

Progressive Education Society's
Modern College of Arts, Science and Commerce
(Autonomous),

Shivajinagar, Pune - 5

**(An Autonomous College Affiliated to Savitribai Phule
Pune University, Pune: 7)**

Framework of Syllabus

For

M.Sc. (Computer Application)

(Based on NEP 2020 framework)

(To be implemented from the Academic Year 2026-27)

Semester 1 (First Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4+2)	26CsCmaP111	Major Paper 1 (Theory)	Design and Analysis of Algorithms	4	4	50	50	100
	26CsCmaP112	Major Paper 2 (Theory)	Artificial Intelligence	4	4	50	50	100
	26CsCmaP113	Major Paper 3 (Theory)	Python Programming	4	4	50	50	100
	26CsCmaP114	Major Paper 4 (Practical)	Lab on Python Programming	4	2	25	25	50
Major Electives (4)	26CsCmaP121	Major Elective 1 (Theory)	Software Development Engineering in Testing	4	4	50	50	100
	26CsCmaP122	Major Elective 2 (Theory)	Advanced Database Concepts	4	4	50	50	100
RM (4)	26CsCopP122	RM Section 1	Research Methodology & Research using Artificial Intelligence	2	4	50	50	100
		RM Section 2		2				
Total				24	22	275	275	550
Extra Credit Course	26CpHrtP101	Non-CGPA Course	Human Rights I	1	1	-	25	25

Semester 2 (First Year)

Course Type	Code	Course	Course / Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4+2)	26CsCmaP211	Major Paper 1 (Theory)	Advanced Operating System	4	4	50	50	100
	26CsCmaP212	Major Paper 2 (Theory)	Information System Security	4	2	25	25	50
	26CsCmaP213	Major Paper 3 (Practical)	Lab on DOT NET and Advanced Operating System	8	4	50	50	100
	26CsCmaP214	Major Paper 4 (Practical)	Project	4	2	25	25	50
	26CsCmaP215	Major Paper 5 (Theory)	DOT NET	4	2	25	25	50
Major Electives (4)	26CsCmaP221	Major Elective 1 (Theory)	Agile Methodology and Design Thinking	2	4	50	50	100
	26CsCmaP222	Major Elective 2 (Theory)	Cloud Computing	2	2	25	25	50
	26CsCmaP223	Major Elective 2 (Practical)	Lab course on Cloud Computing	4	2	25	25	50
OJT(4),	26CsCmaP204	OJT	On Job Training	8	4	50	50	100
Total				28	22	275	275	550
Extra Credit Course	26CpHrtP201	Non-CGPA Course	Human Rights II	1	1	-	25	25

Semester 3 (Second Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4+2)	26CsCmaP311	Major Paper 1 (Theory)	Mobile Technologies	4	4	50	50	100
	26CsCmaP312	Major Paper 2 (Theory)	Full Stack Development I (MERN/MEAN)	4	4	50	50	100
	26CsCmaP313	Major Paper 3 (Theory)	Block Chain Technology	4	4	50	50	100
	26CsCmaP314	Major Paper 4 (Practical)	Lab on Mobile Technologies and Full Stack Development	4	2	25	25	50
Major Electives (4)	26CsCmaP321	Major Elective 1 (Theory)	Machine Learning and Deep Learning	2	2	25	25	50
	26CsCmaP322	Major Elective 1 (Practical)	Lab on Machine Learning and Deep Learning	4	2	25	25	50
	26CsCmaP323	Major Elective 2 (Theory)	Business Intelligence	4	4	50	50	100
RP (4)	26CsCmaP304	RP	Research Project I	8	4	50	50	100
Total				28	22	275	275	550
	26CpCysP301	Non-CGPA Course	Cyber Security I	2	2	-	50	50

Extra Credit Course	26CpSkdP302	Non-CGPA Course	Skill Development I	2	2	-	50	50
	26CpPolP303	Non-CGPA Course	Introduction to Indian Constitution	2	2	-	50	50

Semester 4 (Second Year)

Course Type	Code	Course	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4)	26CsCmaP411	Major Project 1	Industrial / Institutional Training	6	16	200	200	400
RP (4)	26CsCmaP404	RP	Research Project II	12	6	75	75	150
Total				22	22	275	275	550
Extra Credit Course	26CpCysP401	Non-CGPA Course	Cyber Security II	2	2	-	50	50
	26CpSkdP402	Non-CGPA Course	Skill Development II	2	2	-	50	50

OJT : On Job Training: Internship/Apprenticeship

FP : Field Project

RM: Research Methodology

RP: Research Project

Semester –I
(First Year)

**Modern College of Arts, Science and Commerce (Autonomous)
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First Year of M.Sc. (Computer Application)

Course Code: 26CsCmaP111

Course Name: Design and Analysis of Algorithms

Teaching Scheme: TH: 4 Hours/Week

Credit: 4

Examination Scheme: CIA :50 Marks

End-Sem: 50 Marks

Prerequisites:

- Basic knowledge of algorithms and programming concepts
- Data Structures and Advanced Data Structures
- Basic Knowledge of Graphs and Algorithms

Course Objectives:

- To design the algorithms
- To select the appropriate algorithm by doing necessary analysis of algorithms
- To learn basic Algorithm Analysis techniques and understand the use of asymptotic notation, Understand different design strategies

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Analyze the problem	1
CO 2	Develop the algorithm in order to solve the problem	2
CO3	Classification of the problem using different strategies	3
CO 4	Understand and apply the appropriate design strategy to develop algorithm	4
CO 5	Design algorithm in context of space and time complexity	5
CO 6	Apply asymptotic notations find the complexity of algorithm	6

Course Contents:

Unit 1	Basics of Algorithms	8 lectures
	1.1. Algorithm definition and characteristics 1.2. Space complexity 1.3. Time complexity, worst case-best case-average case complexity, asymptotic notation 1.4. Recursive and non-recursive algorithms.	
Unit 2	Divide and conquer strategy	4 lectures
	2.1. Control abstraction 2.2. Binary search 2.3. Merge sort, Quicksort 2.4. Comparison between Traditional method of Matrix Multiplication vs. Strassen's Matrix Multiplication	
Unit 3	Greedy Method	10 lectures
	3.1. Control Abstraction 3.2. Knapsack problem 3.3. Job sequencing with deadlines, 3.4. Minimum-cost spanning trees: 3.4.1. Kruskal and Prim's algorithm 3.5. Optimal merge patterns 3.6. Huffman coding 3.7 Shortest Path: Dijkstra's algorithm	
Unit 4	Dynamic Programming	10 lectures
	4.1. Matrix chain multiplication 4.2.0/1 Knapsack Problem 4.2.1. Functional Method 4.3. Concept of Shortest Path 4.3.1. Single Source shortest path 4.3.2. Dijkstra's Algorithm 4.3.3. Bellman Ford Algorithm 4.3.4. All pairs Shortest Path 4.3.5. Longest common subsequence 4.4. String editing, 4.4.1. Travelling Salesperson Problem	
Unit 5	Backtracking	10 lectures
	5.1.General method 5.2.Fixed Tuple vs. Variable Tuple Formulation 5.3.n- Queen's problem 5.4.Graph coloring problem 5.5.Hamiltonian cycle 5.6.Sum of subsets	
Unit 6	Branch and Bound	10 lectures
	6.1. Introduction 6.2.Definitions of LCBB Search 6.3.Bounding Function, Ranking Function 6.4.Formulation using LCBB	
Unit 7	Problem Classification	8 lectures
	7.1 Non deterministic algorithm 7.2 The class of P, NP, NP-hard and NP - Complete problems 7.3 Cook's theorem	

References:

1. Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, Computer Algorithms, Galgotia
2. T. Cormen, C. Leiserson, & R. Rivest, Algorithms, MIT Press, 1990
3. A. Aho, J. Hopcroft & J. Ullman, The Design and Analysis of Computer Algorithms,
4. Addison Wesley, 1974
5. Donald Knuth, The Art of Computer Programming (3 vols., various editions, 1973-81), Addison Wesley
6. Steven Skiena, The Algorithm Manual, Springer ISBN:9788184898651
7. Jungnickel, Graphs, Networks and Algorithms, Springer, ISBN:3540219056

Course Code : 26CsCmaP112

Course Name: Artificial Intelligence

Teaching Scheme: TH: 04 Hours/Week

Credit: 04

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisites:

- **Data Structure and Algorithm.**
- **Discrete mathematics.**
- **Knowledge of Programming Language**

Course Objectives:

- Understand the fundamental concepts of Artificial Intelligence.
- Identify and apply appropriate search strategies for AI problem.
- Illustrate and Identify knowledge and represent AI algorithms using Heuristics Search Techniques.
- Understand Fundamentals of Game Theory.
- Understand GenAI and LLMs, RAG and Prompt Engineering
- Implementation and Deployment of model

