytics, Heatmaps, A/B Testing)
2.4. Predictive Analytics & Customer Insights
2.5. Recommendation Engines & Personalization
2.6. Conversion Rate Optimization (CRO)

2.7.	Fraud Detection Using AI in E-Commerce	
Chapter3	**E-Commerce Security and Privacy**	**6 Hours**
3.1.	Importance of Security in E-Commerce	
3.2.	Threats to E-Commerce (Phishing, Fraud, Cyber Attacks	
3.3.	Cryptography & Secure Transactions (SSL/TLS, Encryption)	
3.4.	Digital Signatures & Certificates	
3.5.	Firewalls & Intrusion Detection Systems	
Chapter4	**Advanced E-Commerce Technologies**	**5 Hours**
4.1.	Machine Learning for Product Recommendations	
4.2.	Block chain for Secure Transactions and Smart Contracts	
4.3.	Cloud Computing and SaaS Platforms for E-Commerce	
4.4.	The Role of 5G in E-Commerce Growth	
Chapter5	**Global Trends of E-Commerce**	**6 Hours**
5.1.	Cross-Border E-Commerce and Global Expansion	
5.2.	Mobile Commerce (M-Commerce) Innovations	
5.3.	Subscription-Based E-Commerce Models	
5.4.	Social Commerce (Instagram, Facebook Shops, TikTok Commerce)	
5.5.	Ethical and Sustainable E-Commerce Practices	
5.6.	Future Challenges in E-Commerce	
Reference Books:		
1.	E-Commerce Analytics: Analyze and Improve the Impact of Your Digital Strategy, Judah Phillips, Pearson	
2.	Cloud Computing: Principles and Paradigms, RajkumarBuyya, James Broberg, Andrzej Goscinski, Wiley	
3.	Global E-Commerce: Theory and Case Studies, Jie Lin, Fei Gao, Springer	
4.	Logistics and Supply Chain Management, Martin Christopher, Pearson	

SavitribaiPhule Pune University
S.Y.B.Sc. (Computer Science) - Sem – IV
Course Type: GE/OE   Course Code: OE-252-CS-T
Course Title :Web Design II

Teaching Scheme 02 Hrs/ week	No. of Credits 2	Examination Scheme IE :15 marks UE: 35 marks

Prerequisites

- Knowledge and understanding of HTML is essential for structuring web pages.
- Basic design principles can enhance your web design abilities.
- Knowledge of programming concepts like variables, loops, and functions can be helpful when learning JavaScript.

Course Objectives

- To learn to define the structure and content of XML documents using XML.
- To know and learning how to use the DOM to access and manipulate XML data within applications.
- To prepare the learners with the fundamentals of CSS programming and scripting languages.
- Learners should know how to create and interact with web pages effectively, develop static and dynamic websites, and understand how they work together.

Course Outcomes

On completion of the course, student will be able to–

- Learn and use the CSS to design Webpages.
- Understand Linking and publishing of Web pages.
- Plan, design and implement webpages.
- Develop a dynamic web pages using JavaScript (client side programming).

Course Contents

Chapter 1	**CSS(Cascading Style Sheet)**	**8 Hours**

1.1. Introduction of CSS and its Syntax
1.2. Ways to Insert CSS and Background image handling
1.3. Background colour management using CSS
1.4. Text and Font management using CSS
1.5. Managing Hyperlinks and List using CSS
1.6. Designing Borders and Outline
1.7. Setting Page Margin using CSS

Chapter 2	**XML(Extensible Markup Language)**	**8 Hours**

2.1. XML Namespaces and Infoset and Document Type
2.2. Definitions (DTDs)
2.3. XML Schemas and XML-Parser
2.4. Data Modeling, Document and Object Model (DOM)
2.5. Displaying XML with XSLT

Chapter 3	Introduction to JavaScript	8 Hours
3.1.	Concept of Script, Types of Scripts, Scripting Languages	
3.2.	Introduction to JavaScript.	
3.3.	Variables, identifier and Operator, Control structure.	
3.4.	Examples on JavaScript Operators.	
3.5.	Functions	
3.6.	Event Handling in JavaScript with examples.	
Case Study		**6 Hours**
Case study 1: Creation of forms, small case study to create HTML pages using all the above learnt techniques. **Case study 2:** Redesigning the Website of a Small Business. **Case study 3:** Create a Styled Web Page for a Coffee Shop.		
Reference Books:		
1.	Learning Web Design: A beginner's Guide to HTML, CSS, Javascript, and Web Graphics - Jennifer Robbins	
2.	HTML5: The Missing Manual - Matthew MacDonald	
3.	HTML and JavaScript – Ivan Bayross	
4.	Mastering HTML, CSS &Javascript Web Publishing	

