

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of Syllabus

For

M.Sc. (Computer Science)

(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 Major Paper 4 (Practical)	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4+4+2)	26CsCmpP111	Major Paper 1 (Theory)	Design and Analysis of Algorithm	2	2	25	25	50
	26CsCmpP112	Major Paper 2 (Theory)	Artificial Intelligence	2	2	25	25	50
	26CsCmpP113	Major Paper 3 (Theory)	Advanced Database Concepts	2	2	25	25	50
	26CsCmpP114	Major Paper 4 (Theory)	Data Mining and Data Engineering	2	2	25	25	50
	26CsCmpP115	Major Paper 5 (Practical)	Lab Course on Advanced Database Concepts	4	2	25	25	50
	26CsCmpP116	Major Paper 6 (Practical)	Lab Course on Artificial Intelligence and Advanced Python	4	2	25	25	50
	26CsCmpP117	Major Paper 7 (Practical)	Project on Emerging Trends	4	2	25	25	50
Major Electives (4)	26CsCmpP121	Major Elective 1 (Theory)	Software Testing and Quality Assurance	4	4	50	50	100
	26CsCmpP122	Major Elective 2 (Theory)	DOT NET	2	2	25	25	50
	26CsCmpP123	Major Elective 2 (Practical)	Lab Course on DOT NET	4	2	25	25	50
RM (4)	26CsCopP131	RM Section 1	Research Methodology & Research Using Artificial Intelligence	2	4	50	50	100
		RM Section 2		2				
Total				30	22	275	275	550
Extra Credit Course	26CpHrtP201	Non-CGPA Course	Human Rights II	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)	26CsCmpP211	Major Paper 1 (Theory)	UNIX Internals	2	2	25	25	50
	26CsCmpP212	Major Paper 2 (Theory)	Machine Learning	2	2	25	25	50
	26CsCmpP213	Major Paper 3 (Theory)	Cloud Computing	2	2	25	25	50
	26CsCmpP214	Major Paper 4 (Theory)	Full Stack Development I (MERN/MEAN)	2	2	25	25	50
	26CsCmpP215	Major Paper 4 (Practical)	Lab Course on Machine Learning & Cloud Computing	4	2	25	25	50
	26CsCmpP216	Major Paper 4 (Practical)	Lab Course on Advanced JavaScript	4	2	25	25	50
	26CsCmpP217	Major Paper 4 (Practical)	Lab Course on Full Stack Development I (MERN/MEAN)	4	2	25	25	50
Major Electives (4)	26CsCmpP221	Major Elective 1 (Theory)	Information System Security	4	4	50	50	100
	26CsCmpP222	Major Elective 2 (Theory)	Agile Methodology and Design Thinking	2	2	25	25	50
	26CsCmpP223	Major Elective 2 (Practical)	Lab Course on Agile Methodology and Design Thinking	4	2	25	25	50
OJT(4)	26CsCmpP204	OJT	On Job Training	8	4	50	50	100
Total				34	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)	26CsCmpP311	Major Paper 1 (Theory)	Business Intelligence	2	2	25	25	50
	26CsCmpP312	Major Paper 2 (Theory)	Deep learning	2	2	25	25	50
	26CsCmpP313	Major Paper 3 (Theory)	Blockchain Technology	2	2	25	25	50
	26CsCmpP314	Major Paper 4 (Theory)	Full Stack Development II (MERN/MEAN)	2	2	25	25	50
	26CsCmpP315	Major Paper 5 (Practical)	Lab Course on Deep Learning	4	2	25	25	50
	26CsCmpP316	Major Paper 6 (Practical)	Lab Course on DevOps	4	2	25	25	50
	26CsCmpP314	Major Paper 7 (Practical)	Lab Course on Full Stack Development II (MERN/MEAN)	4	2	25	25	50
Major Electives (4)	26CsCmpP321	Major Elective 1 (Theory)	Natural Language Processing	4	4	50	50	100
	26CsCmpP322	Major Elective 2 (Theory)	Emerging Trends in Computer Science	4	4	50	50	100
RP (4)	26CsCmpP304	RP	Research Project I	8	4	50	50	100
Total				32	22	275	275	550
Extra Credit Course	26CpCysP301	Non-CGPA Course	Cyber Security I	2	2	-	50	50
	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	26CsCmpP411	Major Paper	Industrial / Institutional Training	6	16	150	150	300
RP (6)	26CsCmpP404	RP	Research Project II	12	6	75	75	150
Total				18	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

Course Code: 26CsCmpP111
Course Name: Design and Analysis of Algorithms
Teaching Scheme: TH: 2 Hours/Week **Credit: 2**
Examination Scheme: CIA :25 Marks **End-Sem: 25 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	2 Lectures
	1.1 Algorithm definition and characteristics 1.2 Space complexity 1.3 Time complexity, worst case-best case-average case 1.4 complexity, asymptotic notation 1.5 Recursive and non-recursive algorithms.	
Unit 2	Divide and conquer strategy	5 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	6 Lectures
	3.1 Control Abstraction 3.2 Knapsack problem 3.3 Job sequencing with deadlines, 3.4 Minimum-cost spanning trees: 3.5 Kruskal and Prim's algorithm 3.6 Optimal merge patterns 3.7 Huffman coding 3.8 Shortest Path: Dijkstra's algorithm	
Unit 4	Dynamic Programming	9 Lectures
	4.1 Matrix chain multiplication 4.2 0/1 Knapsack Problem 4.2.1 Functional Method 4.4 Concept of Shortest Path 4.4.1 Single Source shortest path 4.4.2 Dijkstra's Algorithm 4.4.3 Bellman Ford Algorithm 4.4.4 All pairs Shortest Path 4.4.5 Longest common subsequence 4.5 String editing, 4.4.8 Travelling Salesperson Problem	
Unit 5	Backtracking	6 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	2 Lectures
	6.1 Introduction 6.2 Definitions of LCBB Search 6.3 Bounding Function, Ranking Function 6.4 Formulation using LCBB	

References:

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

Course Code: 26CsCmpP112
Course Name: Artificial Intelligence
Teaching Scheme: TH: 02 Hours/Week **Credit: 02**
Examination Scheme: CIA: 25 Marks **End-Sem: 25 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.	1
CO 2	Identify and apply appropriate search strategies for AI problem.	2
CO3	Illustrate and Identify knowledge and represent AI algorithms using Heuristics Search Techniques.	3
CO 4	Understand Fundamentals of Game Theory.	4
CO 5	Understand GenAI and LLMs, RAG and Prompt Engineering	5
CO 6	Implementation and Deployment of model	6

Course Contents:

Unit 1	Introduction to AI	3 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	7 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	7 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	4 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	5 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	4 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.
5. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd edition.
6. Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013

Course Code: 26CsCmpP113
Course Name: Advanced Database Concepts
Teaching Scheme: TH: 2 Hours/Week **Credit: 2**
Examination Scheme: CIA :25 Marks **End-Sem: 25 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 1	Introduction to Advanced Databases	3 Lectures
	1.1 Database System Architectures 1.2 Centralized and Client-Server Architectures 1.3 Cloud-Based Architectures 1.4 Big Data and Real-Time Databases	
Unit 2	NoSQL (Anyone from MongoDB / CASSANDRA)	12 Lectures
	2.1 Definition of NoSQL 2.2 Features of NoSQL	