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand the fundamental concepts of Artificial Intelligence.	01
CO 2	Identify and apply appropriate search strategies for AI problem.	02
CO3	Illustrate and Identify knowledge and represent AI algorithms using Heuristics Search Techniques.	03
CO 4	Understand Fundamentals of Game Theory.	04
CO 5	Understand GenAI and LLMs, RAG and Prompt Engineering	05
CO 6	Implementation and Deployment of model	06

Course Contents:

Unit 1	Introduction to AI	8 lectures
	1.1 Introduction to AI 1.2 History of AI 1.3 Advantages and Disadvantages of AI 1.4 Applications of AI 1.5 Architecture of AI	
Unit 2	Problem Solving	10 lectures
	2.1 Problem space 2.2 Solving Problems by Searching 2.3 Heuristic search techniques (A*, AO*, Best First Search, Generate and test, Hill Climbing) 2.4 Constraint satisfaction problems 2.5 Mean Ends Analysis	
Unit 3	Knowledge and Reasoning	10 lectures
	3.1 Building a Knowledge Base: Propositional logic, first order logic, situation calculus. 3.2 Uncertain Knowledge and Reasoning 3.3 Knowledge representation -Production based system, Frame based system. 3.4 Inference – Backward chaining, Forward chaining	
Unit 4	Game Theory	10 lectures
	4.1 Minmax, Alpha-beta Pruning. 4.2 Monte Carlo Tree Search 4.3 Overview of different forms of learning 4.4 Limitations of Game Search Algorithms	
Unit 5	Introduction to Generative AI	10 lectures
	5.1 Introduction to Generative AI 5.2 Introduction of Large Language Models (LLMs) and RAG(Retrieval Augmented Generation) 5.3 AI Agents 5.4 Prompt Engineering	
Unit 6	Implementation of Model	10 lectures
	6.1 Introduction of AI Model 6.2 Key Stages of AI Model Implementation 6.3 Model Deployment 6.4 Testing and Analysis using tool	

References:

1. Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832
2. Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901
3. Artificial Intelligence, Tata McGraw Hill, 2nd Edition, by Elaine Rich and Kevin Knight
4. Introduction to Artificial Intelligence and Expert System, Prentice Hall of India Pvt. Ltd., New Delhi, 1997, 2nd Printing, by Dan Patterson.
6. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 3rd edition.
7. Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013

Course Code : 26CsCmaP113

Course Name : Python Programming

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisites:

- Basic knowledge of computer programming concepts
- Understanding of basic data structures
- Familiarity with operating systems and programming logic

Course Objectives:

- To introduce students to Python programming language and its features.
- To develop problem-solving skills using Python.
- To understand Python data structures and functions.
- To implement object-oriented programming concepts using Python.
- To introduce file handling and exception handling techniques.
- To expose students to Python libraries used in data analytics.
- To understand basic web application development using Python frameworks.

Course Outcomes:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Recall and describe the basic syntax, keywords, and features of Python programming language	3
CO 2	Explain Python data types, operators, control structures, and program flow	3
CO3	Apply Python programming constructs such as functions, data structures, and file handling to develop programs	5
CO 4	Analyze object-oriented programming concepts including classes, objects, inheritance, and polymorphism in Python programs.	5
CO 5	Evaluate different Python techniques and libraries for solving data analysis and programming problems.	4
CO 6	Design and develop applications using Python frameworks, libraries, and programming concepts	5

Course Contents:

Unit No.	Title	Number of Lectures
Unit 1	Introduction to Python	05
	1.1 History and features of Python 1.2 Python environment setup and IDE 1.3 Python interpreter and script execution 1.4 Applications of Python 1.5 Python keywords and identifiers 1.6 Variables and dynamic typing 1.7 Python statements and indentation	

Unit 2	Python Fundamentals & Control Flow Statements	08
	2.1 Input and output functions (print(), input()) 2.2 Python data types 2.3 Type conversion 2.4 Operators in Python 2.5 Python membership operators (in, not in) 2.6 Python identity operators (is, is not) 2.7 Operator precedence 2.8 Conditional statements (if, if-else, nested if) 2.9 Looping statements (for, while, break, continue, pass)	
Unit 3	Python Data Structures	06
	3.1 Strings 3.2 Lists 3.3 Tuples 3.4 Sets 3.5 Dictionaries	
Unit 4	Functions in Python	08

	4.1 Defining functions using def 4.2 Function calling mechanisms 4.3 Types of function arguments - o positional arguments - o keyword arguments - o default arguments 4.4 Variable scope and lifetime of variables 4.5 Documentation strings (Docstrings) 4.6 Variable length arguments (*args, **kwargs) 4.7 Call by reference vs call by value behavior 4.8 Anonymous functions (lambda) 4.9 Recursion and recursive algorithms 4.12 Generators and iterators 4.13 Generator expressions and list comprehensions 4.14 Argument unpacking	
Unit 5	File Handling	04
	5.1 File opening and closing 5.2 Reading from files 5.3 Writing to files 5.4 File modes 5.5 File methods 5.6 Working with directories	

Unit 6	Object-Oriented Programming in Python	06
	6.1 Concepts of Object-Oriented Programming 6.2 Classes and objects 6.3 Constructors (init) 6.4 Instance variables and methods 6.5 Encapsulation and data hiding 6.6 Inheritance 6.7 Polymorphism 6.8 Method overriding	
Unit 7	Exception Handling	04
	7.1 Errors and exceptions 7.2 try-except block 7.3 Multiple exceptions 7.4 try-except-finally 7.5 Raising exceptions 7.6 User-defined exceptions	
Unit 8	Python for Data Analytics	08
	8.1 Introduction to NumPy · Arrays · Array indexing · Mathematical operations	

	8.2 Introduction to Pandas · Series and DataFrames · Importing data · Data manipulation · DataFrame operations	
Unit 9	Python Web Framework	06
	9.1 Introduction to Django Framework 9.2 Django architecture (MVT) 9.3 Creating simple web application	
Unit 10	Project / Practical Implementation	05
	10.1 Use of Python libraries and frameworks in a mini project 10.2 Data analysis or web-based application	

Reference Books:

1. Learning Python (5th Edition) – Mark Lutz – O'Reilly Media – ISBN: 978-1449355739
2. Python Crash Course (2nd Edition) – Eric Matthes – No Starch Press – ISBN: 978-1593279288
3. Automate the Boring Stuff with Python (2nd Edition) – Al Sweigart – No Starch Press – ISBN: 978-1593279929
4. Python for Data Analysis (3rd Edition) – Wes McKinney – O'Reilly Media – ISBN: 978-1098104030
5. Django for Beginners – William S. Vincent – WelcomeToCode – ISBN: 978-1735467207
6. Programming Python (4th Edition) – Mark Lutz – O'Reilly Media – ISBN: 978-0596158101

Web references:

1. <https://docs.python.org/3/> (*Official Python Documentation*)
2. <https://www.w3schools.com/python/>
3. <https://realpython.com/>
4. <https://www.geeksforgeeks.org/python-programming-language/>
5. <https://numpy.org/doc/> (*NumPy Documentation*)
6. <https://pandas.pydata.org/docs/> (*Pandas Documentation*)
7. <https://docs.djangoproject.com/en/stable/> (*Django Documentation*)
8. <https://matplotlib.org/stable/users/index.html>

Course Code : 26CsCmaP114

Course Name : Lab on Python Programming

Teaching Scheme: TH:4 Hours/Week

Credits :02

Examination Scheme: CIA : 25 Marks

End-Sem : 25 Marks

Prerequisites:

- Basic knowledge of computer systems and operating systems.
- Understanding of fundamental programming concepts such as variables, data types and control structures.
- Familiarity with basic problem-solving and algorithmic thinking.

