Savitribai Phule Pune University

Degree Program
B.Sc. (Information Technology)

With

Major Course: Information Technology
(Faculty of Science and Technology)

Syllabi for

T.Y.B.Sc. (Information Technology)

Choice Based Credit System (CBCS) Syllabus
Under National Education Policy (NEP)

To be implemented from the Academic Year 2026-2027

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

Course Type	Course Code	Course Title	Course Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (8T+4P)	IT301MJ	Full Stack Development using Python Programming	2		2		15	35	50
	IT302MJ	Object Oriented Analysis and Design	2		2		15	35	50
	IT303MJ	Core Java	2		2		15	35	50
	IT304MJ	Data Structure	2		2		15	35	50
	IT305MJP	Practical Based on IT301MJ		2		4	15	35	50
	IT306MJP	Practical Based on IT303MJ		2		4	15	35	50
Major Elective (2T+2P	IT307MJ	Data Mining	2		2		15	35	50
	IT308MJP	Practical Based on IT307MJ		2		4	15	35	50
		OR							
	IT309MJ	VB.NET	2		2		15	35	50
	IT310MJP	Practical Based on IT309MJ		2		4	15	35	50
VSC 2(T)	IT321VSC	Web Application Development	2		2		15	35	50
FP/OJT/ CEP (2)	IT331FP	Project		2		4	15	35	50
Minor (2T)	IT341MN	Network Infrastructure & Operations Management OR Cloud Computing Security and Management	2		2		15	35	50
TOTAL			14	08	14	16			550

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

Course Type	Course Code	Course Title	Course Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core (8+4)	IT351MJ	Data Analysis Tools	2		2		15	35	50
	IT352MJ	Software Testing	2		2		15	35	50
	IT353MJ	Advanced Java	2		2		15	35	50
	IT354MJ	Soft Computing	2		2		15	35	50
	IT355MJP	Practical Based on IT351MJ		2		4	15	35	50
	IT356MJP	Practical Based on IT353MJ		2		4	15	35	50
Major Elective (2+2)	IT357MJ	Mobile Application Development	2		2		15	35	50
	IT358MJP	Practical Based on IT357MJ		2		4	15	35	50
	OR								
	IT359MJ	Go Programming	2		2		15	35	50
	IT360MJP	Practical Based on IT359MJ		2		4	15	35	50
VSC(2)	IT371VSCP	Practical based on Web Application Development (IT321VSC)		2		4	15	35	50
FP/OJT/ CEP(4)	IT381OJT	On Job Training		4		8	30	70	100
TOTAL			10	12	12	24			550

Semester-V

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT301MJ
Subject: Full Stack Development using Python Programming

Teaching Scheme	No. of Credits	Examination Scheme
2 hours / week	2	CE: 15 marks EE: 35 marks

Prerequisites

- Basic knowledge of Python Programming
- Understanding of DBMS concepts and SQL queries
- Familiarity with command line and IDE usage (VS Code, PyCharm, etc)

Course Objectives: -

- To understand the fundamentals of web applications and full stack development
- To introduce backend development using Python and Flask framework
- To develop knowledge of API creation and integration
- To learn database connectivity and data handling in applications
- To build and deploy simple full stack applications

Course Outcomes: - Student will be able to: -

CO1: Explain basic concepts of web applications and client–server architecture
CO2: Develop simple backend applications using Python and Flask
CO3: Design and implement RESTful APIs for data communication
CO4: Perform database operations and integrate them with applications
CO5: Build and test a basic full stack application

Course Contents

Chapter 1	**Introduction to Web and Full Stack Concepts**	**5 hours**

1.1 Basics of Web Applications and difference between static and Dynamic Websites
1.2 Client-Server Architecture and request-response cycle
1.3 Components of Full Stack: Frontend, Backend, Database
1.4 Overview of HTTP/HTTPS protocols and methods (GET, POST, PUT, DELETE)

Chapter 2	**Backend Development using Python**	**7 hours**

2.1 Introduction to backend programming and role of server-side scripting
2.2 Basics of Flask framework and application structure
2.3 Handling user input through forms and request objects
2.4 Generating responses in different formats (HTML, JSON)

Chapter 3	**API Development and Integration**	**7 hours**

3.1 Concept of APIs and their importance in full stack development
3.2 Designing and developing RESTful APIs using Flask
3.3 Working with JSON data for data exchange
3.4 Testing and debugging APIs using tools (Postman basics

Chapter 4	**Database Integration with Python**	**5 hours**

4.1 Overview of relational databases and connection with Python
4.2 Performing CRUD operations using SQL queries
4.3 Integration of database with Flask applications
4.4 Managing data validation and basic error handling

Chapter 5	Full Stack Application Development	6 hours
5.1 Designing simple user interface using basic HTML forms 5.2 Integrating frontend with backend and database 5.3 Implementing basic validation and error handling 5.4 Testing, debugging, and running complete application		
Reference Books: 1. Full Stack Web Development – Philip Ackermann 2. Flask Web Development: Developing Web Applications with Python – Miguel Grinberg 3. Building REST APIs with Flask – Kunal Relan Building REST APIs with Flask		
E-Books and Online Learning Material 1. W3Schools (HTML, CSS, Python, SQL Tutorials) 2. GeeksforGeeks (Flask & API Tutorials) 3. Covers Flask from basics to advanced topics including API, database integration, and projects The Joy of Computing using Python - https://nptel.ac.in/courses/106/106/106106182/		

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT302MJ
Title: Object Oriented Analysis and Design

Teaching Scheme	**No. of Credits**	**Examination Scheme**
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

Fundamental Knowledge of Software Engineering

Course Objectives: -

- Understand object-oriented principles in software development.
- Apply OO concepts in system analysis and design.
- Model software systems using UML diagrams.
- Design maintainable and reusable object-oriented systems.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Apply object-oriented principles in software analysis.
CO2: Develop UML models for real-world problems.
CO3: Design modular and reusable software systems.
CO4: Bridge theoretical SE concepts with practical OO implementation.

Course Contents

Chapter 1	**Introduction to Object-Oriented Concepts**	**6 Hours**

1.1 Evolution from Procedural to Object-Oriented Development
1.2 Overview of Software Engineering vs Object-Oriented Approach
1.3 Object-Oriented Paradigm:
  1.3.1 Objects and Classes
  1.3.2 Abstraction
  1.3.3 Encapsulation
  1.3.4 Inheritance
  1.3.5 Polymorphism
1.4 Advantages of Object-Oriented Development
1.5 Comparison: Structured vs Object-Oriented Development

Chapter 2	**Requirements Engineering & Object-Oriented Analysis**	**6 hours**

2.1 Requirement Gathering Techniques
2.2 Functional vs Non-Functional Requirements
2.3 Use Case Modeling:
  2.3.1 Actors and Use Cases
  2.3.2 Use Case Diagrams
  2.3.3 Use Case Documentation (Textual Format)
2.4 User Stories and Agile Perspective
2.5 Identifying Classes, Attributes, and Methods
2.6 CRC (Class-Responsibility-Collaborator) Cards
2.7 Domain Modeling Concepts