	2.3 Types of NoSQL Databases 2.4 Advantages of NoSQL 2.5 Difference Between RDBMS & NoSQL 2.6 Introduction to CRUD Operations 2.7 MongoDB Aggregation Framework 2.8 ACID & BASE Consistency Models 2.9 Applications of MongoDB 2.10 Introduction to Cassandra 2.11 Cassandra Architecture 2.12 Statements in Cassandra 2.13 Replication & Consistency 2.14 Applications of Cassandra	
Unit 3	Parallel Databases	3 Lectures
	3.1 Introduction to Parallel Databases 3.2 Types of Parallelism 3.2.1 Inter-Query Parallelism 3.2.2 Intra-Query Parallelism 3.2.3 Inter-Operation Parallelism 3.2.4 Intra-Operation Parallelism 3.3 Performance Parameters of Parallel Databases 3.3.1 Speedup 3.3.2 Scaleup 3.3.3 Throughput 3.4 Key Aspects of Virtualization in Parallel Databases 3.4.1 Concept of Virtualization 3.4.2 Virtual Machines and Database Systems 3.4.3 Benefits of Virtualization in Databases	
Unit 4	Distributed Databases	4 Lectures
	4.1 Introduction to Distributed Databases 4.2 Types of Distributed Databases 4.3 Architecture of Distributed Databases 4.4 Data Distribution Strategy 4.4.1 Data Storage 4.4.2 Data Replication 4.4.3 Replication Schemas 4.5 Distributed Query Processing and Optimization 4.5.1 Query Decomposition 4.5.2 Data Localization 4.5.3 Global Query Optimization 4.5.4 Local Query Optimization 4.6 Recovery of Distributed Databases 4.6.1 Types of Failures 4.6.2 Core Recovery Techniques 4.6.3 Distributed Commit Protocols (Two Phase Commit, Three Phase Commit) 4.6.4 Recovery Strategies	
Unit 5	Graph Databases & GraphQL	6 Lectures
	5.1 Graph Database Fundamentals 5.1.1 Property Graph Model 5.1.2 Nodes, Relationships, Properties 5.2 Neo4j Introduction 5.3 Neo4j Architecture	

	5.3.1 Native Graph Storage 5.3.2 Index-Free Adjacency 5.3.3 ACID Compliance 5.3.4 Causal Clustering 5.4 Neo4j Ecosystem 5.4.1 Cypher Query Language 5.4.2 Neo4j AuraDB 5.4.3 Graph Data Science 5.4.4 Neo4j Bloom 5.4.5 Neo4j Desktop 5.5 Social Network Modeling and Analytics using Graph Databases 5.5.1 Social Graph Data Modeling 5.5.2 Behavioral Interaction Analysis 5.5.3 Community Detection Graph Algorithms 5.5.4 Recommendation Systems 5.5.5 Network Health and Security 5.6 GraphQL Basics 5.6.1 Schema and Types 5.6.2 Operations 5.6.3 Resolvers	
Unit 6	Experiential Learning	2 Lectures
	6.1 Case Studies (MongoDB, Cassandra, Graph database can also use API integration) 6.2 Mini project using MongoDB / Neo4j	

References:

1. Database System Concepts – Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill Education, ISBN-13: 978-9332901384, ISBN-10: 9332901384.
2. Database Management Systems – Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill Education, ISBN: 978-8131708859.
3. SQL, PL/SQL: The Programming Language of Oracle – Ivan Bayross, BPB Publications.
4. Database Systems: Concepts, Design and Applications – S. K. Singh, Pearson Education.
5. Introduction to SQL: Mastering the Relational Database Language – Rick F. van der Lans, Pearson Education.
6. Modern Database Management – Jeffrey A. Hoffer, V. Ramesh, Heikki Topi, Pearson Education.
7. Database Management Systems – Debabrata Sahoo, McGraw-Hill Education India.
8. Getting Started with NoSQL – Gaurav Vaish, Packt Publishing, ISBN-10: 1849694982.
9. *Neo4j Documentation and Developer Guides* – Neo4j, <https://neo4j.com/docs/>

Course Code: 26CsCmpP114
Course Name: Data Mining and Data Engineering

Teaching Scheme: TH: 2 Hours/Week

Examination Scheme: CIA: 25 Marks

Credit: 2

End-Sem: 25 Marks

Prerequisites:

- Basic programming skills
- Basic skills in statistics and linear algebra
- Basic knowledge of Databases
- Basic knowledge of SQL and Data Handling

Course Objectives:

- This course will introduce the concepts, techniques, design and applications of data warehousing and data mining.
- Some systems for data warehousing and/or data mining will also be introduced.
- The course is expected to enable students to understand and implement classical algorithms in data mining and data warehousing
- To provide knowledge of clustering techniques, big data technologies, and data engineering concepts, including ETL processes, data pipelines, and workflow orchestration used in modern data systems.

Course outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Describe the fundamental concepts of data mining and data warehousing, including basic data mining tasks, data mining metrics, data processing steps, and applications of data mining.	1
CO 2	Explain the architecture of data warehouses, OLAP operations, dimensional modeling techniques, and data preprocessing methods such as cleaning, integration, transformation, and reduction.	2
CO 3	Apply various data mining techniques such as frequent item-set mining, association rule mining, and algorithms like Apriori and FP-tree for discovering patterns from datasets.	3
CO 4	Analyze classification and prediction techniques including decision trees, Bayesian classification, and regression models, and evaluate issues such as overfitting, pruning, and missing values.	4
CO 5	Evaluate the performance of data mining models using accuracy measures such as precision, recall, F-measure, confusion matrix, cross-validation, and bootstrap techniques, and examine the effectiveness of various data mining tools.	5
CO 6	Design data processing solutions using clustering techniques, big data technologies, and data engineering pipelines, including ETL processes, workflow orchestration, and data pipeline design.	6

Course Contents

Unit 1	Introduction to Data Mining	2 Lectures
	1.1. Basic Data Mining Tasks 1.2. DM versus Knowledge Discovery in Databases 1.3. Data Mining Issues 1.4. Data Mining Metrics 1.5. Social Implications of Data Mining 1.6. Overview of Applications of Data Mining	
Unit 2	Introduction to Data Warehousing	3 Lectures
	2.1 Architecture of Data Warehouse 2.2 OLAP and Data Cubes 2.3 Dimensional Data Modeling-Star, Snowflake Schemas 2.4 Data Processing 2.5 Need 2.6 Data Cleaning 2.7 Data Integration 2.8 Transformation 2.9 Data Reduction 2.10 Machine Learning 2.11 Pattern Matching	
Unit 3	Data Mining Techniques	4 Lectures
	3.1 Frequent Item-Sets 3.2 Association Rule Mining 3.3 Rule Basic Measures – Support 3.4 and Confidence 3.5 Apriori Algorithm 3.6 Use of Sampling for Frequent Item 3.7 Set 3.8 FP tree algorithm	
Unit 4	Classification & Prediction	5 Lectures
	4.1 Decision Tree 4.2 Construction, Performance, Attribute Selection 4.3 Issues: Over-Fitting, Tree Pruning Methods, Missing Values 4.4 Classification and Regression Trees 4.5 Bayesian Classification 4.6 Bayes Theorem, Naïve Bayes classifier 4.7 Prediction 4.8 Linear Regression 4.9 Non-linear Regression	
Unit 5	Accuracy Measures and Data Mining Tools	3 Lectures
	5.1 Precision, Recall, F-measure, Confusion Matrix 5.2 Cross-validation, Bootstrap 5.3 Usage of DM Tools	

	5.4 Sample applications of Data Mining	
Unit 6	Clustering	3 Lectures
	6.1 Distance Based Clustering 6.2 K-Means Clustering 6.3 Expectation Maximization (EM) Algorithm 6.4 Hierarchical Clustering 6.5 Agglomerative Clustering 6.6 Divisive Clustering 6.7 Computing Inter-Cluster Distance	
Unit 7	Basics of Data Engineering	2 Lectures
	7.1 Introduction to Data Engineering 7.2 Data Engineering Architecture 7.3 Data Lakes & Lakehouses 7.4 Role & Responsibilities of Data Engineers 7.5 Future Trends in Data Engineering	
Unit 8	Introduction to Big Data	2 Lectures
	8.1 Big Data Ecosystem 8.2 Hadoop Architecture 8.3 HDFS 8.4 Distributed Data Processing 8.5 Apache Spark Basics 8.6 Hue and Pig	
Unit 9	Data Integration and ETL	4 Lectures
	9.1 ETL Process 9.2 Data Ingestion Techniques 9.3 Data Transformation Techniques 9.4 Data Quality and Data Cleaning 9.5 Workflow Orchestration (eg. Apache Airflow) 9.6 Data Pipeline 9.7 Data Pipeline Design	

References

1. Data Mining: Concepts and Techniques — Jiawei Han, Micheline Kamber, Jian Pei; Publisher: Elsevier / Morgan Kaufmann; ISBN: 9789380931913 / 9788131205358.
2. Data Mining: Introductory and Advanced Topics — Margaret H. Dunham, S. Sridhar; Publisher: Pearson Education; ISBN: 9780130888921.
3. Machine Learning — Tom M. Mitchell; Publisher: McGraw-Hill Education; ISBN: 9780070428072.
4. Pattern Classification (2nd Edition) — Richard O. Duda, Peter E. Hart, David G. Stork; Publisher: John Wiley & Sons; ISBN: 9780471056690.
5. Pattern Recognition and Machine Learning — Christopher M. Bishop; Publisher: Springer; ISBN: 9780387310732.
6. Database Management Systems (2nd Edition) — Raghu Ramakrishnan, Johannes Gehrke; Publisher: McGraw-Hill Education; ISBN: 9780072465631.