Course Objectives:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO1	To provide hands-on experience in Python programming through practical assignments	1
CO2	To develop problem-solving skills using Python programming constructs.	2
CO3	To implement Python data structures and functions for solving computational problems.	3
CO4	To apply object-oriented programming concepts in Python applications.	4
CO5	To demonstrate file handling and exception handling techniques through practical exercises.	5
CO6	To use Python libraries such as NumPy and Pandas for basic data analysis tasks.	6
CO7	To develop simple applications using Python frameworks and libraries.	7

Sr.No	List of Assignments
1	Basic Python Programming: Variables, input/output functions (print(), input()), Python data types and type conversion.
2	Python Operators: Arithmetic, relational, logical, membership and identity operators.
3	Control Flow Statements: Conditional statements (if, if-else, nested if) and looping statements (for, while, break, continue, pass).
4	Python Data Structures – I: String operations and string methods.
5	Python Data Structures – II: Lists, tuples and set operations.
6	Python Data Structures – III: Dictionary creation, dictionary methods and operations.
7	Functions in Python: User-defined functions, function arguments (positional, keyword, default, variable length), lambda functions and recursive functions.
8	File Handling: File opening and closing, file modes, reading and writing files, file methods and directory operations.
9	Object-Oriented Programming: Classes and objects, constructors (__init__), instance variables and methods.
10	Advanced OOP Concepts: Encapsulation, inheritance, polymorphism and method overriding.
11	Exception Handling: Errors and exceptions, try-except, multiple exceptions, try-except-finally, user-defined exceptions.
12	Python for Data Analytics: NumPy arrays, array indexing and mathematical operations.
13	Pandas Library: Series, DataFrames, importing data, data manipulation and DataFrame operations.
14	Python Web Framework: Introduction to Django, Django architecture (MVT) and simple web application development.
15	Mini Project: Implementation of a data analysis or web-based application using Python libraries/frameworks.

Course Code : 26CsCmaP121

Course Name : Software Development Engineering in Testing

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Desirable Prerequisites:

- Knowledge of Software Engineering

Course Objectives:

- To introduce Testing Concepts and Evolution
- To explain Testing Strategies and their usage
- To discuss the levels of testing
- Choose appropriate testing techniques
- Understand the role of tester & testing tools support

Course Outcomes:

CO No.	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand the software testing process & principles	Understand(2)
CO 2	Understand specific software testing levels & types	Understand(2)
CO 3	Apply the software testing techniques in commercial environments.	Apply(3)
CO 4	Construct test strategies and plans for software testing.	Analyze(4)
CO 5	Demonstrate the usage of software testing tools for test effectiveness, efficiency, and coverage.	Apply(5)

Course Contents

Total Lectures: 60 Hrs.

Unit No.	Title	Lectures
Unit 1	Fundamentals of Testing	6
	• Definition of software testing ○ Objective of testing ○ Testing and Debugging • Necessity of Software Testing ○ Quality assurance and testing ○ Error, defects and failures ○ Defects, Root Causes and Effects • Seven Testing Principles	

	• Test Process : Software Testing Life cycle (STLC)	
Unit 2	Software Testing Fundamentals	14
	• Definition of SDLC • Phases of SDLC • SDLC Models - Waterfall Model, V Model • Agile Testing- Test Driven Software Development • Test Levels ○ Unit Testing, Integration Testing, System Testing, Acceptance Testing • Types of Testing ○ Functional testing (Black-box) ○ Non-functional testing (Testing of software product characteristics) & its types ○ Structural testing (White-box) ○ Change related testing - Confirmation (Re-testing) and Regression Testing	
Unit 3	Static Testing and Dynamic Testing	14
	• Difference Between Static and Dynamic Testing • Static Techniques – Review ○ Review Process (Informal & Formal), Technical or Peer Review, Walkthrough, Inspection • Static Techniques – Static Analysis ○ Control flow analysis, Data Flow Analysis • Test Design Techniques • Black Box Testing Techniques ○ Equivalence Partitioning ○ Boundary Value Analysis ○ Decision Table Testing ○ State Transition Testing ○ Use case Testing • White-Box Testing Techniques ○ Statement Coverage ○ Decision Coverage • Experience based Testing Techniques ○ Error Guessing ○ Exploratory Testing	
Unit 4	Test Management	14
	• Test Organization ○ Tasks of Test manager and tester • Test Planning and Estimation • Test Process Monitoring & Control • Configuration Management • Risk and Testing ○ Project and Product risk	

	• Defect/Incident management ○ Defect Life Cycle ○ Defect / Incident Report • Case Study on Test Plan & test cases for application	
Unit 5	Tools Support for Testing	12
	• Definition of Automation Testing • Benefits of Automation Testing • Types of Test tools – CAST (only type & their purpose) • Effective use of Tools: Benefits & Risks • Introduction of a tool into an organization • Testing tools – ○ Selenium, Test NG, Postman	

References:

Reference books:

1. Lessons Learned in Software Testing: By Cem Kaner , James Bach, Bret Pettichord, paperback publication ISBN 9781283294928
2. Software Testing by Ron Patton, Lisa Crispin, Janet Gregory, 1st edition, paperback publication ISBN-13978-0321534460
3. Foundations of Software Testing (ISTQB certification), Dorothy Graham, Erik van Veenendaal ,Isabel Evans ,Rex Black ISBN-13 978-1844809899
4. Agile Testing : A Practical Guide for Testers and Agile Teams, by Lisa Crispin and Janet Gregory, paperback publication ISBN: 978-1847940933
5. Fundamentals of Software Engineering –Rajib Mall, 3rd Edition

Recommended Learning Material:

- <https://istqb.org/>
- <https://www.softwaretestingmaterial.com/selenium-tutorial/>

Recommended Certifications:

- CAST (Certified Associate in Software Testing)
- ISTQB (International Software Testing Qualifications Board Certification)

Course Code : 26CsCmaP122

Course Name : Advanced Database Concepts

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisites:

- Basic knowledge of Database Management Systems (DBMS)
- Understanding of relational databases and SQL
- Basic knowledge of data structures and computer networks

Course Objectives:

- To understand advanced database architectures and modern database technologies.
- To study NoSQL databases and their applications in large-scale data management.
- To analyze parallel and distributed database systems for efficient data processing.
- To explore graph databases and their role in modeling complex relationships.
- To develop practical skills in using modern database tools and technologies.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand advanced database architectures including centralized, client-server, cloud-based, and big data database systems.	1
CO 2	Explain the concepts of NoSQL databases and apply CRUD operations using modern database systems such as MongoDB or Cassandra.	2
CO3	Analyze different types of parallel database architectures and evaluate their performance parameters.	3
CO 4	Understand the design principles of distributed databases including data distribution, query processing, and recovery mechanisms.	4
CO 5	Apply graph database concepts using Neo4j for modeling and analyzing complex networked data such as social networks.	5
CO 6	Implement practical database solutions through case studies and experiential learning using modern database technologies and APIs.	6

Course Contents:

Unit No.	Title	Number of Lectures
Unit 1	Introduction to Advanced Databases	4
	1.1 Database System Architectures 1.2 Centralized and Client-Server Architectures 1.3 Server System Architecture 1.4 Parallel Systems 1.5 Distributed Systems	
Unit 2	Parallel Databases	8
	2.1 Introduction 2.2 Goals of Parallel Databases 2.3 Different Types of DBMS Parallelism 2.4 Performance Parameters 2.5 Parallel Data Architecture 2.6 Evaluation of Parallel Query 2.6.1 Inter and Intra Query Parallelism 2.6.2 Inter and Intra operation Parallelism 2.7 Optimization of Parallel query 2.8 Virtualization	
Unit 3	Distributed Databases	9

	3.1 Introduction 3.2 Goals of Distributed Databases 3.3 Types of Distributed Databases 3.4 Data replication 3.5 Replication Schemas 3.6 Query Processing and Optimization 3.7 Recovery 3.7.1 Two-phase commit protocol 3.7.2 Concurrency problems 3.7.3 Concurrency Controls	
Unit 4	Object Based Databases	10
	4.1 Concepts of Object Databases 4.2 Features of OODBMS 4.3 Challenges in ODBMS Implementation 4.4 Object Identity – Object structure 4.5 Objects and Attributes 4.5.1 Type Constructors 4.5.2 Encapsulation of Operations 4.5.3 Methods 4.5.4 Persistence 4.5.5 Type and Class Hierarchy 4.6 Structures and Unstructured data 4.7 Case Studies	
Unit 5	XML Databases	9

	5.1 XML Data Model 5.2 DTD 5.3 XML Schema 5.4 XML Querying 5.4 Web Databases 5.6 JDBC 5.7 Information Retrieval	
Unit 6	Big Databases	6
	6.1 Introduction 6.2 Five V's of Big data 6.3 NoSQL Databases 6.4 Examples of NoSQL DB 6.5 Advantages 6.6 NoSQL Vs SQL	
Unit 7	NoSQL (Any one from MongoDB / CASSANDRA)	12
	7.1 Definition of NoSQL 7.2 Features of NoSQL 7.3 Types of Databases – NoSQL 7.4 Advantages of NoSQL 7.5 Difference Between RDBMS & NoSQL 7.6 Introduction to CRUD Operations 7.7 MongoDB Aggregation Framework 7.8 ACID & BASE Consistency Models	

	7.9 Application of MongoDB 7.10 Introduction to Cassandra 7.11 Cassandra Architecture 7.12 Statements in Cassandra 7.13 Replication & Consistency 7.14 Application of Cassandra	
Unit 8	Experiential Learning	2
	8.1 Create same database using RDBMS and NoSQL 8.2 Do operations on these databases 8.3 Do comparative study of it.	