Chapter 3	Unified Modeling Language (UML)	8 hours

3.1 Introduction to UM L
3.2 Structural Diagrams
- 3.2.1 Class Diagram
- 3.2.2 Object Diagram
- 3.2.3 Package Diagram

3.3 Behavioral Diagrams
- 3.3.1 Use Case Diagram
- 3.3.2 Sequence Diagram
- 3.3.3 Communication Diagram
- 3.3.4 Activity Diagram
- 3.3.5 State Chart Diagram

3.4 Additional Diagrams
- 3.4.1 Component Diagram
- 3.4.2 Deployment Diagram

Chapter 4	Object-Oriented Design Principles	5 hours

4.1 Design Concepts: Coupling & Cohesion
4.2 SOLID Principles
4.3 GRASP Principles (Basic Introduction)
4.4 Interface Design Concepts
4.5 Reusability and Maintainability

Chapter 5	Design Patterns, Testing & Case Study	5 hours

5.1 Introduction to Design Patterns
- 5.1.1 Creational: Singleton, Factory
- 5.1.2 Structural: Adapter, Decorator
- 5.1.3 Behavioral: Observer, Strategy

5.2 Testing in OO Systems:
- 5.2.1 Unit Testing
- 5.2.2 Integration Testing

5.3 Test-Driven Development (TDD)
5.4 Software Metrics (CK Metrics – overview)
5.5 Case Study (Library / Banking / E-commerce System)

Reference Books:

1. Applying UML and Patterns – Craig Larman
2. Object-Oriented Analysis and Design with Applications – Grady Booch
3. The Unified Modeling Language User Guide – Grady Booch, James Rumbaugh, Ivar Jacobson
4. Design Patterns: Elements of Reusable Object-Oriented Software – Erich Gamma et al.
5. Agile Software Development, Principles, Patterns, and Practices – Robert C. Martin
6. Software Engineering – Ian Sommerville
7. UML Distilled – Martin Fowler
8. Head First Design Patterns – Freeman et al.

E-Books and Online Learning Material

1. NPTEL Object-Oriented Analysis and Design: IIT Kharagpur / IIT Madras-Covers Units 1–5– Includes UML, use cases, CRC, patterns: https://nptel.ac.in
2. Software Engineering: IIT Kharagpur - Strong for Requirements Engineering & UML
3. MIT OpenCourseWare :Software Engineering (6.005 / 6.031)- Requirements, modeling, testing, design principles - https://ocw.mit.edu
4. IBM / Industry Learning: IBM Developer – UML & OO Concepts,UML basics,Design principles,Patterns - https://developer.ibm.com

5. Design Patterns (Beginner Friendly): Refactoring.Guru-Simple explanations of:Singleton, Factory, Adapter, Observer, Strategy, https://refactoring.guru
6. Testing & TDD : Martin Fowler – Testing Articles- Unit testing, TDD concepts https://martinfowler.com

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT303MJ
Title: Core Java

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

- Object Oriented Concepts of any language

Course Objectives: -

- Learn about java programming using oops concepts.
- Understand fundamentals of java program such as control structures, tokens, string, arrays, etc
- Learn fundamental features of object oriented language and JAVA.
- Understand how to develop Encapsulation, Inheritance and polymorphism using programming examples.
- To understand how to design applications with thread.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Able to solve real world problems using OOP techniques.

CO 2: Able to understand the use of abstract classes.

CO3: Understand the concept of classes, object

CO4: Understand the concepts of packages and Collections.

CO5: Able to design GUI based applications

Course Contents

Chapter 1	**Introduction to Object Oriented Programming (OOPs) and Java**	**4 hours**

1.1 Fundamentals of Object Oriented Programming(OOP) concepts (Abstraction, Encapsulation ,Inheritance, Polymorphism)
1.2 History of Java , Features of Java
1.3 JDK Environment
1.4 Java Virtual Machine, Java Runtime environment Structure of java program
1.5 Data Types, Final Variable, Control structures
1.6 Simple Java program
1.7 Accepting Input (Command Line Arguments, BufferedReader, Scanner)

Chapter 2	**Objects and Classes**	**5 hours**

2.1 Classes and objects: Definition classes, Creating objects, Fields,
2.2 Access Specifiers, Modifiers & access control (Default, public, private, protected, private protected).
2.3 Array of Objects
2.4 Constructors: Types of constructor, Constructor Overloading
2.5 Methods: Method Overloading, Recursion, Passing and Returning object form Method
2.6 new operator, this and static keyword, finalize() method
2.7 Creating , Accessing And Using Packages ,Wrapper Classes

Chapter 3	Inheritance and Interface	6 hours

3.1 Inheritance Basics (extends Keyword) and Types of Inheritance
3.2 Superclass, Subclass and use of Super Keyword
3.3 Method Overriding and runtime polymorphism
3.4 Use of final keyword related to method and class
3.5 Use of abstract class and abstract methods
3.6 Defining and Implementing Interfaces
3.7 Runtime polymorphism using interface

Chapter 4	Exception and File Handling	6 hours

4.1 Dealing with errors , Exception class, Checked And Unchecked Exception
4.2 Catching Exceptions, Multiple Catch Block, Nested try block
4.3 Creating User Defined Exception
4.4 Introduction to Files And Streams
4.5 Input-OutputStream: FileInput/OutputStream, BufferedInput/OutputStream, DataInput/OutputStream
4.6 Reader-Writer : FileReader/Writer, BufferedReader/Writer, InputStreamReader, OutputStreamWriter

Chapter 5	Swing Programming	9 hours

1.1 Swing : Introduction to Swing Component and Container Classes , Swing Controls- JLabel and Image Icon, JText Field, JButton, JToggle Button, JCheck Box, JRadio Button, JTabbed Pane, JScroll Pane, JList, JTable, JComboBox, JFileOpen,JColorChooser.

Reference Books:

1. Programming with JAVA - EBalgurusamy
2. The Complete Reference – JAVA HerbertSchildt
3. Programming in Java, S. Malhotra, S. Chudhary, 2nd edition, Oxford Univ. Press.
4. Java Programming and Object-oriented Application Development, R. A. Johnson, Ceng

E-Books and Online Learning Material

1. https://www.geeksforgeeks.org/java/java/
2. https://www.w3schools.com/java/
3. https://www.tutorialspoint.com/java/index.htm

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT304MJ
Subject: Data Structure

Teaching Scheme	No. of Credits	Examination Scheme
2 hours / week	2	CE: 15 marks EE: 35 marks

Prerequisites

1. Fundamental concepts of computers.
2. Basic knowledge of algorithms and problem solving
3. Knowledge of Python Programming Language

Course Objectives: -

- To learn the systematic way of solving problem
- To understand the different methods of organizing large amount of data
- To efficiently implement the different data structures
- To efficiently implement solutions for specific problems.

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

CO1: Inculcate and apply various skills in problem solving.
CO2: Use well-organized data structures in solving various problems.
CO3: Differentiated the usage of various structures in the problem solution.
CO4: Implement the algorithms to solve problems using appropriate data structures.