7. Data Mining: Practical Machine Learning Tools and Techniques — Ian H. Witten, Eibe Frank, Mark A. Hall; Publisher: Elsevier / Morgan Kaufmann; ISBN: 9789380501864.
8. Fundamentals of Data Engineering — Joe Reis, Matt Housley; Publisher: O'Reilly Media; ISBN: 9781098108304.
9. Designing Data-Intensive Applications — Martin Kleppmann; Publisher: O'Reilly Media; ISBN: 9781449373320.
10. Data Engineering with Python — Paul Crickard; Publisher: Packt Publishing; ISBN: 9781800204560.
11. Learning Spark: Lightning-Fast Big Data Analysis — Holden Karau, Andy Konwinski, Patrick Wendell; Publisher: O'Reilly Media; ISBN: 9781492050049.
12. OLAP Solutions: Building Multidimensional Information Systems — Erik Thomsen; Publisher: John Wiley & Sons; ISBN: 9780471400301.

Course Name: Lab Course on Advanced Database Concepts
Teaching Scheme: Practical: 4 Hours/Week **Credits: 2**
Examination Scheme: CIA: 25 Marks **End-Sem: 25 Marks**

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Install and configure modern database systems such as MongoDB and Neo4j.	1
CO 2	Create and manage databases, collections, nodes, and relationships in NoSQL and graph databases.	2
CO3	Perform CRUD operations and execute queries to manipulate and retrieve data effectively.	3
CO 4	Apply advanced query techniques such as aggregation, filtering, sorting, and pattern matching.	4
CO 5	Model real-world problems using graph databases and analyze relationships between data entities.	5
CO 6	Develop practical database applications through case studies using modern database technologies.	6

Subject:- MongoDB	
Sr. No.	Topic of Practical Assignment
1.	Installation and Setup of MongoDB Environment
2.	Creation of Database and Collections
3.	Insert Documents into Collections (Single and Multiple Documents)
4.	Perform CRUD Operations (Insert, Find, Update, Delete)
5.	Querying Documents using Comparison and Logical Operators
6.	Sorting and Limiting Query Results
7.	Aggregation Framework (Aggregation Pipeline, \$match, \$group, \$sum, \$count)
8.	Working with Indexes and Performance Optimization
9.	Working with Cursors and Query Results
10.	Use of Regular Expressions in Queries

Subject:- Graph Database (Neo4j)	
Sr. No.	Topic of Practical Assignment
1.	Installation and Setup of Neo4j Environment
2.	Graph Basics and Data Creation (Nodes, Relationships, Properties)
3.	Insert Data and Perform CRUD Operations using Cypher
4.	MATCH Queries and Filtering using WHERE Clause
5.	Relationship and Path Queries
6.	Pattern Matching in Graph Queries
7.	Sorting and Limiting Results in Cypher Queries
8.	Social Network Modeling using Neo4j (Mini Case Study)

Course Code: 26CsCmpP116
Course Name: Lab Course on Artificial Intelligence and Advanced Python
Teaching Scheme: Practical: 4 Hours/Week
Examination Scheme: CIA :25 Marks

Credit: 2
End-Sem: 25 Marks

Lab Course on Artificial Intelligence

Lab 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

Subject:- Artificial Intelligence	
Sr. No.	Topic of Practical Assignment
1.	Implementation of Uninformed Search Techniques.
2.	Implementation of Informed Search Techniques.
3.	Implementation of Constraint Satisfaction Problems.
4.	Implementation of Game theory algorithms.
5.	Implementation of Water Jug Problem.
6.	Implementation of 8-puzzle problem.
7.	Implementation of N-Queens Problem.
8.	Implementation of Generative AI using Python.
9.	Program to implement simple chatbot
10.	Development of a Model.

Lab Course on Advanced Python

Lab Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Apply object-oriented programming concepts in Python to design and develop modular and reusable programs	3
CO 2	Implement file handling techniques, functional programming concepts, and regular expressions to process and manipulate data efficiently	3
CO3	Develop database-driven applications using Python for performing data storage, retrieval, and manipulation operations	5
CO 4	Build dynamic web applications using Python web frameworks	5
CO 5	Utilize scientific and essential Python libraries for data analysis and computation.	4
CO 6	Explore modern Python trends	5

Course Contents:

Subject:- Advanced Python	
Sr. No.	Assignments
1	Assignments on basic python
2	Assignments on OOP (Inheritance, Overriding, Polymorphism)
3	Assignments on file handling. (Reading and Writing files, working on various files such as CSV, JSON)
4	Validate use data using regular expressions and Extract contents from files using pattern matching.
5	Implement functional programming concepts using map(), filter(), and lambda functions on a list of numbers.
6	Assignments on Pandas ,NumPy,SciPy
7	Assignments on data visualization
8	Assignments on Text to Speech and Speech to Text conversion
9	Assignments on Django framework
10	Miniproject

Course Code: 26CsCmpP117
Course Name: Project on Emerging Trends
Teaching Scheme: 4 Hours/Week **Credit: 2**
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: 26CsCmpP121

Course Name: Software Testing and Quality Assurance

Teaching Scheme: TH: 4 Hours/Week

Credit: 4

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisites: Basic concepts software development & software Engineering

Course Objectives:

- To understand the principles of software development emphasizing processes and activities of quality assurance
- To study fundamental concepts in software testing, including software testing objectives, process, strategies, and methods.
- To understand test design techniques based on functionality and structure of software
- To understand test planning, monitoring, and control process
- To gain the techniques and skills on how to use software testing tools to support software testing activities

Course Outcomes:

After successful completion of this course students will able to:

CO No.	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Understand the role of software quality assurance in contributing to the efficient delivery of software solutions.	2
CO 2	Understand specific software tests with well-defined objectives and targets.	2
CO3	Apply the software testing techniques in commercial environments.	3
CO 4	Construct test strategies and plans for software testing.	4
CO 5	Demonstrate the usage of software testing tools for test effectiveness, efficiency, and coverage.	5

Course Contents:

Unit 1	Software Quality Assurance Fundamentals	10 Lectures
	1.1 Definition of Quality, Quality Assurance, Quality Control, Difference between QA and QC, Software Quality Assurance Challenges 1.2 Software Quality Assurance, SQA Planning & Standards (ISO 9000) 1.3 SQA Activities 1.4 Building Blocks of SQA 1.5 Software Quality factors 1.6 CMM levels, Six Sigma	
Unit 2	Software Testing Fundamentals	14 Lectures