Reference books:

1. Database System Concepts :-Silberschatz, Korth, Tata McGraw-Hill Publication, ISBN- 13: 978-9332901384, ISBN-10: 9332901384
2. Database Management System :-Raghu Ramkrishnan, Tata McGraw-Hill Publication, ISBN: 978-81-317- 0885-9
3. SQL, PL/SQL The Programming Language Oracle :- Ivan Bayross, BPB Publication.
4. Database Systems Concepts , Designs and Application by Shio Kumar Singh , Pearson
5. Introduction to SQL by Reck F. van der Lans by Pearson
6. Modern Database Management by Jeffery A Hoffer ,V.Ramesh, Heikki Topi , Pearson
7. Database Management Systems by Debabrata Sahoo ,Tata Mac Graw Hill
8. Getting Started with NoSQL Kindle Edition by Gaurav Vaish, ISBN-10: 1849694982

Course Code : 26CsCopP122

Course Name : Research Methodology and Research using Artificial Intelligence

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisites:

- Basic knowledge of computer applications and internet usage.
- Familiarity with basic research concepts and academic writing.
- Interest in using digital tools and artificial intelligence for research activities.

Course Objectives:

- Introduce the fundamentals of Artificial Intelligence and its role in modern research processes.
- Familiarize students with AI-based research tools for literature search, academic discovery, and knowledge organization.
- Develop skills in using AI tools for data collection, survey design, and research data management.
- Enable students to analyze and visualize research data using AI-supported analytical tools and techniques.
- Teach effective academic writing and citation management using AI tools while following standard citation styles.
- Promote ethical and responsible use of AI in research, including awareness of plagiarism, bias, and academic integrity.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Define the basic concepts of artificial intelligence and its role in modern research practices, including AI tools used in research discovery and literature review.	1
CO 2	Explain the differences between traditional research methods and AI-assisted research, along with the benefits, limitations, ethical concerns, and bias in AI systems.	2
CO3	Use appropriate AI tools for literature search, research discovery, survey design, journal finder and data collection in academic research.	3
CO 4	Analyze research data using AI-supported data analysis tools such as spreadsheets, Python, Tableau, Power BI, and Weka, and interpret the results using visualization techniques.	4
CO 5	Evaluate AI-generated research outputs, sources, and analytical results while considering issues of accuracy, plagiarism risks, and research ethics.	5

CO 6	Develop a structured research paper or mini research project using AI tools for literature review, data analysis, citation management, and academic writing while maintaining research integrity.	6
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Section 1: Research Methodology

Course Contents

Unit No.	Title	Number of Lectures
Unit 1	Research problem and design	15
	1.1 Introduction to research : meaning and definition of research, objective of research, importance of research, characteristics of good research, purpose and role of research, classification of research 1.2 Research problem : defining of research problem, Criteria for selecting the research problem, , importance of literature survey in defining research problem. Hypothesis :Defining Hypothesis, types of hypothesis, characteristics of good hypothesis, formulation of hypothesis 1.3 Research Design :Definition and features of research design, Concept of research design, types of research design, preparation of research design, Sampling techniques, characteristics of good sampling designs	
Unit 2	Data analysis, report writing and publication ethics	15
	2.1 Data Analysis: Definition of Data, methods of data collection, analysis of data, types of data analysis, Questionnaire, Design of Questionnaire, Testing hypothesis : parametric and non-parametric tests : T-test, Z-test, Chi-square test, ANOVA 2.2 Report writing : importance of interpretation of results, meaning, definition and significance of report /thesis writing, Principals of research report drafting, Types of reports, layout of research report, important parts of reports, precautions of preparation of report/ thesis 2.3 Publication ethics :definition, introduction and importance, best practices/ standard settings initiative and guidelines COPE, WAME, etc, conflict of interest, Publication misconduct :definition, concept problems that lead to unethical behavior, violation of publication ethics, predatory publishers and journals, software tools to identify predatory publications developed by SPPU	

References :

1. C. R. Kothari (2004) Research Methodology : Methods and Techniques 2nd Edition, New age International (p) Ltd Publications, New Delhi, India
2. J.W. Creswell and J.D. Creswell (2017) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th Edition, SAGE Publications, USA.

RM Section 2**Course Name: Research Using Artificial Intelligence Teaching Scheme:****Prerequisites:**

- Basic knowledge of computer applications and internet usage.
- Familiarity with basic research concepts and academic writing.
- Interest in using digital tools and artificial intelligence for research activities.

Course Objectives:

- Introduce the fundamentals of Artificial Intelligence and its role in modern research processes.
- Familiarize students with AI-based research tools for literature search, academic discovery, and knowledge organization.
- Develop skills in using AI tools for data collection, survey design, and research data management.
- Enable students to analyze and visualize research data using AI-supported analytical tools and techniques.
- Teach effective academic writing and citation management using AI tools while following standard citation styles.
- Promote ethical and responsible use of AI in research, including awareness of plagiarism, bias, and academic integrity.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO1	Define the basic concepts of artificial intelligence and its role in modern research practices, including AI tools used in research discovery and literature review.	1
CO2	Explain the differences between traditional research methods and AI-assisted research, along with the benefits, limitations, ethical concerns, and bias in AI systems.	2
CO3	Use appropriate AI tools for literature search, research discovery, survey design, journal finder and data collection in academic research.	3
CO4	Analyze research data using AI-supported data analysis tools such as spreadsheets, Python, Tableau, Power BI, and Weka, and interpret the results using visualization techniques.	4
CO5	Evaluate AI-generated research outputs, sources, and analytical results while considering issues of accuracy, plagiarism risks, and research ethics.	5

CO6	Develop a structured research paper or mini research project using AI tools for literature review, data analysis, citation management, and academic writing while maintaining research integrity.	6
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Course Contents:

Unit 1	Introduction to AI in Research	4 Lectures
	1.1 Understanding Artificial Intelligence in the Context of Research 1.2 Role of AI Technologies in Modern Research Practices 1.3 Differences Between Traditional Research Methods and AI-Assisted Research 1.4 Overview of Various AI Tools Used in Academic and Professional Research 1.5 Benefits of Integrating AI in Research Activities 1.6 Limitations and Challenges Associated with AI Tools 1.7 Ethical Concerns in AI-Supported Research 1.8 Understanding Bias in AI Systems and Its Impact on Research Outcomes	
Unit 2	AI Tools For Research Discovery	4 Lectures
	2.1 Usage of Free Tools Like Google Scholar, Semantic Scholar, Research Rabbit etc. 2.2 AI Techniques for Effective Literature Searching 2.3 Identifying High-Quality and Relevant Academic Sources Using AI 2.4 Role of AI in Tracking Citations and Influential Publications 2.5 Top Emerging AI Research Fields and Challenges	
Unit 3	AI For Literature Review	4 Lectures
	3.1 Tools for Literature Review like Semantic Scholar, Google NotebookLM, Perplexity AI 3.2 Using AI to Generate Keywords 3.3 Evaluating AI-Generated Content 3.4 Key Steps in Organizing Findings with AI 3.5 Best Practices and Ethical Considerations 3.6 AI Methods for Identifying Research Gaps 3.7 Best Practices for AI-Assisted Research Gap Detection	
Unit 4	AI for Data Collection Methods	4 Lectures
	4.1 AI in Survey Design 4.2 Key Uses of AI in Survey Design and Survey Distribution 4.3 Advantages of AI-Powered Surveys 4.4 Top AI-Powered Survey Tools 4.5 Challenges and Considerations 4.6 Key Technologies for AI PDF Extraction Tools 4.7 Tools Used to Create Surveys, Questionnaires, Forms, and Collect Data • Survey Monkey • Google Forms • Typeform	

Unit 5	AI for Data Analysis	4 Lectures
	5.1 Tools for Data Analysis • Spreadsheet Tools • Python • Tableau • Power BI • Weka 5.2 Use of AI for Data Cleaning 5.3 Applying Statistical Methods with AI Support 5.4 Visualizing Data through Charts, Graphs, and Dashboards Using AI 5.5 Key Applications of AI in Interpreting Results 5.6 Introduction to Predictive Analysis and Modeling Using AI	
Unit 6	AI for Writing Research Papers	4 Lectures
	6.1 Tools • Grammarly • QuillBot • Notion 6.2 Organizing and Structuring Academic Research Papers 6.3 AI for Citation and Reference Tools • Zotero • Mendeley 6.4 Understanding Common Citation Styles such as APA, MLA, and IEEE using AI 6.5 Using AI for Organizing Research Sources and References and Generating Citations and Bibliographies Automatically 6.6 Journal Finder and Indexing Tools	
Unit 7	Research Integrity and Ethics with AI	4 Lectures
	7.1 Understanding Academic Integrity in AI-Assisted Research 7.2 Recognizing Risks of Plagiarism when using AI Tools 7.3 Plagiarism Detection Tools 7.4 Understanding AI Hallucinations and Inaccurate Outputs 7.5 Proper Acknowledgment of AI Assistance in Academic Work 7.6 Institutional Policies Regarding AI Usage in Research 7.7 Responsible and Transparent Use of AI Technologies	
Unit 8	Practical Research Project	2 Lecture
	Students will complete a mini research paper using AI tools and research methodologies.	