Course Contents

Unit 1	**Introduction to Data Structures**	**4 hours**

1.1 Introduction
  1.1.1 Data type, Data object, ADT (ADT of array, Operations), Data Structure
  1.1.2 Need of Data Structure
  1.1.3 Types of Data Structure
1.2 Algorithm analysis
  1.2.1 Space complexity, time complexity
  1.2.2 Best, Worst, Average case analysis, asymptotic notation (Big O, Omega ΩTheta)

Unit 2	**Array as a Data Structure and Linked List**	**6 hours**

2.1 Searching: Linear, Binary
2.2 Sorting Technique: Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort
2.3 Linked List: List as a Data Structure, Dynamic implementation of Linked List
2.4 Types of Linked List: Singly, Doubly, Circular
2.5 Operations on Linked List- create, traverse, insert, delete, search, reverse

Unit 3	**Stack**	**6 hours**

3.1 Introduction
3.2 Representation of Stack -Static & Dynamic
3.3 Operations (init(), push(), pop(), isEmpty(), isFull(), peek())
3.4 Applications (String reversal, Function Call, infix to postfix, infix to prefix, postfix Evaluation)

Unit 4	**Queue**	**6 hours**

4.1 Introduction
4.2 Representation of Queues-Static & Dynamic

4.3 Operations of Queues -init (), enqueue (), dequeue (), isEmpty (), isFull () , peek()

4.4 Types of Queues

4.4.1 Simple Queue

4.4.2 Circular Queue

4.4.2 Priority Queue

4.4.3 Double Ended Queue

Unit 5	**Trees and Graphs**	**8 hours**

5.1 Concept & Terminologies of Tree, Representation (Static and Dynamic)
5.2 Binary tree, binary search tree, Operations on BST (create, Insert, delete)
5.3 Tree traversals–recursive and non-recursive (preorder, inorder, postorder)
5.4 Heapsort
5.5 Concept & Terminologies of Graph
5.6 Graph Representation– Adjacency matrix, Adjacency list, Inverse Adjacency list,
5.7 Traversals–BFS and DFS

Reference Books:

1. Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles by Karumanchi, Narasimha
2. Data Structures using Python 2021 Edition by Dr Shriram K. Vasudevan.
3. Hands-On Data Structures and Algorithms with Python, Second Edition by Benjamin Baka, Dr. Basant Agarwal, Dr. Basant Agarwal

E-Books and Online Learning Material:

1. https://www.w3schools.com/python/
2. The Joy of Computing using Python - https://nptel.ac.in/courses/106/106/106106182/
3. Programming, Data Structures and Algorithms using Python https://nptel.ac.in/courses/106/106/106106145/
4. https://www.geeksforgeeks.org/dsa/dsa-tutorial-learn-data-structures-and-algorithms/

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
Subject Code: IT305MJP

Title: Practical Based on Full Stack Development using Python Programming (IT301MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours / week	2	CE: 15 marks EE:35marks

Prerequisites

1. Basic knowledge of Python programming (functions, loops, conditions)
2. Understanding of DBMS concepts and SQL using PostgreSQL (psql shell)
3. Familiarity with basic command line tools and IDEs (VS Code / PyCharm)

Course Objectives: -

- To understand the fundamentals of web applications and full stack development
- To introduce backend development using Python and Flask framework
- To develop skills for API creation and integration
- To build simple full stack applications with database connectivity

Course Outcomes: -Students will be able to: -

CO1: Explain concepts of web applications and client–server architecture

CO2: Develop backend applications using Python and Flask

CO3: Design and implement APIs for data communication

CO4: Perform database operations and integrate them into applications

CO5: Build and test a basic full stack application integrating frontend, backend, and database

Practical Assignments

Assignment 1: Introduction to Basic Web Concepts and HTML Page Design

- Create simple static HTML page
- Identify components of web application

Assignment 2: Understanding Client–Server Architecture and HTTP Communication

- Demonstrate request–response using browser
- Study HTTP methods (GET, POST)

Assignment 3: Installation and Setup of Flask Framework with First Application

- Install Flask and create first app
- Run basic server and display output

Assignment 4: Development of Basic Web Application using Flask Routing

- Create routes using Flask
- Display simple HTML response

Assignment 5: Handling User Input through HTML Forms and Flask Request Object

- Create form using HTML
- Accept input using Flask request object

Assignment 6: Implementing Response Handling and Dynamic Data Display

- Return JSON response
- Display dynamic data on browser

Assignment 7: Development of GET API using Flask Framework

- Create GET API using Flask
- Fetch and display data

Assignment 8: Development of POST API and JSON Data Handling

- Create POST API
- Send and receive JSON data

Assignment 9: Testing and Debugging APIs using Postman Tool

- Test APIs using Postman
- Perform GET and POST requests

Assignment 10: Establishing Database Connection using Python

- Connect Python with PSQL(PostgreSQL)/SQLite
- Execute basic queries

Assignment 11: Implementation of CRUD Operations using Database

- Insert and retrieve data
- Update and delete records

Assignment 12: Integration of Flask Application with Database

- Connect Flask app with database
- Display data from database

Assignment 13: Form Data Handling with Database Integration

- Store form data in database
- Retrieve and display data

Assignment 14: Implementation of Input Validation and Error Handling Techniques

- Implement input validation
- Handle errors in application

Assignment 15: Development of Mini Full Stack Application

- Develop simple full stack application
- Integrate frontend, backend, and database

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT306MJP
Title: Practical Based on Core Java (IT303MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Object Oriented Programming concepts

Course Objectives: -

- To learn implementation of object-oriented concepts with Java.
- To understand collection classes and interfaces.
- To know the process of application development using Graphical User Interface (GUI).

Course Outcomes: -

After completing the course, students will be able to:

CO1: Identify classes, objects, class members and relationships for a given problem. And Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.

CO2: Design end to end applications using object oriented constructs. Read and make elementary modifications to Java programs that solve real-world problems.

CO3: Apply collection classes for storing java objects.

Practical Assignments

Assignment 1 :

- Java Tools and IDE
- Simple java programs
- Introduction to the java environment and set environment variable
- Use of java tools like java, javac, jdb and javadoc
- Defining simple classes and creating objects.
- Write a Hello World Program in Java.
- Write a Program in Java to Add two Numbers

Assignment 2

- Array of Objects and Packages
- Defining a class.
- Creating an array of objects.
- Creating a package and Simple I/O
- Data types
- Control Statements
- Write a Java program to accept a number from command prompt and generate multiplication table of a number.
- Write a Java program to print the factors of a number.
- Write a Java program to display Fibonacci series using recursion.
- Write a Java program to accept a number from user and print all prime numbers upto that number (Use Buffered Reader class)
- Write a Java program to print the sum of elements of the array.

- Write a Program to Swap Two Numbers
- Java Program to Print Patterns programs.