	2.1. Definition & Objectives of Testing 2.2. Role of testing and its effect on quality 2.3. Causes of software failure: Definition of - Error, Bug, Fault, Defect and Failure, 2.4. Seven Testing Principles 2.5. Software Testing Life cycle (STLC) 2.6. V Model 2.7. Agile Testing- Test Driven Software Development 2.8. Levels of Testing- Unit (Component) Testing, Integration Testing, System Testing, User Acceptance Testing (UAT) 2.9. Test Types 2.9.1. Functional testing (Black-box) 2.9.2. Non-functional testing (Testing of software product characteristics) & its types 2.9.3. Structural testing (White-box) 2.9.4. Testing related to changes – Confirmation (Re-testing) and Regression Testing	
Unit 3	Static & Dynamic Testing	14 Lectures
	3.1. Static Techniques – Review Review Process (Informal & Formal), Technical or Peer Review, Walkthrough, Inspection 3.2. Static Techniques – Static Analysis Data Flow Analysis, Control Flow Analysis, Cyclomatic Complexity 3.3. Test Design Techniques: - Black Box Testing Techniques Equivalence Partitioning, Boundary Value Analysis, Decision Table Testing, State Transition Testing 3.4. Test Design Techniques: -White Box Testing Techniques Statement coverage, Decision coverage 3.5. Test Design Techniques – Experience based techniques Error Guessing, Exploratory Testing	
Unit 4	Test Management	10 Lectures
	4.1. Test Organization- Roles & Skills of Tester, Test Manager 4.2. Test Planning & estimation 4.3. Test Monitoring & Control 4.4. Configuration Management 4.5. Risk and Testing- Project Risk & Product Risk 4.6. Defect / Incident Management 4.7. Defect Life Cycle, Defect / Incident Report 4.8. Case Study on Test Plan & Test cases for application	
Unit 5	Tool Support for Testing	8 Lectures
	5.1. Types of Test tools – CAST (only type & their purpose) 5.2. Effective use of tools: Benefits and Risks	

	5.3. Introduction of a tool into an organization 5.4. Testing tools Selenium, Test NG, ,JMeter,Postman JIRA	
Unit 6	Experiential Learning	4 Lectures
	6.1 Writing functional test cases for a web login module 6.2 Applying boundary value analysis for form validation 6.3 Calculating Cyclomatic complexity of sample programs 6.4 Implementing automated tests using Selenium WebDriver 6.5 Performing load testing using JMeter 6.6 Testing REST APIs using Postman 6.7 Recording and managing defects using JIRA	

References:

1. Foundations of Software Testing by Rex black, Erik Van Veenendaal, Dorothy Graham (2020)- Cengage Learning: London UK, 5th Edition (for ISTQB)
2. Software Quality Assurance: From Theory to Implementation by Daniel Galin, Pearson Addison-Wesley, 2012.
3. Software Engineering-A Practitioner's Approach by Roger S. Pressman, McGraw Hill pub. 2010
4. Software Testing by Ron Patton, TechMedia Pub.
5. Fundamentals of Software Engineering –Rajib Mall, 3rd Edition

Recommended Learning Material:

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

Recommended Certifications:

1. CAST (Certified Associate in Software Testing)
2. ISTQB (International Software Testing Qualifications Board Certification)

Course Code: 26CsCmpP122

Course Name: DOT NET

Teaching Scheme: TH: 2 Hours/Week

Credit: 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

Course Objectives:

- To understand the DOTNET framework
- Learn C# language features
- Learn 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#	8 Lectures
	1.1 Introduction to DOTNET 1.1.1 DOT NET class framework 1.2 Introduction to C# 1.3 Language features 1.3.1 Variables and Expressions, type conversion, Flow Control 1.4 Functions, Delegates 1.4.1 Debugging and error handling 1.4.2 Exception handling (System Defined and User Defined) 1.5 Object Oriented Concepts	

	1.5.1 Concept of hiding base class methods, Function 1.5.2 Overriding, 1.5.3 Function Overloading 1.5.4 Event Handling 1.6 Collections, Comparisons and Conversions 1.6.1 Defining and using collections, 1.6.2 Indexers, iterators 1.6.3 Type comparison, Value Comparison 1.6.4 Overloading Conversion operators, as operator 1.7 Generics 1.7.1 Using generics 1.7.2 Defining Generics, generic Interfaces 1.7.3 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	5 Lectures
	3.1 DOTNET Assemblies 3.1.1 Components 3.1.2 NET Assembly features 3.1.3 Structure of Assemble 3.1.4 Calling assemblies, private and shared assemblies 3.1.5 Introduction to Cookies, Sessions 3.1.6 Session events 3.1.7 State management Recommendations 3.2 Web Services 3.2.1 HTTP, XML & Web services 3.2.2 SOAP 3.2.3 Building ASP.NET web service 3.2.4 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	4 Lectures
	5.1 Event Driven Programming and Post Back 5.1.1 HTML events 5.1.2 ASP.NET page events 5.1.3 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
	Build a small project using ASP.NET Core	

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: 978059652956

Course Code: 26CsCmpP123
Course Name: Lab Course on DOT NET
Teaching Scheme: Practical: 4 Hours/Week
Examination Scheme: CIA: 25 Marks

Credit: 02
End-Sem: 25 Marks

Course Outcomes:

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

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

Subject: - Lab Course on DOT NET	
Sr. No.	Topic of Practical Assignment
1	Introduction to .NET Environment - Installing and using Microsoft Visual Studio - Creating first program in C#
2	Basic Concepts of Object-Oriented Programming Language using C#. - Using Flow of Control Statement - Using Class and Object - Debugging and error handling - Use of types of properties - Use of Functions, Delegates - Exception Handling - Method Overriding, Overloading
3	Windows Programming - Use of Common controls, Container controls of Form - Event Handling

	Button click events, Form events, Keyboard and mouse events • Validation of Form • Accessing Data with ADO.NET • Use of ADO.NET Data Binding ,SQL Queries (Select,Update,Insert,Delete)
4	Web Programming with ASP.NET • ASP.NET Server Controls • ASP.NET Web Controls • Validation Controls • Concept of Session and Cookies • Use of ADO.NET Data Binding ,SQL Queries
5	Mini Project

Course Code: 26CsCopP131
Course Name: Research Methodology
Section 1

Teaching Scheme: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: -

End-Sem: 50 Marks

Prerequisite Courses:

- B.A., B.Sc. B. Com, B.Voc., BBA, BBA IB, BBA CA

Course Objectives:

- To make students aware about research and its importance
- To obtain knowledge regarding systematic gathering of data and get advanced knowledge in the selected topic
- To inculcate logical and organized thinking in students
- To investigate some existing situation or problem by creating new system or method
- To help students to design research problem

Course Outcomes:

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

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Recall and explain the fundamental significance and objectives of research	1
CO 2	Understand concepts of publication ethics and analyze differences between ethical/unethical practices	2
CO 3	Apply criteria to choose relevant research problems and analyze their feasibility	3,4
CO 4	Formulate clear and testable hypotheses based on research problem	4
CO 5	Perform data analysis using parametric/non-parametric tests and organize data effectively	5
CO 6	Draft comprehensive research reports adhering to principles of scientific writing and ethics	6

Course Contents

Unit 1	Research Problem and Design	15 Lectures
	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 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 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 Lectures
	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 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 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.
3. C. G. Thomas (2021) Research Methodology and Scientific Writing, 2nd Edition, Springer Nature, New York. M. Kheider lectures from University of Biskra (2017) <https://univ-biskra.dz/sites/fll/images/houadjli%20Ahmed%20Chaouki.pdf>

Course Code: 26CsCopP131

RM Section 2

Course Name: Research Using Artificial Intelligence

Teaching Scheme: TH: 2 Hours/Week

Credit: 2

Examination Scheme: -

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

Course Contents:

Unit 1	Introduction to AI in Research	10 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	9 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	9 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	8 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	7 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	8 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	8 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	1 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)

Course Code: 26CsCmpP211

Course Name: Unix Internals

Teaching Scheme: TH: 2 Hours/Week

Examination Scheme: CIA: 25 Marks

Credit: 2

End-Sem: 25 Marks

Prerequisites:

- General knowledge of operating systems
- Working knowledge of C programming.
- Basic algorithms and data structure concepts.