Note: 1 Slot = 4 Hours

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem –IV
Course Type:GE/OE.   Course Code: OE-253-CS-T
Course Title: Digital Marketing II

Teaching Scheme 02 Hours /Week	No. of Credits 2	Examination Scheme IE :15 Marks UE:35Marks

Prerequisites

- Digital marketing requires creativity and problem-solving abilities.
- Experience with social media platforms (Facebook, Instagram, Twitter, LinkedIn, etc.) is beneficial, as digital marketing

Course Objectives

- To understand Digital Marketing as the most powerful marketing tool.
- To Learn to create digital marketing artworks.
- To use social media sites like Facebook, Instagram, Twitter, LinkedIn, and others to raise sales, engage customers, and establish your brand.

Course Outcomes

On completion of the course, student will be able to–

CO1: Understand and learn marketing strategies and results effectively to stakeholders.

CO2: Assess and enhance digital marketing campaigns' return on Investment.

CO3: Analyze and implement practical experience with industry-standard digital marketing tools.

CO4: Analyze and use variety of social media channels to create and interact with communities, raise awareness of a brand.

Course Contents

Chapter1	**Online Consumer Behavior Analysis**	**8 Hours**

1.1   Consumer Behavior
1.2   Segmentation and Targeting online customers
1.3   Psychological Responses
1.4   Social Trends

Chapter2	**Social Media Marketing**	**8 Hours**

2.1.   Social Media Sites
2.2. - Influence of Social Media Marketing
2.3.   Power of Social Media
2.4.   Monetization through Social Media

Chapter3	Future of Digital Marketing	8 Hours
3.1. Use of Artificial Intelligence (AI) in Digital Marketing. 3.2. Common use of household gadgets for online marketing. 3.3. Digital Marketing strategies.		
Case Study		**6 Hours**
Case Study 1 Experiential Learning: Creating a website. Case Study 2 Online Consumer Behavior Analysis for an E-Commerce Fashion Brand		
Reference Books:		
1 Digital Marketing: Nitin Kamat, Chinmay Kamat (Himalaya Publishing House) 2 "Digital Marketing for Dummies" by Ryan Deiss and Russ Henneberry 3 "Influence: The Psychology of Persuasion" by Robert B. Cialdini 4 "Social Media Marketing Workbook: How to Use Social Media for Business" by Jason McDonald		

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science) - Sem –IV
Course Type: GE/OE.   Course Code: OE-254-CS-T
Course Title: AI for Everyone II

Teaching Scheme: 2 hours / week	No. of Credits: **2**	Examination Scheme: CA:15 Marks UA: 35Marks

Course Objectives: -

1   Understand the basics of artificial intelligence and its subfields.
2   Explore real-world applications of AI across different industries.
3   Gain insights into the ethical, social, and economic implications of AI.
4   Develop an appreciation for the potential of AI to drive innovation and transformation.

Course Outcomes: -On completion of the course, student will be able to–

CO1: Understand different types if AI Models

CO2: Learn and use content optimization using AI.

CO3: Compare and implement Animations and motions in AI

CO4: Understand and analyse AI tools.

Course Contents

Chapter 1	**Advanced AI Fundamentals**	**6 Hours**

1.1	Deep Dive into AI, Machine Learning & Deep Learning	
1.2	Types of AI Models: Generative AI, NLP, Computer Vision, Reinforcement Learning	
1.3	Latest AI Trends: AGI, Large Language Models (LLMs), and multimodal AI	
1.4	Exploring AI Frameworks & APIs: Open AI, Hugging Face, Google AI	

Chapter 2	**AI for Advanced Text & Content Creation**	**8 Hours**

2.1	AI for Long-form Writing & Reports	
2.2	Automating Research & Citation Management	
2.3	AI for SEO & Content Optimization	
2.4	Using AI for Professional Emails & Business Writing	

Chapter 3	**Advanced AI for Image & Video Processing**	**8 Hours**

3.1	AI Image Generation Beyond Basics	
3.2	Deepfake Technology & Ethical Concerns	
3.3	AI Video Editing & Creation	
3.4	AI Animation & Motion Capture	

Chapter 4	AI Tools	8 Hours
4.1	Chat GPT (Open AI)	
4.2	Google Gemini (Bard AI)	
4.3	Canva, Beautiful. AI, Gamma, Slides AI	
4.4	Rytr, Grammarly	

References:

1. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig.
2. Practical AI for Business Leaders – Anand S. Rao
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