References:

1. Haber, Eldar & Jemielniak, Dariusz & Kurasiński, Artur & Przegalinska, Aleksandra. (2025). Using AI in Academic Writing and Research: A Complete Guide to Effective and Ethical Academic AI. 10.1007/978-3-031-91705-9.
2. Polin, Brian A., and Livia Levine. 2025. "Enhancing Literature Reviews Through AI Integration: A Case Study on Cognitive Efficiency." Acta Psychologica 260:105626. doi: 10.1016/j.actpsy.2025.105626.

3. Niranjana, P. S., & Sehrawat, R. (2025). Academic integrity in the age of AI: Plagiarism, ChatGPT, and the future of assessment. In [Book Title, e.g., Ethical Perspectives on Artificial Intelligence] (Chapter 11). Noble Science Press.
4. Fütterer, Tim, Diego G. Campos, Thomas Gfrörer, Rosa Lavelle-Hill, Kou Murayama, and Ronny Scherer. 2025. "AI Tools for Systematic Literature Reviews and Meta-Analyses in Educational Psychology: An Overview and a Practical Guide." *Learning and Individual Differences* 126:102849. doi: 10.1016/j.lindif.2025.102849.

Websites:

1. <https://www.surveymonkey.com/product/features/ai-survey-generator/>
2. <https://www.typeform.com/>
3. <https://www.datacamp.com/tutorial/tutorial-power-bi-for-beginners>
4. <https://www.mendeley.com/>
5. <https://www.datacamp.com/tutorial/tableau-tutorial-for-beginners>

Semester –II
(First Year)

Progressive Education Society's

Modern College of Arts, Science and Commerce (Autonomous)

Shivajinagar, Pune - 5

First Year of M.Sc. (Computer Application)

Course Code : 26CsCmaP211

Course Name : Advanced Operating System

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisites

- Knowledge of Basic Operating System Concepts
- Knowledge of Computer Architecture

Course Objectives

- Understand design issues related to process management
- Understand design issues related to memory management
- Understand design issues related to file management
- Study advanced operating system concepts
- Study synchronization and scheduling in parallel systems

Course Outcomes

CO No.	Course Outcomes	Bloom's Level
CO1	Recall and describe OS services, system calls and file system structures	1
CO2	Explain and interpret fundamental concepts of process and memory management	2
CO3	Apply scheduling and synchronization techniques to solve process management problems	3
CO4	Analyze CPU scheduling, deadlock handling and memory allocation strategies	4
CO5	Evaluate storage management and virtual memory policies for different system requirements	5
CO6	Design and develop shell scripts for system-level automation and file manipulation	6

Course Contents

Unit No.	Title	Lectures
Unit 1	Introduction	6
	1.1 Definition 1.2 Types of Operating Systems 1.3 System Boot 1.4 Services provided by OS 1.5 UNIX Operating System: a. Architecture b. UNIX File System c. File system layout d. Files and directory management	
Unit 2	Process Management	5
	2.1 Process states 2.2 Process Control Block 2.3 Scheduling queues and schedulers 2.4 Context switch 2.5 System boot and init process 2.6 System Calls: fork(), exec(), sleep(), wakeup()	
Unit 3	CPU Scheduling	7
	3.1 CPU-I/O burst cycle 3.2 CPU scheduler 3.3 Pre-emptive scheduling 3.4 Dispatcher 3.5 Scheduling Criteria 3.6 Algorithms: a. FCFS b. SJF c. Priority d. Round Robin e. Multilevel Queue f. Multilevel Feedback Queue	
Unit 4	Memory Management	10

	4.1 Address space & binding 4.2 Swapping 4.3 Contiguous allocation 4.4 Fragmentation 4.5 Paging & Segmentation 4.6 Virtual Memory: a. Demand paging b. Page replacement algorithms c. Performance analysis 4.7 Copy-on-write 4.8 System calls: malloc(), vfault(), pfault()	
Unit 5:	Deadlock	6
	5.1 System model 5.2 Necessary conditions 5.3 Resource Allocation Graph 5.4 Prevention 5.5 Avoidance (Banker's Algorithm) 5.6 Detection 5.7 Recovery	
Unit 6	File System	7
	6.1 File access methods 6.2 Super block 6.3 Directory structure 6.4 Inodes 6.5 System calls: siget(), iput(), namei(), ialloc(), ifree() 6.6 File operations: open(), read(), write(), lseek(), close(), creat(), mknod(), chdir(), chroot() 6.7 Mounting & unmounting 6.8 Allocation methods 6.9 Free space management	
Unit 7	Introduction to Shell	13

	7.1 Types of shell 7.2 Working of shell 7.3 Shell commands 7.4 Permissions, users & groups 7.5 Variables 7.6 Operators 7.7 Conditional statements & loops 7.8 Command-line arguments 7.9 I/O redirection 7.10 Functions & file manipulation	
Unit 8	Inter-Process Communication	6
	8.1 Shared memory 8.2 Message passing 8.3 Critical section problem 8.4 Semaphores 8.5 Classical synchronization problems: a. Bounded buffer b. Reader–Writer c. Dining philosophers 8.6 Signals 8.7 Pipes	

Reference Books

1. Operating System Concepts – Silberschatz, Galvin & Gagne
2. The Design of the UNIX Operating System – Maurice J. Bach
3. Advanced Programming in the UNIX Environment – Richard Stevens
4. Modern Operating Systems – Andrew S. Tanenbaum
5. Linux Command Line & Shell Scripting – Richard Blum & Christine Bresnahan

Course Code : 26CsCmaP212

Course Name : Information System Security

Teaching Scheme: TH:4 Hours/Week

Credits :02

Examination Scheme: CIA : 25 Marks

End-Sem : 25 Marks

Desired Prerequisites:

- Knowledge of basic Information Systems

Course Objectives:

- To enable students to get sound understanding of Information system security and cryptography

Course Outcomes:

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

- Develop knowledge and skills for career in Information Security

Course Contents:

Unit No.	Title	Number of Lectures
Unit 1	Conceptual Foundation of Information Systems Security	5
	1.1 Concepts and Terminology: Threats, Attacks, Vulnerabilities, Risks, Risk Assessment and Mitigation 1.2 Security – Confidentiality, Integrity, availability, Identification, Authentication, Authorization, Accountability, Privacy	
Unit 2	Cryptography	4

	2.1 Techniques 2.2 Mathematical Foundation 2.3 Stream Ciphers 2.4 Block Ciphers 2.5 Cryptanalysis	
Unit 3	Symmetric/Secret Key Encryption	8
	3.1 Algorithm Types and Modes 3.2 DES (Data Encryption Standard) 3.3 Double DES 3.4 Triple DES 3.5 AES (Advanced Encryption Standard) 3.6 IDEA 3.7 Blowfish 3.8 RC5	
Unit 4	Public Key Encryption	10
	4.1 Principles of public key crypto-systems 4.2 Mathematical Foundation 4.3 RSA Algorithm 4.4 Key Management 4.5 Diffie-Hellman Key Exchange 4.6 Elliptic curve cryptography 4.7 Digital Signatures using DSA (Digital Signature Algorithm) 4.8 DSS (Digital Signature Standard) and RSA	
Unit 5	Message Integrity Techniques	6
	5.1 MD5 5.2 SHA	
Unit 6	Public Key Infrastructure	6
	6.1 Trust Hierarchy 6.2 Digital Certificates 6.3 Transaction Certificates	
Unit 7	Authentication Techniques	8
	7.1 Passwords 7.2 Pass-code	

	7.3 Pass-phrase 7.4 Challenge-response 7.5 Biometrics based registration and Authentication 7.6 Kerbores	
Unit 8	Internet Security Protocols	12
	8.1 SSL/TLS 8.2 TSP 8.3 SET 8.4 3-D Secure Protocol 8.5 Electronic Money 8.6 Email Security(PGP, PEM, S/MIME) 8.7 IP Security: IPSec, VPN	
	EXPERIENTIAL LEARNING	1

Reference Books:

1. Atul Kahate," Cryptography And Network Security" TMH, ISBN-10: 9781259029882
2. Nina Godbole, "Information Systems Security", Wiley, ISBN-13: 978-8126516926