Course Objectives:

- To learn Advanced Operating Systems Concepts
- To understand the programming interface to the Unix/Linux system
- To provide an understanding of the system calls of Operating Systems
- To provide an understanding of the structure of files and directory in Unix/Linux
- To get knowledge of the signal handling.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Understand the Operating Systems Structure with examples of Unix/Linux.	1
CO 2	Explain the structure of files and directory in Unix/Linux OS.	2
CO3	Identify and Use various system calls related to file subsystem.	3
CO 4	Analyse the process control subsystem structure in Unix/Linux OS	4
CO 5	Assess various system calls related to the process control subsystem.	5
CO 6	Develop the concept of signal handling with practical implementation	6

Course Contents:

Unit 1	Introduction to UNIX/LINUX Kernel	2 Lectures
	1.1 Overview of operating system 1.2 Introduction to Unix/Linux OS 1.3 Architecture of Unix/Linux 1.4 Basics of navigating Unix/Linux environment	
Unit 2	File system	5 Lectures
	2.1 Introduction to Unix/Linux file system 2.2 File system layout 2.3 Files and directory management 2.4 Processes and process management	

Unit 3	Usage of command line-shell	5 Lectures
	3.1 Introduction 3.2 Shell Commands 3.3 Permissions, users and groups 3.4 Writing, executing and debugging basic script 3.5 Making interactive scripts 3.6 Conditional statements and Loops 3.7 Command line arguments 3.8 Functions and file manipulations 3.9 Regular expressions and filters	
Unit 4	Different Types of System Calls	8 Lectures
	4.1 Process Control 4.2 File management 4.3 Device management 4.4 Information maintenance 4.5 Programming using system calls	
Unit 5	Signals	4 Lectures
	5.1 Introduction to signals 5.2 Interrupts Concept 5.3 Difference between signals and Interrupts 5.4 Signal function 5.5 Signal names 5.6 Signal generation	
Unit 6	Interprocess Communication(IPC)	6 lectures
	6.1 Introduction to IPC 6.2 IPC between processes on a single computer system 6.3 IPC between processes on different systems 6.4 Pipes-creation IPC between related processes using FIFOs (Named pipes) 6.5 Differences between unnamed and named pipes	

References:

1. Linux System Programming — Robert Love; Publisher: O'Reilly Media; ISBN: 9781449339531.
2. The Design of the UNIX Operating System — Maurice J. Bach; Publisher: Prentice Hall; ISBN: 9780132017992.

3. Advanced Programming in the UNIX Environment — W. Richard Stevens, Stephen A. Rago; Publisher: Addison-Wesley; ISBN: 9780321637734.
4. Modern Operating Systems — Andrew S. Tanenbaum; Publisher: Pearson Education; ISBN: 9780136006633.
5. Linux Command Line and Shell Scripting Bible (2nd Edition) — Richard Blum, Christine Bresnahan; Publisher: Wiley; ISBN: 9781118983843.
6. UNIX for Programmers and Users (3rd Edition) — Graham Glass, King Ables; Publisher: Pearson Education; ISBN: 9780131270459.

Course Code: 26CsCmpP212
Course Name: Machine Learning

Teaching Scheme: TH: 2Hours/Week
Examination Scheme: CIA: 25 Marks

Credit: 2
End-Sem: 25 Marks

Prerequisites:

- Knowledge of DBMS and Data mining
- Basic knowledge of the Python programming language
- Knowledge of Mathematical Concepts like Probability, Linear Algebra and Statistics Multivariate Calculus

Course Objectives:

- To understand human learning aspects
- To understand fundamental concepts, scope, and applications of machine learning
- To apply machine learning techniques for problem-solving
- To use tools and techniques for understanding the concept of machine learning

Course Outcomes:

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

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Demonstrate a clear understanding of machine learning concepts, terminology, and application areas.	1
CO 2	Identify and differentiate between supervised, unsupervised, and semi-supervised learning techniques based on problem requirements.	2
CO3	Apply data preprocessing and dimensionality reduction techniques, including PCA, to prepare datasets for machine learning models.	3
CO 4	Implement and analyze supervised learning algorithms for classification and regression tasks.	4
CO 5	Apply unsupervised learning techniques such as clustering and association rule mining to discover patterns in unlabeled data.	5
CO 6	Evaluate and compare machine learning models using performance metrics, cross-validation, and analytical reasoning.	6

Course Contents:

Unit 1	Introduction to Machine Learning	10 Lectures
	1.1 What is Machine Learning? 1.2 When to use Machine Learning 1.3 Why study Machine Learning 1.4 Applications of Machine Learning 1.5 Types of Learning 1.5.1 Supervised Learning 1.5.2 Unsupervised Learning 1.5.3 Semi-supervised Learning	

	1.6 Dimensionality Reduction 1.6.1 Introduction to Dimensionality Reduction 1.6.2 Subset Selection 1.6.3 Principal Component Analysis (PCA) 1.7 Designing a Learning System 1.7.1 Steps in Developing a Learning System 1.7.2 Data Preprocessing 1.7.3 Handling Missing Data 1.7.4 Categorical Data Encoding 1.7.5 Feature Scaling 1.7.6 Training Set Vs Test Set 1.7.7 Data Modeling Phases	
Unit 2	Supervised Learning	10 Lectures
	2.1 Supervised Learning – Concept and Workflow 2.2 Classification Techniques 2.2.1 Decision Tree 2.2.2 Support Vector Machine (SVM) 2.2.3 Naïve Bayes 2.2.4 K-Nearest Neighbors (KNN) 2.2.4 Logistic Regression 2.3 Regression Techniques 2.3.1 Simple Linear Regression 2.3.2 Multiple Linear Regression 2.4 Model Evaluation and Performance Metrics 2.4.1 Confusion Matrix 2.4.2 Accuracy 2.4.3 Precision and Recall 2.4.4 Cross Validation 2.4.5 Model Comparison	
Unit 3	Unsupervised Learning	6 Lectures
	3.1 Unsupervised Learning – Introduction 3.2 Clustering Algorithms 3.2.1 K-Means Clustering 3.2.2 Hierarchical Clustering 3.3 Rule-Based Learning 3.3.1 Association Rule Mining 3.3.2 Apriori Algorithm 3.3.3 FP-Growth Algorithm 3.3.4 Support and Confidence 3.3.5 Comparison of Association Rule Algorithms	
Unit 4	Model Optimization and Practical Issues in Machine Learning	4 Lectures
	4.1 Bias–Variance Trade-off 4.2 Overfitting and Underfitting 4.3 Regularization Techniques 4.4 Feature Selection and Model Optimization 4.5 Ethical Issues and Limitations of Machine Learning	

Reference Books

1. Pat Langley, Elements of Machine Learning, Morgan Kaufmann Publishers. ISBN-13: 978-1558603011

2. William W. Hsieh, Machine Learning Methods in the Environmental Sciences: Neural Networks and Kernels, Cambridge University Press. ISBN 10: 1108456901 / ISBN 13: 9781108456906.
3. Jiawei Han, Micheline Kamber, and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers (Elsevier). ISBN-10. 9780128117606 · ISBN-13. 978-0128117606
4. Peter Harrington, Machine Learning in Action, DreamTech Press (Elsevier India). ISBN-13 978-9350044131, ISBN-10 9350044137

Text Books

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education.
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press.
3. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, Taylor & Francis Group.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.