Assignment 3:

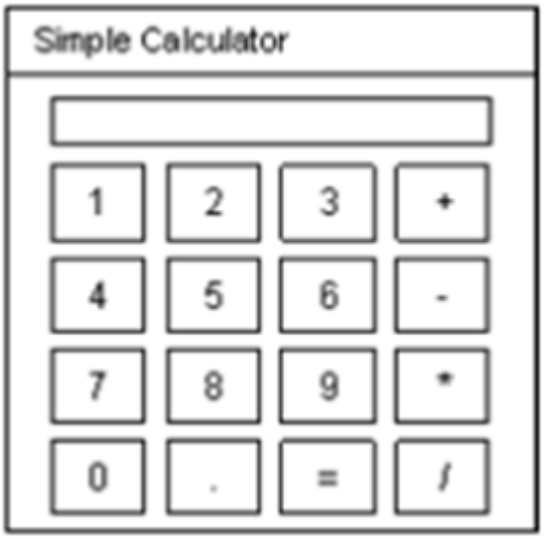
- Constructor
- Inheritance and Interfaces
- To implement inheritance in java.((Types of Inheritance)
- To define abstract classes.
- To define and use interfaces and Functional Interface.
- Method Overriding,
- Super keyword
- Write a Java program to create a super class Vehicle having members Company and Price. Derive two different classes LightMotorVehicle (mileage) and HeavyMotorVehicle (capacity_in_tons). Accept the information for "n" vehicles and display the information in appropriate form. While taking data, ask user about the type of vehicle first.
- Define a class Employee having members – id, name, department, salary. Define default and parameterized constructors. Create a subclass called Worker with private member bonus. Define methods accept and display in both the classes. Create "n" objects of the Worker class and display the details of the worker having the maximum total salary (salary + bonus).
- Create an interface "CreditCardInterface" with methods: viewCreditAmount(), useCard(), payCard(), and increaseLimit(). Create a class "SolverCardCustomer" (name, cardnumber (16digit), creditamount-initialized to 0, creditLimit-set to 50,000) which implements above interface. Inherit class GoldCardCustomer from SilverCardCustomer having same methods but creditLimit of 1,00,000. Create an object of each class and perform operations. Display appropriate messages for success or failure of transaction. (Use method overloading)

Assignment 4:

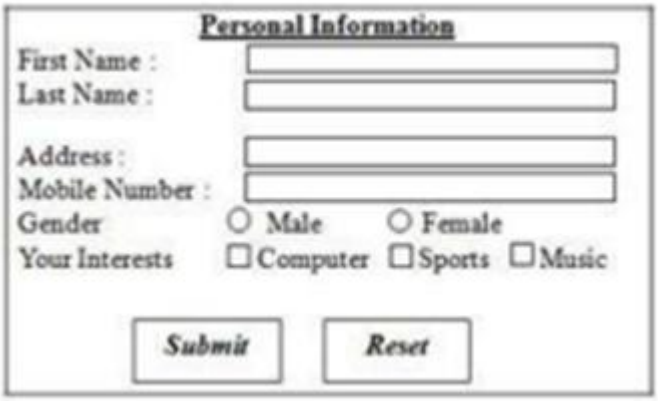
- Write a java program to accept a number from the user, if number is zero then throw user defined exception ―Number is 0, otherwise check whether no is prime or not.
- Write a java program that displays the number of characters, lines and words of a file.

Assignment 5:

- GUI Designing
  - Event Handling
  - To demonstrate GUI creation using Swing Package and Layout managers.
  - To understand Event handling mechanism in Java.
  - Using Event classes, Event Listeners and Adapters
  - Create java application using Swing.
  - Write a java program to design the following GUI using Swing components.



- Write a java program to design a following GUI using Swing. After submission, display the accepted details on the next page. (Use Event Handling)



Reference Books:

1. Programming with JAVA - EBalgurusamy
2. The Complete Reference – JAVA HerbertSchildt
3. Programming in Java, S. Malhotra, S. Chudhary, 2nd edition, Oxford Univ. Press.
4. Java Programming and Object-oriented Application Development, R. A. Johnson, Ceng

E-Books and Online Learning Material

1. https://www.geeksforgeeks.org/java/java/
2. https://www.w3schools.com/java/
3. https://www.tutorialspoint.com/java/index.htm

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT307MJ
Title: Data Minning

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Fundamentals of Databases
2. Mathematical Techniques for IT.

Course Objectives: -

- To introduce students the basic concepts and techniques of Data Mining
- To study data mining algorithms for solving practical problems.
- Be familiar with mathematical foundations of data mining tools.
- To understand data mining techniques in various applications like social, scientific and environmental context.
- Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes: -

After completing the course, students will be able to:

CO1 : Understand the functionality of the various data mining component.
CO2 : Explain the analyzing techniques of various data.
CO3 : Describe different methodologies used in data mining.
CO4 : Analyze the frequent patterns using association analysis algorithms like apriori etc.
CO5 : Develop ability to design various algorithms based on data mining tools

Course Contents

Chapter 1	**Introduction to Data Mining & Data Warehousing**	**06 hours**

1.1 Basic of Data mining - Techniques , Applications, Issues / Challenges in data mining
1.2 Knowledge Discovery in Databases (KDD)
1.3 Introduction & Basic Concepts of Data warehouse -
Characteristics, Architecture , Data Mart and Data Cubes
1.4 Data Mining Modeling –
1.4.1 Types of OLAP - Different OLAP Operations
1.4.2 OLTP Vs OLAP
1.5 Fact Table and Dimension Table
1.6 Dimensional Data Modeling
1.6.1 Star Schema
1.6.2 Snowflake schema

Chapter 2	**Classification and Regression**	**10 hours**

2.1 Introduction to Decision Tree
2.2. Classification : Introduction
Issues
- Over-fitting
- Tree pruning methods
- Attribute selection Measures

2.3 Types of Classification
2.3.1 Rule-Based Classification
2.3.2 Random Forests
2.3.3 Support Vector Machines (SVM)
2.3.4 K-Nearest neighbors Algorithm and its numerical
2.4 Regression : Introduction
2.5 Types of Regression
2.5.1 Linear regression
2.5.2 Non-linear regression
2.5.3 Logistic Regression

Chapter 3	**Clustering**	**06 hours**

3.1 Basics of Clustering
3.2 Types of Clustering
3.3 Hierarchical clustering
3.3.1 Divisive
3.3.2 Agglomerative
3.4 K-means

Chapter 4	**Association**	**8 hours**

4.1 Introduction
4.2 Association Rule Mining
4.2.1 Support
4.2.2 Confidence
4.2.3 Item sets
4.2.4 Frequent item-sets
4.3 Market Basket Analysis
4.4 Apriori algorithm
Problems based on all above topics.