Course Code : 26CsCmaP213

Course Name : Lab on DOT NET and Advanced Operating System

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand the basics of the .NET environment and Visual Studio. Describe structure and syntax of C# programs.	1,2
CO 2	Apply object-oriented programming concepts using C#. Implement control statements, classes, objects, functions, delegates, and exception handling.	3
CO3	Analyze program logic using debugging techniques. Differentiate between overloading and overriding. Examine errors in handling mechanisms.	4
CO 4	Develop Windows applications using controls and event handling. Analyze form validation and user interactions. Implement database operations using ADO.NET.	3,4
CO 5	Develop web applications using ASP.NET controls. Implement session and cookies for state management. Evaluate database connectivity and CRUD operations using ADO.NET.	3,4,5
CO 6	Design and develop a complete mini project integrating .NET technologies. Demonstrate problem-solving and implementation skills in real-world applications.	6

Course Contents:

Subject: - Lab Course on DOT NET	
Sr. No.	Topic of Practical Assignment
1.	Introduction to .NET Environment A. Installing and using Microsoft Visual Studio B. Creating first program in C#
2.	Basic Concepts of Object-Oriented Programming Language using C#. A. Using Flow of Control Statement B. Using Class and Object C. Debugging and error handling D. Use of types of properties

	E. Use of Functions, Delegates F. Exception Handling G. Method Overriding, Overloading
3.	Windows Programming A. Use of Common controls, Container controls of Form B. Event Handling • Button click events • Form events • Keyboard and mouse events C. Validation of Form D. Accessing Data with ADO.NET E. Use of ADO.NET I. Data Binding II. SQL Queries (Select, Update, Insert, Delete)
4.	Web Programming with ASP.NET A. ASP.NET Server Controls B. ASP.NET Web Controls C. Validation Controls D. Concept of Session and Cookies F. Use of ADO.NET I. Data Binding II. SQL Queries
5.	Mini Project Examples: • Student Management System • Library Management System • Login and Registration system

Advanced Operating Systems – Lab Assignments

Exp. No.	Title	Practical Work / Programs
1	Linux Environment Study	Study Linux file system structure, system boot process, and use basic commands (ps, top, df, uname)
2	Process Creation & System Calls	Write programs using fork(), exec(), sleep(), wait() and display PID/PPID
3	CPU Scheduling Algorithms	Implement FCFS, SJF, Priority and Round Robin scheduling with Gantt chart
5	Page Replacement Algorithms	Implement FIFO, LRU and Optimal page replacement algorithms and calculate page faults
6	Deadlock Handling	Implement Banker's Algorithm and Deadlock Detection algorithm
7	File System Operations	Write programs using open(), read(), write(), lseek(), close() and create file copy utility

Course Code : 26CsCmaP214

Course Name : Project

Teaching Scheme: TH:4 Hours/Week

Credits :02

Examination Scheme: CIA : 25 Marks

End-Sem : 25 Marks

Prerequisites:

- Understanding of recent technological developments and digital tools
- Basic research and report writing skills
- Ability to use online resources for information collection

Course Objectives:

- To encourage research, analysis, and presentation of technological advancements
- To enhance critical thinking and understanding of the future impact of new technologies

Course Outcomes:

After successful completion of this course students will able to:

CO No.	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Define and list various emerging technologies and their basic concepts.	1
CO 2	Explain the working principles and applications of emerging technologies such as AI, IoT etc.	2
CO3	Apply knowledge of emerging technologies to identify real-world applications and industry use cases.	3
CO 4	Analyze different emerging trends and compare their advantages, challenges, and potential impact.	4
CO 5	Evaluate the effectiveness and future scope of emerging Technologies	5
CO 6	Develop a project report or presentation that explores a selected emerging technology and proposes innovative ideas or solutions.	6

Guidelines: -

- The Project can be done under any Platform, Language and Technology.
- CIA of the Project will be done by the Project Guide.
- Assessment will be done weekly in the respective batch.
- Evaluation will be on the basis of weekly progress of project work, progress report, orals, results, demonstration and documentation.

- Students should fill the status of the Project work on the Progress report and get the Signature of Project Guide regularly.
- Progress report should also include how much time you have spent on specific task/module.

Format of Project Progress Report:

Name of the Student	
Seat Number	
Roll Number	
Company/ Organization Name	
Title of the Project	
Project Guide's Name	

[illegible]

Course Code :26CsCmaP215

Course Name : DOT NET

Teaching Scheme: TH:4 Hours/Week

Credits :02

Examination Scheme: CIA : 25 Marks

End-Sem : 25 Marks

Prerequisites:

- Knowledge of object-oriented programming concepts such as data abstraction, encapsulation, inheritance, and polymorphism.
- Familiarity with programming language such as C++ and/or Java.
- Knowledge of web development

Objectives:

- To understand the DOTNET framework,
- C# language features
- Web development using ASP.NET

Course Outcomes

After successful completion of this course students will be able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Knowledge of object-oriented concepts Design user experience and functional requirements C#.NET application.	1
CO 2	Code solutions and compile C# projects within the .NET framework.	2,3
CO3	Design and develop professional console and window based .NET application, WEB application	4,5,6
CO 4	Data Binding concepts using ADO.NET in window-based application, Web Application	4,6
CO 5	Determine design patterns which is best practice for Web service interface documents.	5,6
CO 6	Discuss the current problems in the Company and suggest solution(s) using .NET applications.	6

Course Contents:

Unit 1	Introduction to DOTNET Framework and C#	5 lectures
	1.1 Introduction to DOTNET • DOT NET class framework 1.2 Introduction to C# 1.2.1 Language features • Variables and Expressions, type conversion, Flow Control • Functions, Delegates • Debugging and error handling, exception handling (System Defined and User Defined) 1.2.2 Object Oriented Concepts • Concept of hiding base class methods, Function Overriding, Function Overloading • Event Handling 1.2.3 Collections, Comparisons and Conversions • Defining and using collections, • Indexers, iterators • Type comparison, Value Comparison • Overloading Conversion operators, as operator 1.2.4 Generics • Using generics • Defining Generics, generic Interfaces • Generic methods, Generic Delegate	
Unit 2	Window Programming	3 lectures
	2.1 Introduction to Window Controls 2.2 Data Access 2.2.1 File System Data 2.2.2.XML 2.2.3 Databases, Data Pages and ADO.NET 2.2.4 Data Binding	
Unit 3	DOTNET Assemblies and Web Services	3 lectures
	3.1 DOTNET Assemblies • Components • NET Assembly features • Structure of Assemble • Calling assemblies, private and shared assemblies • Introduction to Cookies, Sessions • Session events • State management Recommendations 3.2 Web Services • HTTP, XML & Web services • SOAP • Building ASP.NET web service • Consuming a web service	

Unit 4	Web Programming	2 lectures
	4.1 Basic Web programming 4.2 Advanced Web programming 4.3 Deployment Web applications	
Unit 5	Introduction to ASP.NET	3 lectures
	5.1 Event Driven Programming and Post Back • HTML events • ASP.NET page events • ASP.NET Web control events	
Unit 6	Server Controls and Variables, control Structures	4 lectures
	6.1 Forms, webpages, HTML forms, Webforms 6.2 Request & Response in Non-ASP.NET pages 6.3 Using ASP.NET Server Controls 6.4 Datatypes: Numeric, text, arrays, data collections 6.5 Overview of Control structures 6.6 Functions: web controls as parameters 6.7 ASP.NET Server Controls	
Unit 7	Networking	2 lectures
	7.1 Networking overview 7.2 Networking programming options 7.2.1 WebClient 7.2.2 WebRequest and WebResponse 7.2.3 TcpListener&TcpClient	
Unit 8	Introduction to GDI+	2 lectures
	8.1 Overview of Graphical Drawing 8.2 Pen Class, Brush Class, Font Class 8.3 Using Images 8.4 Clipping, Drawing2D, Imaging	
Unit 9	Experiential learning	1 lecture

References:

1. Professional C# 2012 and .NET 4.5
Authors: Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner
Wrox Publication, ISBN-13: 9781118314425
2. Professional C# 7 and .NET Core 2.0
Authors: Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner
Wrox Publication, ISBN-13: 9781119449270
3. Beginning ASP.NET 4.5.1 in C# and VB
Author: Imar Spaanjaars
Wrox Publication, ISBN-13: 9781118846773

4. Inside C#, by Tom Archer, Microsoft Press © 2001, ISBN: 0735612889

5. Programming ASP.NET 3.5 by Jesse Liberty, Dan Maharry, Dan Hurwitz,
O'Reilly, ISBN:9780596529567

Online References (Websites)