Course Code: 26CsCmpP213
Course Name: Cloud Computing

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA :25 Marks

Credit: 2
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

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 2.6.1 VM Provisioning Process 2.6.2 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: 26CsCmpP214
Course Name: Full Stack Development I (MERN/MEAN)
Teaching Scheme: TH: 2 Hours/Week **Credit: 2**
Examination Scheme: CIA :25 Marks **End-Sem: 25 Marks**

Prerequisites:

- Familiarity with HTML, CSS, and basic JavaScript.
- Basic understanding of web browsing and internet technologies.
- Basic knowledge of database concepts

Course Objectives:

- Introduce the fundamentals of full stack development and the architecture of modern web applications.
- Provide knowledge of web technologies and protocols such as HTTP/HTTPS, REST architecture, and version control using Git.
- Develop skills in frontend development using Angular, including components, routing, data binding, and forms.
- Teach backend development using Node.js and Express.js for building scalable server-side applications and RESTful APIs.
- Enable students to design and manage NoSQL databases using MongoDB including schema design and CRUD operations.
- Integrate frontend, backend, and database technologies to build complete MEAN stack web applications.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Define the fundamental concepts of full stack development, web application architecture, client-server model, and MEAN stack components.	1
CO 2	Explain the working of web technologies including HTTP/HTTPS, REST architecture, version control, and the structure of modern web applications.	2
CO3	Use Angular framework features such as components, modules, data binding, routing, and forms to develop frontend web interfaces.	3
CO 4	Analyze the Node.js architecture, modules, and Express.js middleware to design backend services and RESTful APIs.	4
CO 5	Evaluate NoSQL database design using MongoDB, including schema creation, CRUD operations, and query optimization for web applications.	5
CO 6	Develop a complete MEAN stack web application by integrating Angular frontend, Node.js/Express backend, and MongoDB database with REST API communication.	6

Course Contents:

Unit 1	Introduction to Full Stack Development	2 Lectures
	1.1 Concept of Full Stack Development 1.2 Overview of Web Application Architecture 1.3 Client–Server Model 1.4 Frontend vs Backend Vs Database 1.5 Introduction to MEAN Stack 1.6 Advantages of MEAN Stack 1.7 Real-world Applications of MEAN Stack	
Unit 2	Web Development Fundamentals	2 Lectures
	2.1 Basics of Internet and Web 2.2 HTTP and HTTPS Protocol 2.3 Structure of Web Applications 2.4 Introduction to REST Architecture 2.5 Introduction to Version Control (Git basics)	
Unit 3	Frontend Development using Angular	8 Lectures
	3.1 Introduction to Angular Framework 3.2 Angular Architecture & Angular Component Lifecycle 3.3 Components and Modules 3.4 Angular CLI 3.5 Data Binding 3.6 Directives and Pipes 3.7 Angular Routing 3.8 Forms in Angular (Template Driven & Reactive) 3.9 HTTP Client in Angular	
Unit 4	Backend Development using Node.js	5 Lectures
	4.1 Introduction to Node.js 4.2 Node.js Architecture and Event Loop 4.3 Installing Node.js and npm 4.4 Modules in Node.js 4.5 File System Operations 4.6 Creating HTTP Server 4.7 Package Management with npm	
Unit 5	Express.js Framework	5 Lectures
	5.1 Introduction to Express.js 5.2 Setting up Express Application 5.3 Middleware Concept 5.4 Routing in Express 5.5 Handling Requests and Responses 5.6 Building REST APIs using Express (GET, POST, PUT, DELETE)	
Unit 6	Database using MongoDB	6 Lectures
	6.1 Introduction to NoSQL Databases 6.2 MongoDB Architecture 6.3 Collections and Documents	

	6.4 CRUD Operations in MongoDB 6.5 MongoDB Query Language 6.6 Introduction to Mongoose ODM 6.7 Schema and Models	
Unit 7	Integration of MEAN Stack	4 Lectures
	7.1 Connecting Angular with Backend APIs 7.2 Connecting Node.js with MongoDB 7.3 REST API Communication & API Testing using Postman	

References:

1. E. Brown, Web Development with Node and Express, 2nd ed. Sebastopol, CA: O'Reilly Media, 2019.
- A. Q. Haviv, MEAN Web Development, 2nd ed. Birmingham, UK: Packt Publishing, 2018.
2. S. Kumar, Full Stack Development with MongoDB and Node.js. New Delhi, India: BPB Publications, 2017.
3. S. Seshadri, Angular: Up and Running. Sebastopol, CA: O'Reilly Media, 2018.
4. E. Elrom, MEAN Stack Development. Birmingham, UK: Packt Publishing, 2019.

Websites:

1. MDN Web Docs, "MDN Web Docs," [Online]. Available: <https://developer.mozilla.org>
2. W3Schools, "W3Schools Online Tutorials," [Online]. Available: <https://www.w3schools.com>
3. W3C, "World Wide Web Consortium," [Online]. Available: <https://www.w3.org>
4. Node.js, "Node.js Official Website," [Online]. Available: <https://nodejs.org>
5. MongoDB, "MongoDB Official Website," [Online]. Available: <https://www.mongodb.com>
6. Angular, "Angular Official Documentation," [Online]. Available: <https://angular.io>
7. Express.js, "Express Web Framework," [Online]. Available: <https://expressjs.com>
8. Postman, "Postman API Platform," [Online]. Available: <https://www.postman.com>

Course Code: 26CsCmpP215
Course Name: Lab Course on Machine Learning & Cloud Computing
Teaching Scheme: Practical: 4 Hours/Week **Credits: 2**
Examination Scheme: CIA: 25 Marks **End-Sem: 25 Marks**

Lab Course on Machine Learning

Lab Course Outcomes:

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

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Apply Python libraries to preprocess and analyse real-world datasets.	1
CO 2	Implement supervised and unsupervised machine learning algorithms using Python.	2
CO3	Implement unsupervised machine learning algorithms using Python.	3
CO 4	Evaluate and compare machine learning models using appropriate performance metrics.	4
CO 5	Optimize models using feature selection and hyperparameter tuning techniques.	5
CO6	Design and implement machine learning solutions for real-world problem statements.	6

Subject:- Machine Learning	
Sr. No.	Topic of Practical Assignment
1	Data Preprocessing
2	Exploratory Data Analysis (EDA)
3	Simple Linear Regression
4	Multiple Linear Regression
5	Logistic Regression
6	k-Nearest Neighbors (k-NN)
7	Decision Tree Classifier
8	Naïve Bayes Classifier
9	Support Vector Machine (SVM)
10	K-Means Clustering

Lab Course on Cloud Computing

Lab Course Outcomes:

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 Rekognition

Course Code :26CsCmpP216

Course Name: Lab Course on Advanced JavaScript

Teaching Scheme: Practical: 4 Hours/Week

Credits: 2

Examination Scheme: CIA: 25 Marks

End-Sem: 25 Marks

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Recall the basic concepts of JavaScript, including variables, data types, operators, and ES6 features.	1
CO 2	Explain JavaScript functions, scope, closures, and object-oriented concepts.	2
CO3	Use JavaScript to develop programs involving functions, objects, and DOM manipulation for dynamic web pages.	3
CO 4	Analyze asynchronous programming mechanisms such as event loop, callbacks, promises, and async/await.	4
CO 5	Evaluate different techniques for interacting with web services and APIs using AJAX and Fetch API.	5
CO 6	Design and develop modular JavaScript applications integrating browser APIs and modern frameworks.	6

Subject:- Lab Course on Advanced Java Script	
Sr. No.	Topic of Practical Assignment(Syllabus)
1	Introduction to JavaScript and Modern Features • JavaScript execution environment • Variables and constants (var, let, const) • JavaScript data types and operators • Introduction to ES6 features • Arrow functions • Template literals • Default parameters • Rest and spread operators • Destructuring of arrays and objects
2	Functions and Scope • Function declaration and function expression • Anonymous functions • Higher-order functions • Callback functions • Closures and lexical scope • Immediately Invoked Function Expression (IIFE)
3	Objects and Object-Oriented Concepts • Creating and using objects • Object properties and methods • Constructor functions

	• Prototypes and prototype chain • ES6 classes • Inheritance in JavaScript • Encapsulation and polymorphism
4	Asynchronous Programming • Concept of asynchronous programming • Event loop and call stack • Callback mechanism • Promises and promise chaining • Async and Await • Error handling in asynchronous operations
5	Document Object Model (DOM) • Structure of the DOM • Accessing and selecting HTML elements • Modifying content and attributes • Creating and deleting elements • Event handling and event listeners • Event propagation (bubbling and capturing) • Client-side form validation
6	Web Services • Fetch API for data requests • Handling JSON data • Interaction with RESTful APIs
7	Modules and Code Organization • Concept of JavaScript modules • Exporting and importing modules • Organizing code using modules
8	Browser Storage and Web APIs • Cookies and their usage • Local Storage and Session Storage • Geolocation API • Canvas API for graphics
9	Introduction to JavaScript Frameworks • Need for JavaScript frameworks • Overview of popular frameworks (React, Angular, Vue) • Basic idea of component-based development