Reference books

1. Data Mining Concepts and Techniques by Jiawei Han and Micheline Kamber, ELSEVIER, Third Edition, ISBN: 9780123814791, 9780123814807
2. Data Mining : Introductory and Advanced Topics by Margaret Dunham, S. Sridhar, Pearson Publication
3. R and Data Mining, By Yanchang Zhao, Elsevier Inc., ISBN-10: 0123969638
4. Data Mining: Concepts and Techniques, Han, Elsevier ISBN:9789380931913/9788131205358
5. Tom Mitchell, ―Machine Learning‖, McGraw-Hill, 1997
6. Christopher M. Bishop, ―Pattern Recognition and Machine Learning‖, Springer 2006
7. Data Mining: Practical Machine Learning Tools and Techniques by Ian H.Witten, Eibe Frank, McGraw Hill

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT308MJP
Title: Practical based on Data Mining (IT307MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites :

1. Basic knowledge of Python programming.
2. Different types of Algorithms of Data Mining

Course Objectives: -

- To study the basic concepts of Data Mining
- To Implement various data mining algorithms .
- To Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Identify the key processes of data mining
CO2 : Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
CO3: Identify appropriate data mining algorithms to solve real world problems
CO4: Analyze the frequent patterns using association analysis algorithms like apriori etc.
CO5 : Develop ability to design various algorithms based on data mining tools

Course Contents

Assignments 1:- R Programming

R Programs using Decision Making and Loops, Vectors, List, Matrix, Factors, Data Frame.

- Write a R program to calculate the multiplication table using a function.
- Write R Program to find the factorial of a number.
- Write R Program to check 3 digit armstrong number
- Write a R program to find the minimum and the maximum of a Vector. Also sort a Vector in ascending and descending order.
- Write a R program to create two 2x3 matrix and add, subtract, multiply and divide the matrices.

For Following programs Use Jupyter/Spyder notebook or Anaconda Navigator or any IDLE of python on any platform.

Assignments 2:- Data Pre-processing

- Write a Program to implement Data cleaning -find all null values/missing values in a given dataset and remove them. [use any dataset]
- Write a python program to implement Reshaping/Transform data- Conversion of Categorical values in Numeric format for a given dataset.(LabelEncoder or One –Hot Encoder).[use any dataset]

Assignments 3:- Classification

- Write a python program to build a Decision Tree Classifier Model for diabetes dataset.check model accuracy and confusion matrix.
- Write a python program to implement Naive Bayes Classifier Model using Play Tennis to predict [0:overcast,2:Mild,1:normal ,0:Weak] tuple belongs to which class whether play sports or not.

Assignments 4 :- Association Rules

- Write a Python program to read the Iris dataset and apply the Apriori algorithm.
- Write a Python program to apply the Apriori algorithm on the Groceries dataset. Display support, confidence, and lift for each rule.

Assignments 5:- Regression

- Write a program in python to apply simple linear regression and predict the Score of the student if he/she has studied 9 hours.

```
Student={ 'Hours' : [1, 2, 3, 4, 5, 6, 7, 8],
          'Scores': [50, 55, 60, 65, 70, 75, 80, 85] }
```

- Write a program in python to apply multiple linear regression using following dataset and Predict CO2 emissions for a car with engine size 2.5 liters and 6 cylinders

```
x= ([[1.0, 4], [2.0, 6], [3.0, 8], [2.5, 6], [3.5, 8], [4.0, 12]])    # [Engine Size (in liters),
                                                                          Number of Cylinders]
y= ([150, 200, 250, 220, 270, 300]) # CO2 Emissions (in grams per kilometer)
```

Assignments 6 :- Clustering

- Write a python program to implement k-means algorithms on Iris dataset.
- Write a python program to implement hierarchical Agglomerative clustering algorithm.

Reference Books :

1. R and Data Mining, By Yanchang Zhao, Elsevier Inc., ISBN-10: 0123969638
2. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, McGraw Hill

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT309MJ
Title: VB.NET

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Object-Oriented Programming Concepts

Course Objectives: -

- Understand the fundamentals of .NET framework.
- Develop basic to intermediate applications using VB .NET.
- Design user-friendly graphical interfaces.
- Handle data using databases.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Explain the architecture of the .NET framework and the role of VB.NET in application development.

CO2: Develop simple real-world applications integrating GUI, database, and programming logic.

CO3: Connect to databases using ADO.NET.

CO4: Apply debugging and exception handling techniques to build reliable applications.

CO5: Develop programs using VB .NET by applying basic programming constructs such as variables, control structures, and functions.

Course Contents

Chapter 1	**Introduction to the .NET Framework**	**4 hours**

1.1 IDE (Integrated Development Environment)
1.2 Event-Driven Programming
1.3 . NET Framework
1.4 Architecture of .Net
1.5 Execution Process of .Net Application
1.6 Features of .Net and Advantages of .Net
1.7 Develop simple . Net Application

Chapter 2	**Introduction to VB.Net**	**12 hours**

2.1 Basics of VB.Net
  2.1.1 Operators
  2.1.2 Data Types
2.2 Control Structures
  2.2.1 Decision-making statements
  2.2.2 Loops—for, while, do-while, etc.
2.3 Exit Statements
2.4 Build Console Applications
  2.4.1 Methods - Read(), Readline(), Write(), Writeline(), etc.

2.5 Build Windows Applications

2.5.1 Controls - Form, TextBox, Button, Label, CheckBox, ListBox, ComboBox, RadioButton. DateTimePicker, MonthCalender, Timer, Progressbar, Scrollbar, PictureBox, ImageBox, ImageList, TreeView, ListView, Toolbar, StatusBar, Datagridview

2.5.2 Menus and Pop-Up Menus

2.5.3 Predefined Dialog controls

2.5.4 DialogBox - InputBox(), MessageBox(), MsgBox()

Chapter 3	**Object-Oriented Programming in VB .Net**	**6 hours**

3.1 Class and Object
3.2 Properties, methods, and events.
3.3 Constructors and Destructors
3.4 Method overloading
3.5 Inheritance
3.5.1 MyBase , MyClass keywords.
3.6 Access modifiers: Public, Private, Protected, Friend.
3.7 Method Overriding.
3.8 Interfaces.
3.9 Polymorphism
3.10 Exception Handling

Chapter 4	**Architecture Of ADO.Net**	**4 hours**

4.1 Database : Connection, Command, DataAdapter ,DataSet, DataReader, DataTable
4.2 Connection to database with Server Explorer
4.3 Multiple Table Connection
4.4 Data binding with controls like TextBox, ListBox, DataGrid.
4.5 Navigating data source
4.6 DataGridView, DataFormwizard, Data validation

Chapter 5	**Crystal Report**	**4 hours**

5.1 Connection to Database, Table, Queries, Building Report, Modifying Report, Formatting Fields And Object.
5.2 Header, Footer, Working with formula fields, parameter fields, Special fields.
5.3 Working with Multiple Tables.

Reference Books:

1. Programming Microsoft Visual Basic.NET – Francesco Balena
2. The Complete Reference – Visual Basic .NET – Jefrey R. Shapiro
3 · Murach's VB.NET database programming with ADO.NET -Anne Prince and Doug Lowe
4· The Visual Basic.NET COACH
5· Visual Basic .NET 2003 in 21 Days. – Steven Holzner, SAMS Publications.
6· Mastering Crystal Report - BPB Publication
7· Crystal Report – The Complete Reference :- Tata McGraw Hill

E-Books and Online Learning Material

1. https://learn.microsoft.com/en-us/shows/visual-basic-fundamentals-for-absolute-beginners/01
2. https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/2/__PG_MCA_Computer%20Applications_31524%20MCA%20VB.NET%20_8300.pdf
3. https://bcaofficial.wordpress.com/wp-content/uploads/2017/05/vb-net-black-book.pdf

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT310MJP
Title: Practical Based on VB.NET (IT309MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Basic understanding of object-oriented concepts, databases, files, and structured data handling.