1. Udemy

Website: <https://www.udemy.com>

2. GeeksforGeeks

<https://www.geeksforgeeks.org/c-sharp/csharp-programming-language>

Course Code : 26CsCmaP221

Course Name : Agile Methodology and Design Thinking

Teaching Scheme: TH:4 Hours/Week

Credits :02

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Prerequisites:

- Knowledge of Software Engineering

Course Objectives:

- Understand modern software evolution.
- Master human-centered design principles.
- Explore agile framework methodologies.
- Apply design thinking synergy.
- Learn rapid prototyping tools.
- Evaluate professional project metrics.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Solve complex problems	6
CO 2	Create interactive digital prototypes	6
CO3	Manage collaborative scrum teams	3
CO 4	Build effective product backlogs	6
CO 5	Execute iterative sprint cycles	3
CO 6	Validate designs using feedback	5

Course Contents:

Unit 1	Foundations of Modern Software Evolution	12 Lectures
	• The Shift from Waterfall: Limitations of traditional Software Engineering in the modern era. Move from Simple Requirement Gathering and Waterfall. • Introduction to Design Thinking: Definition, history, and the "Human-Centered" approach. Introduction to "Wicked Problems.". Introduction to phases of Design Thinking. ○ Empathize-Define-Ideate- Prototyping-Testing. • The Agile Manifesto: Core values and principles. Need to shift. ○ Introduction to different methods in Agile – SCRUM, Kanban, XP, Lean, TDD, FDD, SAFe	
	• Synergy: Why Design Thinking (Finding the right problem) must precede Agile (Building the solution right). Correlate with Product mgmt. vs project mgmt./engineering	
Unit 2	Design Thinking – Empathize, Define, Ideate	12 Lectures
	• Empathize: Methods for user research. ○ Outcome: Students move from "guessing" to "data-backed" user insights. ○ Example Tools/Techniques: Microsoft/Google Form, —interviews, persona creation, and empathy mapping • Define: identifying the core problem statement ○ Shifting from "The user wants a faster car" to "The user needs to arrive on time.") ○ Example Tools/Techniques: Affinity Mapping: Grouping user feedback into clusters to find patterns. Framing the "Point of View" (POV) (Combining User + Need + Insight.) and Stakeholder Mapping ○ Outcome: A validated POV Statement and a set of 3–5 HMW Questions that will guide the ideation phase • Ideate: ○ Example Tools/Techniques: Brainstorming techniques (SCAMPER or Crazy 8s or 6-3-5 method or Dot Voting) and prioritization of ideas. ○ Outcome: Come up with "moonshot" idea and one "low-hanging fruit" idea.	
Unit 3	Design Thinking: Prototyping and Testing	12 Lectures

	• Prototyping ○ Wireframing and Interactive Prototyping. Developing Low-Fidelity (Paper) and Mid-Fidelity (Digital) prototypes. ○ Example Tools/Techniques: Figma / Adobe XD: The industry gold standard for UI/UX design. ○ Outcome: A clickable prototype that mimics the final product's flow. • User Testing & Feedback ○ Example Tools/Technique: Think-Aloud Protocol and Usability Testing. Loom: For recording user sessions and feedback walkthroughs. ○ Outcome: A prioritized "Iteration Backlog" based on real user behaviour.	
Unit 4	Agile – SCRUM Framework	12 Lectures
	• Scrum Framework • Roles - Product Owner, Scrum Master, Team, Business Owner, SME, Active/Passive team members • What is Sprint? • Ceremonies - Product Backlog grooming, Sprint Planning, Daily Stand-up, Review, Retrospective • Artifacts - Backlog mgmt. - Product Backlog, Sprint Backlog, Increment	

Unit 5	Agile SCRUM – Planning and Execution	12 Lectures
	• WBS: Theme – Epic – User Stories - Tasks • User Stories: Writing effective stories, Acceptance Criteria, and INVEST criteria. • Estimation Techniques: Story Points, Planning Poker, and T-shirt sizing. • Metrics: Tracking progress via Burndown charts, Velocity • Tools (just understand usecases) – Google form, MS Teams, Figma, Jira/confluence, Github, EasyRetro • Practice: Using Agile Tools (JIRA/Trello basics); Retrospective techniques (Start-Stop-Continue)	

References:

1. Design Thinking: Understanding How Designers Think and Work By Author: Nigel Cross
2. The Design of Everyday Things By Author: Don Norman
3. Agile project management with Scrum :
<https://www.pmi.org/learning/library/agile-project-management-scrum-6269>
4. <https://www.scrumalliance.org/>
5. The Official Scrum Guide: The 13-page "Constitution" of Scrum, maintained by Ken Schwaber and Jeff Sutherland. Link:
<https://scrumguides.org/scrum-guide.html>
6. NPTEL Course - <https://nptel.ac.in/courses/110106124>

Course Code: 26CsCmaP222

Course Name: Cloud Computing

Teaching Scheme: TH: 2 Hours/Week

Credit: 2

Examination Scheme: CIA :25 Marks

End-Sem: 25 Marks

Prerequisites:

- Knowledge of Operating System Concepts
- Fundamentals of Computer Networks

Course Objectives:

- To introduce the fundamentals of cloud computing, Dockers and Containers.
- To give Insights into Cloud Service Models and Deployment Models.
- To provide knowledge on virtualization technologies.
- To know about Enterprise Cloud Architecture and Migration Strategies
- To impart the knowledge on Cloud-Native Application Development, AI/ML integration in the cloud

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Define Cloud Computing, fundamentals of cloud computing, List desired features and benefits of Cloud Computing, Identify fundamentals of dockers and containers, serverless computing	1
CO 2	Demonstrate cloud deployment models, cloud service models, XAAS- Anything as a Service	2
CO3	Discover the security and compliance challenges of cloud computing	3
CO 4	Analyze enterprise cloud architectures including multi-cloud environments, cloud bursting models, migration strategies (6R framework), and compare virtualization with container-based architectures.	4
CO 5	Examine the virtualization foundations to cater to the needs of elasticity, portability, and resilience of cloud service providers	5

CO 6	Propose cloud-native architectures, containerization strategies, serverless models, and AI/ML cloud services to determine the most efficient, scalable, and cost-effective solution for modern enterprise workloads.	6
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Course Contents:

Unit 1	Introduction to Cloud Computing	6 Lectures
	1.1 Introduction to Cloud Computing and need of Cloud Computing 1.2 Desired Features of a Cloud 1.3 Pros and Cons of Cloud Computing 1.4 Multitenant Technology 1.5 Cloud Service Models - IAAS, PAAS, SAAS & its Comparison 1.6 Cloud Deployment Models-Public, Private, Hybrid, Community 1.7 XAAS- Anything as a Service – Storage as a service, Network as a Service, Database as a Service 1.8 Cloud Storage Types: Block, File, Object Storage 1.9 Service Level Agreement(SLA) in cloud computing, Billing, Pricing, and Support	
Unit 2	Virtualization Concepts and Virtual Machine Management	5 Lectures
	2.1 Virtualization in Cloud Computing 2.2 Types of Virtualization 2.3 Pros and Cons of Virtualization in Cloud Computing 2.4 Load Balancing and Virtualization 2.5 Understanding Hypervisors 2.6 Virtual Machines Provisioning and Manageability VM Provisioning Process, Virtual Machine Migration Services	
Unit 3	Enterprise Cloud Architecture, Multi-Cloud, and Migration Strategies	3 Lectures
	3.1 Cloud Computing Architecture 3.2 Multi Cloud Environment and Challenges in Multi-Cloud 3.3 Cloud Bursting 3.4 Cloud Migration, the 6 R's of Cloud Migration	
Unit 4	Cloud-Native Application Development	7 Lectures
	4.1 Traditional vs. Cloud Native Applications 4.2 Benefits of Adopting Cloud Native Approaches 4.3 Challenges of Cloud Native 4.4 Concepts of Cloud-Native and Microservice Architectures 4.5 Concept of Containers 4.6 Docker fundamentals	

	4.7 Container Orchestration, Kubernetes 4.8 Introduction to Serverless Computing, Benefits 4.9 Serverless Computing types 4.10 Serverless versus PaaS, Containers versus VMs	
Unit 5	AI, ML & Emerging Cloud Workloads	2 Lecture
	5.1 AI/ML Integration in the Cloud and Benefits 5.2 Cloud-Based AI/ML Services from Major Cloud Providers 5.3 Emerging Cloud Workloads	
Unit 6	Cloud Security	6 Lectures
	6.1 Privacy and Compliance Risks 6.2 Common Threats and Vulnerabilities 6.3 Cloud Access Control Issues 6.4 Cloud Service Provider Risks 6.5 Cloud Computing Security Challenges 6.6 Cloud Security Architecture 6.7 Identity Management and Access Control	
Unit 7	Experiential Learning	1 Lecture
	Understanding cloud platforms and services of Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure (Microsoft Azure), Sales Force	