Sr. No.	Sample Practical Assignments
1	Basic JavaScript 1. Variables and Data Types Explorer Task: Create a web page where the user enters different values and the program displays the detected data type. Sample Example:

	Example: Input: 10 → Output: Type is number Input: 'Hello' → Output: Type is string 2. Operator Playground Task: Take two numbers from the user and perform arithmetic and comparison operations. Sample Example: Example: Input: 10 and 5 → Output: Addition=15, Multiplication=50, 10 > 5 = true 3. Student Grade Calculator Task: Enter marks of 5 subjects and calculate total, percentage and grade. Sample Example: Example: Marks: 80,70,90,60,85 → Percentage: 77% → Grade: A 4. Number Guessing Game Task: Generate random number between 1–100 and allow user to guess with hints. Sample Example: Example: System number=45 User guess=30 → Output: Try Higher 5. Loop Pattern Printer Task: Print star and number patterns using nested loops. Sample Example: Example Output: * ** *** **** 6. Array Analyzer Task: Accept an array of numbers and calculate max, min, sum and average. Sample Example: Example: [10,20,30] → Max=30, Min=10, Sum=60, Avg=20 7. Function Calculator Task: Create calculator using functions like add(), subtract(), multiply(). Sample Example: Example: add(5,3) → 8
2	Arrow Function Practice Task: Convert normal functions to arrow functions. Sample Example: Example: const square = (n) => n*n → square(4)=16
3	Array Methods Practice Task: Use map, filter and reduce on student data. Sample Example: Example: marks=[50,80,90] → filter >70 → [80,90]
4	Rest and Spread Operator Task: Create function sum(...numbers). Sample Example: Example: sum(1,2,3,4) → 10
5	Object Destructuring Task: Extract values from object using destructuring. Sample Example: Example: const {name, age}=student
6	Form Validation Task: Create registration form and validate fields. Sample Example:

	Example: Empty email → Show 'Email is required'
7	Dynamic To-Do List Task: Allow users to add and remove tasks. Sample Example: Example: Add 'Study JS' → Task appears in list
8	Theme Switcher Task: Toggle between dark and light mode. Sample Example: Example: Click 'Dark Mode' → Background turns dark
9	Image Gallery Task: Click thumbnail to show large image. Sample Example: Example: Click image → Display preview above
10	Live Character Counter Task: Display number of characters typed. Sample Example: Example: 'Hello' → Characters: 5
11	Dynamic Table Generator Task: Generate table based on rows and columns entered by user. Sample Example: Example: Rows=2 Cols=2 → Table 2x2 created
12	Product Filter UI Task: Filter products by category. Sample Example: Example: Category='Electronics' → Show only electronics
13	Digital Clock Task: Display real time clock. Sample Example: Example: 10:45:23 AM updating every second
14	Stopwatch Application Task: Create stopwatch with start, stop and reset. Sample Example: Example: Start → 00:00:01 → 00:00:02
15	Random Quote Generator Task: Fetch random quote using API. Sample Example: Example Output: 'Stay hungry stay foolish.'
16	Weather App Task: Enter city and display weather data. Sample Example:

	Example: Pune → Temp: 30°C
17	Delayed Message Function Task: Display message after delay. Sample Example: Example: showMessage('Hello',2000) → Shows after 2 seconds
18	Promise Chain Simulation Task: Simulate login → profile → posts. Sample Example: Example Output: Login successful → Profile loaded → Posts loaded
19	Closure Counter Task: Create counter using closure. Sample Example:
20	Custom map() Implementation Task: Create custom implementation of Array.map(). Sample Example: Example: [1,2,3].myMap(x=>x*2) → [2,4,6]
21	Debounce Function Task: Implement debounce for search input. Sample Example: Example: Typing 'JavaScript' triggers search only once after typing stops
22	Event Delegation Task List Task: Handle delete button click using event delegation. Sample Example: Example: Click delete on task → Task removed
23	Local Storage Notes App Task: Save notes to localStorage. Sample Example: Example: Add note → Refresh page → Note still visible
24	Mini Single Page Application Task: Create navigation without page reload. Sample Example: Example: Click 'About' → About section loads without refresh

Course Code :26CsCmpP217
Course Name: Lab Course on Full Stack Development I
(MERN/MEAN)

Teaching Scheme:Practcial: 4 Hours/Week

Credits: 2

Examination Scheme: CIA: 25 Marks

End-Sem: 25 Marks

Lab Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Recall the basic concepts of Angular framework, project structure, REST APIs, and MongoDB database components used in full stack web development.	1
CO 2	Explain the Angular modular architecture, services, API communication, and Express server structure in a MEAN stack application.	2
CO3	Implement Angular components, services, HTTP interceptors, and REST APIs using Express and MongoDB for web application development.	3
CO 4	Analyze the interaction between frontend, backend, and database layers including API responses, middleware, and schema relationships.	4
CO 5	Evaluate different architectural approaches for scalable Angular applications, including modular structure, lazy loading, and centralized API handling.	5
CO 6	Design and develop a complete full stack CRUD application using Angular, Express, and MongoDB, integrating UI, REST APIs, database schema, and file upload functionality.	6

Subject:- Full Stack Development I (MERN/MEAN)

Sr. No.	Topic of Practical Assignment
1.	Create Angular Application and Project Structure (3 Hours) • Create Angular project using Angular CLI • Understand folder structure • Create multiple components • Run application using ng serve • Revise Basic Advance Concepts
2.	Modular Angular Application Architecture (3 Hours) • Create feature modules • Implement lazy loading • Organize large Angular application structure
3.	Angular Services and API Layer (3 Hours) • Create reusable service layer • Implement centralized API service • Handle API responses

4.	Angular Interceptors (3 Hours) • Create HTTP interceptor • Modify request headers • Handle global API errors
5.	Advanced REST API using Express (3 Hours) • Implement API routing structure • Use middleware for validation • Structure controller and service layers
6.	MongoDB Schema Design (3 Hours) • Design relational-like data models • Implement references between collections • Use Mongoose population • Perform grouped queries
7.	File Upload using Express Middleware (3 Hours) • Upload files using middleware • Store file metadata in MongoDB • Access files from Angular UI
8.	Build Full Stack CRUD Module (9 Hours) Develop a complete module including: • Angular UI • REST API • MongoDB database • CRUD operations Example modules: • Product management • Blog system • Student Management system • To-Do Tasks List management.

Course Code: 26CsCmpP221

Course Name: Information System Security

Teaching Scheme: 4 Lectures/Week

Credits:4

Examination Scheme: CIA: 50 Marks

End-Sem: 50 Marks

Prerequisites:

- Students should have basic knowledge of:
- Fundamentals of computer networks and Internet concepts
- Basic mathematics and number systems used in computing
- Fundamental understanding of data communication and networking protocols

Course Objectives:

- To introduce fundamental concepts of information security including threats, vulnerabilities, risk assessment, and security services such as confidentiality, integrity, and availability.
- To understand the principles of cryptography and mathematical foundations used in securing digital communication.
- To study symmetric key encryption techniques and analyze different algorithms such as **DES (Data Encryption Standard), AES (Advanced Encryption Standard), Blowfish, and RC5.
- To learn public key cryptography mechanisms including RSA (Rivest–Shamir–Adleman), Diffie–Hellman Key Exchange, and Elliptic Curve Cryptography for secure key management and digital signatures.