Course Objectives: -

- To introduce the fundamentals of VB.NET programming and application development.
- To develop problem-solving skills using basic programming constructs and control structures.
- To apply object-oriented programming concepts in software development.
- To provide practical knowledge of exception handling, file handling, and modular programming.
- To familiarize students with database connectivity using ADO.NET.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Apply basic VB.NET applications using programming fundamentals.
CO2: Write structured programs using functions, modules, and control statements.
CO3: Implement object-oriented concepts such as classes, inheritance, and polymorphism
CO4: connect to databases and retrieve data using ADO.NET.
CO5: Perform file operations and handle exceptions in applications.

Practical Assignments

Assignments :

1. Write a VB.NET program to check Addition of two numbers and out an appropriate message to the user.
2. Write a VB.NET program which will find all such numbers which are divisible by 5.
3. Write a VB.NET program which can compute the factorial of a given numbers.
4. Write a VB.NET program that reads a number from the user and calculates its square root. Handle the exception if the number is negative.)
5. Write a VB.NET program to demonstrate inheritance by creating a base class and a derived class and displaying their functionality.
6. Create a class in VB.NET with properties and methods. Instantiate the object and display the output to demonstrate OOP concepts.
7. Write a VB.NET program to demonstrate polymorphism using method overriding.
8. Write a program in VB.NET to implement ADO.NET architecture using SqlConnection, SqlCommand, and SqlDataReader to fetch and display records from a database.
9. Write a VB.NET program to demonstrate disconnected architecture of ADO.NET using DataAdapter and DataSet.
10. Write a VB.NET program to create a file, write data into it, and read the contents from the file.
11. Write a VB.NET program to write student details into a text file and display them.
12. Write a program in VB.NET to append data to an existing file and read all records.
13. Write a VB.NET program to count the number of lines in a file.
14. Write a VB.NET program using a Module to perform arithmetic operations using functions.
15. Create a Module in VB.NET and call its procedures from the Main method.

16. Write a program to demonstrate the use of Sub procedure and Function in a Module.
17. Write a VB.NET program to demonstrate the use of Modules and procedures (Sub and Function).

Reference Books:

1. Programming Microsoft Visual Basic.NET – Francesco Balena
2. The Complete Reference – Visual Basic .NET – Jefrey R. Shapiro
3 · Murach's VB.NET database programming with ADO.NET -Anne Prince and Doug Lowe
4· The Visual Basic.NET COACH
5· Visual Basic .NET 2003 in 21 Days. – Steven Holzner, SAMS Publications.
6· Mastering Crystal Report - BPB Publication
7· Crystal Report – The Complete Reference :- Tata McGraw Hill

E-Books and Online Learning Material :

1. https://learn.microsoft.com/en-us/shows/visual-basic-fundamentals-for-absolute-beginners/01
2. https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/2/__PG_MCA_Computer%20Applications_31524%20MCA%20VB.NET%20_8300.pdf
3. https://bcaofficial.wordpress.com/wp-content/uploads/2017/05/vb-net-black-book.pdf

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT321VSC
Title: Web Application Development

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Basic knowledge of computer fundamentals and operating systems
2. Understanding of programming concepts (variables, conditions, loops)
3. Basic knowledge of database concepts and SQL

Course Objectives: -

- · Understand the fundamentals of web technologies and web architecture
- · Design and develop static web pages using HTML and CSS
- · Implement client-side scripting using JavaScript for interactivity
- · Develop server-side applications using PHP
- · Integrate web applications with databases
- Introduce modern concepts like JSON, AJAX, and Web Services

Course Outcomes: -

After completing the course, students will be able to:

CO1 : Design structured web pages using HTML5
CO2 : Apply styling and layout using CSS3 and responsive design techniques
CO3 : Develop interactive web pages using JavaScript
CO4 : Build dynamic web applications using PHP
CO5 : Perform database operations (CRUD) through web interfaces
CO6 : Understand and use JSON, AJAX, and basic API concepts

Course Contents

Chapter 1	**Basics of Web & HTML5**	**6 hours**

1.1 Introduction to Internet and Web: Definition of Internet, World Wide Web (WWW), Difference between Internet and Web.
1.2 Web Browsers and Web Servers: Types of web browsers, Working of browsers, Introduction to web servers.
1.3 Structure of Web Page: Basic HTML document structure, DOCTYPE declaration, Head and Body sections.
1.4 HTML Basics: Tags and elements, Attributes, Empty and container tags.
1.5 Text Formatting and Lists: Headings, paragraphs, formatting tags (bold, italic, underline, superscript, subscript), Ordered, unordered and definition lists.
1.6 Tables, Links and Images: Table structure and attributes, Merging rows and columns, Anchor tag and hyperlinks, Internal and external links, Image tag and attributes.
1.7 Introduction to HTML5: New features of HTML5, Semantic elements.

Chapter 2	CSS3 & Responsive Design	6 hours

2.1 Introduction to CSS: Purpose, Advantages of CSS.
2.2 Types of CSS: Inline, Internal and External CSS.
2.3 CSS Selectors and Properties: Element, class and ID selectors, Grouping selectors, Basic styling properties.
2.4 Colors, Fonts and Backgrounds: Text colors, Background colors, Font properties, Background images.
2.5 CSS Box Model: Margin, Border, Padding and Content.
2.6 Layout Techniques: Display property, Positioning (static, relative, absolute).
2.7 Responsive Design: Concept of responsive design, Introduction to media queries.

Chapter 3	JavaScript (Client-Side Scripting)	7 hours

3.1 Introduction to JavaScript: Features and uses in web development.
3.2 Variables and Data Types: Declaration of variables, Data types (number, string, boolean).
3.3 Operators and Expressions: Arithmetic, logical and comparison operators.
3.4 Control Statements: if, if-else, loops (for, while).
3.5 Functions: Function definition and function calling.
3.6 Events and Event Handling: Types of events, Event handling methods.
3.7 DOM Manipulation: Accessing elements, Changing content and styles.
3.8 Form Validation: Validation of input fields such as name, email and password.

Chapter 4	PHP & Database Integration	7 hours

4.1 Introduction to PHP: Features and basic syntax of PHP.
4.2 Variables and Operators: Variable declaration, Types of operators.
4.3 Control Statements: if, if-else, loops in PHP.
4.4 Functions: User-defined and built-in functions.
4.5 Form Handling: GET and POST methods.
4.6 Sessions and Cookies: Concept and usage of sessions and cookies.
4.7 Database Connectivity: Connecting PHP with MySQL, Executing queries.
4.8 CRUD Operations: Insert, retrieve, update and delete operations.
4.9 Displaying Records: Fetching data from database and displaying in web pages.

Chapter 5	Modern Web Concepts	4 hours

5.1 Introduction to JSON: Definition and advantages of JSON.
5.2 JSON Syntax and Usage: JSON objects and arrays.
5.3 AJAX Concept: Introduction to AJAX and its advantages.
5.4 Web Services: Introduction and types of web services.
5.5 REST API Overview: Concept and basic working of REST APIs.