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, John Wiley, ISBN-13 : 978-0470903568
2. Cloud Computing: Concepts, Technology & Architecture by Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, PHI, ISBN-13 : 978-0133387520
3. Cloud Security a Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz Russell Dean Vines, Wiley, ISBN: 978-0-470-93894-2.
4. Mastering Cloud Computing Foundations and Applications Programming by Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, : Morgan Kaufmann ,ISBN-13 978-0124114548

E-Books:

1. <https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf>
2. <https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf>
3. <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf>

MOOCs Courses link:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview?
2. Cloud Computing and Distributed System:
https://onlinecourses.nptel.ac.in/noc21_cs15/preview?
3. <http://kcl.digimat.in/nptel/courses/video/106105167/L01.html>

Course Code: 26CsCmaP223

Course Name: Lab on Cloud Computing

Teaching Scheme: TH: 2 Hours/Week

Credit: 2

Examination Scheme: CIA :25 Marks

End-Sem: 25 Marks

Lab Course Outcomes(Cloud Computing):

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Identify various popular Cloud Service Providers(CSP) ,list and understand various services provided by these CSPs	1
CO 2	Demonstrate Infrastructure as a Service, Software as a Service, Platform as a Service, Database as a Service	2
CO3	Implementation of Storage as a Service and IAM (Identity and Access Management)	3
CO 4	Examine VPC(Virtual Private Cloud)	4
CO 5	Determine installation and configuration of cloud Hadoop and demonstrate simple query	5
CO 6	Design, develop, and deploy cloud-based applications using modern cloud technologies including Containerization with Docker, Serverless Computing using AWS Lambda, Machine Learning solutions using Amazon SageMaker, and Image Analysis applications using Amazon Rekognition.	6

Subject:- Cloud Computing

Sr. No.	Topic of Practical Assignment
1.	Working and Implementation of Infrastructure as a service
2.	Working and Implementation of Platform as a services.
3.	Practical Implementation of Storage as a Service
4.	Practical Implementation of Database as a Service
5.	Build your VPC and Launch a Web Server
6.	Working and Implementation of Identity and Access management
7.	Creating and Managing Web Feeds in Cloud Applications
8.	Installation and configuration of cloud Hadoop and demonstrate simple query
9.	Deploy a monolithic web application on a Virtual Machine and analyze limitations.
10.	Create and Deploy a Simple Web Application using Docker
11.	Serverless Application using AWS Lambda
12.	Practical Implementation of Machine Learning using Amazon SageMaker
13.	Practical Implementation of Image Recognition and Analysis using Amazon Recognition

Course Code : 26CsCmaP204

Course Name : On Job Training

Teaching Scheme: TH:4 Hours/Week

Credits :04

Examination Scheme: CIA : 50 Marks

End-Sem : 50 Marks

Perquisite:

Knowledge of Project development

Course Outcome:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Explain the workflow, technologies used in the organization.	1
CO 2	Apply theoretical knowledge of computer science to resolve real-world tasks during the project work.	2
CO 3	Analyze software requirements, system architecture, or code structure to understand the project's scope.	3
CO 4	Evaluate tools, technologies, or programming practices used in the organization in terms of efficiency and relevance.	4
CO 5	Design and implement a software module or contribute to a project under industry supervision.	5
CO 6	Reflect critically on the internship experience to assess personal learning, strengths, and areas for improvement.	6

About On Job Training Examination and Evaluation

- The On Job Training Project Report should be done by every PG Part1 Sem2 student.
- CIA marks will be given based on the submission and status of the project report
- ESE marks will be given based on the power point presentation prepared by the student, presented by the student and oral/viva during the On Job Training evaluation.
- If the student does not submit the report, the CIA marks will be 0(zero) indicating Fail.
- If the student is not present physically for the on job training evaluation, the student will be marked absent.

- **Guidelines about the On Job Training Project report are as follows:**
 - The project report should be a spiral bound copy.
 - One copy to be printed and presented at the time of on job training examination.
 - Softcopy of the project report and the power point presentation should be submitted at the time of the evaluation to the Department.
 - Necessary diagrams. charts, tables etc., UML Diagrams as applicable should be added in the report. The font size should be 12pt, Times New Roman, single line spacing

Index of On Job Training Project report should be of following format:

- Title Page
- Company Certificate
- College Certificate
- Acceptance letter
- Training Schedule/Calendar/Attendance report
- Problem Definition
- Existing System
- Need for computerization
- Scope of the Proposed System
- Objectives of the proposed system

- Requirement Gathering and anticipation
- Platform (H/W, S/W) with version details
- Analysis Specification (Object Oriented Approach)
- Design Specification
- Data Dictionary, Flow Diagram (whichever is applicable)
- Implementation strategies
- Input, Output screens
- Decision tools (if any)
- Testing Strategies
- Limitations and Drawbacks
- Conclusion
- Future Enhancements
- User Manual
- References and Bibliography

Title Page Format:-



Progressive Education Society's
Modern College Of Arts, Science and Commerce, (Autonomous) Shivajinagar, Pune –
411005.

M.Sc. Computer Application

Sem II

OJT PROJCT REPORT

JUNE #YEAR#

A PROJECT REPORT SUBMITTED FOR THE ON JOB TRAINING (OJT)
OF MASTER OF SCIENCE IN <<COMPUTER APPLICATION>>

Name | Class | Roll No. | Date of Submission

*<< to be printed on the letter head of the organization where the student is going to perform
OJT >>*

Acceptance Letter for On Job Training

This is to confirm that we, the _____ accept the application received from the student of from **Progressive Education Society's Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune-5** Mr./Ms. _____ of Class _____ Division _____ having roll number _____

The duration of the On Job Training for Mr./Ms. _____ in our organization will be from _____ to _____.

He / She will work for _____ hours per day to complete the total of 120 hours.

His / Her performance during the On Job Training in our Organization will be monitored and the attendance will be maintained.

The point of contact from our organization for the student progress is _____

<<name and signature of the Authorities of the organization>>

<< to be printed on the letter head of the organization where the OJT is completed>>

On Job Training Completion Certificate

This is to confirm that the student from **Progressive Education Society's Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune 5,**

Mr./Ms. _____ of
Class _____ Division _____ having roll number _____ has
successfully completed the On Job Training in the Subject/Course Name '*On Job Training*'
prescribed for Semester II of the academic year _____.

The duration of the On Job Training for Mr./Ms. _____
in our organization was from _____ to _____. He / She has
worked _____ hours per day.

His / Her performance during the On Job Training in our Organization was Excellent / Good/
Satisfactory/ unsatisfactory.

We are relieving him/her on date _____ after his / her office hours. We wish him/ her all the
best for his / her future endeavors.

<<name and signature of the Authorities of the organization>>

Additional Guidelines about OJT / Internship with evaluation pattern

1. The students will search for the companies/ institutes/ industries, etc under the guidance of Teachers and HOD for the On Job training.
2. The On Job training should be completed by the student after the Second Semester of Sem II PG during the semester in the time other than their regular lectures and practicals.
3. During OJT the student has to complete 120 hours of training in the duration of semester 2 .
4. The Department will prepare the sample list of such companies/ institutes/ industries, etc and will provided to students.
5. The student will apply for the OJT to companies/ institutes/ industries, etc.
6. The Department will sign a MoU with the company selected by each student.
7. The companies/ institutes/ industries, etc will issue the acceptance letter to the student.
8. The student will submit the letter to the Department.
9. There will be one internal mentor for each student at Department level.
10. The daily attendance will be marked by the companies/ institutes/ industries, etc for each student.
11. Upon completion of the training, the companies/ institutes/ industries, etc will issue the completion cum performance letter and the attendance certificate to the student.
12. The student will have to spend at least 8 hours per week for OJT / Internship in the companies/ institutes/ industries, etc.
13. The student will submit the letter to the Department.
14. The evaluation of the student based on OJT will be done by the Department only against the completion cum performance letter and attendance certificate.
15. The evaluation will include :
 - CIA :
 - The student has to prepare and submit a report of the training he/she has undergone. : 30 marks
 - Attendance certificate : 10 marks
 - ESE :
 - The Department will conduct an oral / presentation examination of the student based on the report submitted.
 - The student has to present the work done.
 - Powerpoint presentation preparation : 35 marks
 - Viva and presentation : 25 marks

For ESE, the Department will conduct an oral / presentation examination of the student based on the report submitted. The Department may appoint external examiner from outside college and one internal examiner from the Department.

Following drafts/ templates will be given by the college

- a. Application letter draft
- b. Completion certificate draft
- c. Attendance sheet
- d. MoU draft
- e. Evaluation sheet