Course Outcomes:

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

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Explain the fundamental concepts of information system security including threats, risks, and core principles.	1
CO 2	Apply cryptographic techniques (symmetric and asymmetric) for securing data and communications.	2
CO3	Analyze and compare symmetric and asymmetric encryption algorithms.	3
CO 4	Evaluate message integrity and authentication mechanisms for system security.	4
CO 5	Assess and implement internet and server security protocols and mechanisms.	5
CO 6	Identify and categorize virus threats and suggest mitigation strategies.	6

Course Contents:

Unit 1	Conceptual Foundation of Information Systems Security	3 Lectures
	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	3 Lectures
	2.1 Techniques 2.2 Mathematical Foundation 2.3 Steam Ciphers 2.4 Block Ciphers 2.5 Cryptanalysis 2.6 Steganography	
Unit 3	Symmetric/Secret Key Encryption	6 Lectures
	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	8 Lectures
	4.1 Principles of public key crypto-systems 4.2 Mathematical Foundation 4.3 RSA Algorithm 4.4 Key Management 4.5 Deffie-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	4 Lectures
	5.1 MD5 5.2 SHA	
Unit 6	Public Key Infrastructure	4 Lectures
	6.1 Trust Hierarchy 6.2 Digital Certificates 6.3 Transaction Certificates	
Unit 7	Authentication Techniques	4 Lectures
	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	11 Lectures
	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	

Unit 9	Server Security	4 Lectures
	9.1 Concepts 9.2 Design and Implementation of Firewalls, 9.3 Intrusion Detection Systems (IDS) 9.4 Intrusion Prevention Systems (IPS) etc	
Unit 10	Virus Threats	2 Lectures
	10.1 Network Viruses 10.2 Worms	
	EXPERIENTIAL LEARNING	1 Lecture

Reference Books:

1. Atul Kahate, "Cryptography and Network Security" TMH, ISBN-10: 9781259029882
2. Nina Godbole, "Information Systems Security", Wiley, ISBN-13: 978-8126516926
3. Matt Bishop, Satyanarayana S Venkatramanayya, "Introduction to Computer Security", ISBN: 0-321-24744-2
4. Bruce Schneier, "Applied Cryptography", ISBN 978-1-119-09672-6
5. Stallings, W. (2023). Cryptography and Network Security: Principles and Practice (8th ed.). Pearson Education India. ISBN-13: 978-9357059718

Course Code: 26CsCmpP222

Course Name: Agile Methodology and Design Thinking

Teaching Scheme: TH: 2 Hours/Week

Credit: 2

Examination Scheme: CIA: 25Marks

End-Sem: 25 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 wicked problems	6: Create
CO 2	Create interactive digital prototypes	6: Create
CO 3	Manage collaborative scrum teams	3: Apply
CO 4	Build effective product backlogs	6: Create
CO 5	Execute iterative sprint cycles	3: Apply
CO 6	Validate designs using feedback	5: Evaluate

Course Contents:

Unit 1	Foundations of Modern Software Evolution	6 Lectures
	1.1 The Shift from Waterfall: Limitations of traditional Software Engineering in the modern era. Move from Simple Requirement Gathering and Waterfall. 1.2 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. 1.3 The Agile Manifesto: Core values and principles. Need to shift. Introduction to different methods in Agile – SCRUM, Kanban, XP, Lean, TDD, FDD, SAFe 1.4 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	7 Lectures

		res
	2.1 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 2.2 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 2.3 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	6 Lectures
	3.1 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. 3.2 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	5 Lectures
	4.1 Scrum Framework 4.2 Roles - Product Owner, Scrum Master, Team, Business Owner, SME, Active/Passive team members 4.3 What is Sprint? 4.5 Ceremonies - Product Backlog grooming, Sprint Planning, Daily Stand-up, Review, Retrospective 4.6 Artifacts - Backlog mgmt. - Product Backlog, Sprint Backlog, Increment	
Unit 5	Agile SCRUM – Planning and Execution	6 Lectures
	5.1 WBS: Theme – Epic – User Stories – Tasks 5.2 User Stories: Writing effective stories, Acceptance Criteria, and INVEST criteria. 5.3 Estimation Techniques: Story Points, Planning Poker, and T-shirt sizing.	

	5.4 Metrics: Tracking progress via Burndown charts, Velocity 5.5 Tools (just understand usecases) – Google form, MS Teams, Figma, Jira/confluence, Github, EasyRetro 5.6 Practice: Using Agile Tools (JIRA/Trello basics); Retrospective techniques (Start-Stop-Continue)	
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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: 26CsCmpP223
Course Name: Lab course on Agile Methodology and Design Thinking
Teaching Scheme: Practical: 4 Hours/Week **Credits: 2**
Examination Scheme: CIA: 25 Marks **End-Sem: 25 Marks**

Lab Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Model user empathy mapping.	3: Apply
CO 2	Reframed actionable problem statements.	4: Analyze
CO3	Design interactive digital prototypes.	6: Create
CO 4	Manage structured agile backlogs.	3: Apply
CO 5	Estimate stories using poker.	5: Evaluate
CO 6	Facilitate collaborative sprint ceremonies.	3: Apply

Subject:- Design Thinking and Agile Methodologies

Sample Scenarios for Practicals

- A. **"SeniorConnect" (Healthcare & Accessibility):** A telemedicine and social engagement platform specifically designed for senior citizens (ages 70+) who live alone.
- B. **"CampusBite" (Internal University Ecosystem):** The Concept: A hyper-local, student-run food delivery and pre-order website for the university campus to reduce cafeteria wait times.
- C. **"EcoTrack" (Green E-commerce Extension):** The Concept: A browser extension and web dashboard that analyzes a user's shopping cart (on sites like Amazon) and suggests eco-friendly or local alternatives.
- D. **"FreelanceFlow" (Fintech/SaaS Management):** The Concept: A "Subscription & Invoice" management dashboard for independent software developers to track their SaaS costs and client payments.
- E. **Any other scenario with Teacher's permission**

Make a group of 5-6 students in one Team. Following all practical must be done by that Team with *any one* scenario taken and **same** scenario applied for all the 10 practical.

For better control, Video Recording of all the group activities must be uploaded/submitted by each student as part of submission.

Sr. No.	Topic of Practical Assignment
1	Empathy Mapping & Persona Creation (Individual Activity) Conduct user interviews for a problem (e.g., "Improving the College Library Experience") and build a detailed Empathy Map and User Persona Suggested Tool: Miro/ plain paper
2	Problem Reframing & HMW Formulation (Individual Activity) Synthesize raw interview data into a precise " Point of View " (POV) statement and draft three " How Might We " (HMW) questions to guide the design.

3	Rapid Ideation with any 1 ideation technique (Group Activity) Apply the SCAMPER technique to a popular existing app (e.g., Spotify or WhatsApp) to generate 10+ innovative features
4	Low-to-Mid Fidelity Prototyping (Individual Activity) Design a 5-screen interactive "Happy Path" user flow in Figma , transitioning from a hand-drawn paper sketch to a clickable digital wireframe
5	Jira Project Setup & Backlog Grooming (Group Activity) Create a Scrum project in Jira , configure the board with Epics and Stories, and perform a Backlog Refinement session to ensure stories are "Ready" for a sprint Suggested Tool: Jira by Atlassian. Free Version.
6	User Story Workshop & INVEST Audit (Individual Activity) Draft 10 User Stories for your prototype using the "As a... I want... So that..." Suggested Tool: Jira by Atlassian. Free Version.
7	Relative Estimation with Planning Poker (Group Activity) Practice Relative Estimation by assigning Story Points to a backlog using a digital Planning Poker tool Suggested Tool: Jira by Atlassian. Free Version.
8	Daily Stand-up (Group Activity) conduct a 15-minute Daily Stand-up
9	Sprint Retrospective (Group Activity) Conduct a " Start-Stop-Continue " retrospective ceremony Suggested Tool: Jira by Atlassian. Free Version
10	(Group Activity) Group Discussion: Discuss what every student new learnt while studying this subject and 1 example where he could have applied any one technique for better productivity.

Course Code 26CsCmpP204
Course Name: On Job Training-Project
Teaching Scheme: Practical:8 Hours/Week **Credit : 04**
Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

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 prepared 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).
- 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.
- The student should print the report back to back.
- One copy to be printed and presented at the time of on job training examination. The student may take away the copy after the evaluation gets over.
- One 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. 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.

OJT PROJET REPORT

JUNE #YEAR#

A PROJECT REPORT SUBMITTED FOR THE ON JOB TRAINING (OJT)
OF MASTER OF ARTS/SCIENCE/COMMERCE/ VOCATIONAL IN <<SPECIALIZATION>>

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>>