Reference Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications.
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley Publications.
3. Jon Duckett, PHP & MySQL: Server-Side Web Development, Wiley Publications.
4. Julie C. Meloni, Sams Teach Yourself HTML, CSS, and JavaScript All in One, Pearson.
5. DT Editorial Services, HTML5 Black Book, Dreamtech Press.

E-Books and Online Learning Materia1.

1. **https://www.w3schools.com/**
2. **Introduction to Modern Application Development - https://nptel.ac.in/courses/106106156**
3. **Modern Application Development-https://nptel.ac.in/courses/106106222**

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT331FP
Title: Project

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

- Knowledge of Software Development Life Cycle (SDLC)
- Understanding of system analysis and design concepts
- Familiarity with database concepts and data organization
- Basic knowledge of computer applications and tools
- Understanding of problem-solving and logical thinking techniques
- Ability to work in a team and communicate effectively

Course Objectives: -

- To enable students to apply theoretical knowledge to real-world problem solving.
- To develop skills in requirement analysis, system design, and implementation.
- To provide hands-on experience in software development using appropriate tools and technologies.
- To enhance teamwork, collaboration, and project management skills.
- To train students in preparing professional project documentation and presentations.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Identify real-world problems and define appropriate project objectives and scope.
CO2: Analyze system requirements and design solutions using suitable methodologies and tools.
CO3: Develop and implement a software application using appropriate programming languages and technologies.
CO4: Design and manage databases effectively for the project system.
CO5: Demonstrate teamwork, communication, and project presentation skills.
CO6: Prepare structured project documentation following academic standards.

Project Guidelines

- Students can choose a project topic and implement the same using any language/technology covered in the curriculum so far. The operating environment must be windows.
- Students should work in a team of maximum 3 students.
- Each student within the group must work actively and contribute to the project work.
- The student group will work independently throughout the project work including: Preliminary investigation, Requirement specification, database design and system design.
- Project guide must conduct project presentations (minimum 2) to monitor the progress of the project groups.
- At the end of the project, the group should prepare a report which should conform to academic standards.
- The final project presentation with demonstration (UE) will be evaluated by the project guide (appointed by the college) and one external examiner (appointed by the University).

- All points in the project index, is a compulsory part for the project evaluation and should be carried out by each project group.
- The report should follow index as –

INDEX

Sr. No.	Title	Page No.	Signature of the Instructor
1	**Preliminary Investigation** 1.1 Problem Identification 1.2 Problem Statement / Definition 1.3 Purpose/objective and goals 1.4 Feasibility study 1.5 Project Scope and Limitations		
2	**Requirement Specification** 2.1 System Requirement - Software/hardware specifications - Platform, RAM, Memory storage (if required - specification of server / device) 2.2 Technical Requirement - Programming language, Tools if any 2.3 Functional Requirements 2.4 Data Requirements (As per the project requirement, student can include - Performance requirement & security requirements etc.)		
3	**Database Design** 3.1 Identify end users of the system 3.2 Identify the entities and attributes through ER diagrams 3.3 Identify all tables, fields, relationships between table		
4	**System Design** 4.1 Class diagram 4.2 Object diagram 4.3 Component diagram 4.4 Deployment diagram 4.5 Use case diagram 4.6 Activity diagram 4.7 Sequence diagram		
5	**Screenshots of Input and Output screens**		
6	**Bibliography / References**		

Evaluation Guidelines:

CE (15 Marks)		EE (35 Marks)		
First Presentation	**Second Presentation**	**Project Logic / Presentation**	**Project Documentation**	**Viva**
7	**8**	**15**	**10**	**10**

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT341MN
Title: Network Infrastructure & Operations Management

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Fundamental and advanced concepts of Computer Networking

Course Objectives: -

- To understand the fundamentals of enterprise network infrastructure, including architecture, devices, cabling, data centers, and topology design.
- To develop the ability to plan and design IP addressing schemes, perform subnetting, and understand network deployment processes using DHCP and DNS.
- To gain knowledge of configuring and managing network services.
- To learn techniques for monitoring network performance using key metrics, tools.
- To apply network operations and maintenance practices including preventive maintenance, configuration and change management, incident handling, and proper documentation.

Course Outcomes: -

After completing the course, students will be able to:

CO1 : Understand enterprise network components and architecture.

CO2 : Plan and design IP allocation in enterprise networks.

CO3 : Configure and manage enterprise network services.

CO4 : Monitor and analyze network performance.

CO5 : Apply operational practices in network management.

Course Contents

Chapter 1	**Enterprise Network Infrastructure**	**6 hours**

1.1 Definition : Enterprise Network Architecture Overview, Three-Tier Hierarchical Mode, Core Hardware, Edge & Security

1.2 Role of routers, switches, servers in organizations: Roles, Key Functions

1.3 Structured cabling concepts:

1.4 Data center basics

Chapter 2	**IP Planning & Network Deployment**	**6 hours**

2.1 IP addressing planning in organizations : Concept of IP addressing (IPv4 & IPv6 basics)

Public vs Private IP addresses, IP address classes (Class A, B, C), Need for IP planning in enterprises

IP address hierarchy and allocation strategy

Static vs Dynamic IP addressing

Address exhaustion and introduction to IPv6

2.2 Subnet allocation : Subnet mask and CIDR notation, Subnet calculation

2.3 DHCP configuration concepts

2.4 DNS: working principle, Need for DNS, Hierarchical structure

Chapter 3	Network Services & Configuration	6 hours
3.1 VLAN concepts, implementation, advantages 3.2 File and print services: Definition and purpose, Centralized file storage, File sharing in network (server-client model) , Access permissions (read, write, execute) 3.3 Proxy server 3.4 Client-server configuration : concept components 3.5 Backup and restoration procedures: need, types of backups, storage methods		
Chapter 4	**Network Monitoring & Performance Management**	**6 hours**
4.1 Network performance key parameters, factors affecting performance 4.2 Bandwidth monitoring : concepts , techniques and benefits 4.3 Log management: basics, types, log management process 4.4 Network monitoring tools overview : types of tools , wireshark 4.5 Troubleshooting methodologies : steps in troubleshooting		
Chapter 5	**Network Operations & Maintenance**	**6 hours**
5.1 Preventive maintenance 5.2 Configuration management 5.3 Change management process 5.4 Incident reporting 5.5 Network documentation standards		

Reference Books:

1. Andrew S. Tanenbaum, David J. Wethrall, Computer Network, Pearson Education, ISBN : 978-0- 13-212695-3
2. Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill Education, ISBN: 978-0-07-337622-6
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson Education, ISBN: 978-0-13-359414-0
4. Mani Subramanian, Network Management: Principles and Practice, Pearson Education, ISBN: 978-81-7758-802-4

E-Books and Online Learning Material

Unit 1: Enterprise Network Infrastructure

E-Content :

1. Enterprise Network Architecture Overview (Cisco learning material)
   https://www.cisco.com/c/en_in/solutions/enterprise-networks/index.html [youtube.com]
2. Three-Tier Architecture Explained
   https://www.geeksforgeeks.org/three-tier-architecture/ [e-booksdirectory.com]
3. Data Center Basics
   https://www.ibm.com/topics/data-center [archive.org]

Free Online Books:

- **An Introduction to Computer Networks – Peter Dordal (FREE PDF)**
  https://www.dbooks.org/an-introduction-to-computer-networks-1226/ [dbooks.org]
- **Computer Networks – Tanenbaum (Archive.org – Open access)**
  https://archive.org/details/computer-networks-tanenbaum [archive.org]

Unit 2: IP Planning & Network Deployment

E-Content:

- IP Addressing & Classes
  https://www.geeksforgeeks.org/ip-addressing-introduction/ [cs.colostate.edu]
- Subnetting Explained
  https://www.geeksforgeeks.org/introduction-to-subnetting/ [Chapter 8:...orks - CNL]

- DHCP & DNS Basics
  https://www.cloudflare.com/learning/dns/what-is-dns/ [wireshark.org]

Free Online Books

- **IP Addressing & Subnetting (Workbook – Free PDF)**
  https://anyflip.com/xmawh/qull/basic [anyflip.com]
- **Subnetting – Free PDFs Collection**
  https://www.ebooknetworking.net/ebooks/subnetting.html [ebooknetworking.net]

Unit 3: Network Services & Configuration

E-Content

- VLAN Concepts (Cisco)
  https://www.cisco.com/c/en/us/tech/lan-switching/vlan/index.html [youtube.com]
- Client-Server Model
  https://www.geeksforgeeks.org/client-server-model/ [e-booksdirectory.com]
- Backup & Restore Basics
  https://www.ibm.com/topics/data-backup [archive.org]

Free Books

- **Analytical Network & System Administration – Mark Burgess**
  https://e-booksdirectory.com/details.php?ebook=7096 [e-booksdirectory.com]
- **Linux Networking (Free Book)**
  https://www.linux.org/threads/linux-networking-guide.11316/ [freecomput...rbooks.com]

Unit 4: Network Monitoring & Performance Management

E-Content

- **Wireshark Official Free Learning**
  https://www.wireshark.org/learn/ [wireshark.org]
- Wireshark Free Labs (Hands-on)
  https://labex.io/free-labs/wireshark [labex.io]
- Network Troubleshooting Steps
  https://www.geeksforgeeks.org/network-troubleshooting-steps/ [tutorials....diaket.net]

Free Books

- **Network Monitoring Fundamentals (Cisco PDF)**
  https://cs.petrsu.ru/~vadim/books/Network%20Management%20Fundamentals.pdf [cs.petrsu.ru]

Unit 5: Network Operations & Maintenance

E-Content

- ITIL Network Operations Basics
  https://www.bmc.com/blogs/itil-network-management/ [archive.org]
- Network Documentation Standards
  https://www.lucidchart.com/pages/network-diagram [open.umn.edu]

Free Books

- **ICT Infrastructure Management – FREE (Archive.org)**
  https://archive.org/details/ictinfrastructur0000unse_i3q8 [archive.org]
- **Fundamentals of Infrastructure Management (Open Textbook)**
  https://open.umn.edu/opentextbooks/textbooks/528 [open.umn.edu]

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT341MN
Subject: Cloud Computing Security and Management

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/ week	2	CE: 15 marks EE: 35 marks

Prerequisites

1. Understanding of cloud computing fundamentals (IaaS, PaaS, SaaS)
2. Basic idea of operating systems and virtualization.
3. Familiarity with basic security concepts (authentication, encryption)

Course Objectives: -

- To understand advanced concepts of cloud computing and its architecture
- To learn cloud security frameworks, threats, and protection mechanisms
- To develop knowledge of cloud governance, compliance, and risk management
- To study cloud services, deployment strategies, and management techniques
- To analyze real-world cloud platforms and security practices

Course Outcomes: - Student will be able to: -

CO1: Explain advanced concepts of cloud computing and cloud architecture
CO2: Identify cloud security threats and apply appropriate security mechanisms
CO3: Apply cloud security frameworks and access control techniques
CO4: Analyze cloud governance, risk management, and compliance issues
CO5: Evaluate cloud services and implement secure cloud-based solutions

Course Contents

Chapter 1	**Advanced Cloud Computing Concepts**	**5 hours**

1.1 Cloud Architecture (Front-end & Back-end, Layered Architecture)
1.2 Virtualization vs Containerization (Docker Basics)
1.3 Microservices Architecture in Cloud
1.4 Cloud Deployment Design and Multi-Cloud Concept

Chapter 2	**Cloud Security Frameworks and Controls**	**7 hours**

2.1 Introduction to Cloud Security
2.2 Security Threats and Risks in Cloud Environment (Data Loss, Hacking, etc.)
2.3 Authentication and Authorization
2.4 Data Security and Encryption Basics

Chapter 3	**Advanced Cloud Concepts and Specialized Services**	**7 hours**

3.1 Cloud Migration Strategies
3.2 Service Level Agreements (SLA) in Cloud
3.3 Multi-Tenancy and Data Isolation Techniques.
3.4 Cloud Storage Types and Data Lifecycle Management

Chapter 4	**Cloud Security Management and Case Studies**	**5 hours**

4.1 Security Policies and Risk Management
4.2 Backup and Disaster Recovery
4.3 Identity and Access Management (IAM)
4.4 Case Studies (AWS, Azure, Google Cloud Basics)

Reference Books:

1. **Cloud Security and Privacy –** Tim Mather, Subra Kumaraswamy, Shahed Latif
2. **Cloud Computing: Concepts, Technology & Architecture –** Thomas Erl, Ricardo Puttini, Zaigham Mahmood.
3. **Security in Computing** – Charles P. Pfleeger, Shari Lawrence Pfleeger

E-Books and Online Learning Material

1. **GeeksforGeeks – Cloud Security:** https://www.geeksforgeeks.org/software-engineering/cloud-computing-security/ Covers cloud security concepts, threats, and controls (preventive, detective, corrective)
2. **GeeksforGeeks – AWS Cloud Security Model** https://www.geeksforgeeks.org/security-model-of-aws-cloud/ Explains shared responsibility model, IAM, and security practices.

Semester-VI

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT351MJ
Title: Data Analysis Tools

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Basic knowledge of Python programming
2. Understanding of NumPy and Pandas libraries
3. Familiarity with data visualization concepts
4. Basic knowledge of statistics (mean, median, graphs)
5. Fundamental understanding of Exploratory Data Analysis (EDA)

Course Objectives: -

- To develop the ability to analyze, preprocess, and interpret data using modern tools
- To introduce students to advanced data analysis techniques and visualization methods
- To enable students to build interactive dashboards and reports
- To provide exposure to statistical analysis and basic machine learning concepts
- To prepare students for real-world data-driven problem solving

Course Outcomes: -

After completing the course, students will be able to:

CO1: Perform advanced data preprocessing and cleaning
CO2: Apply data transformation and wrangling techniques
CO3: Create advanced and interactive data visualizations
CO4: Use statistical methods and hypothesis testing for data analysis
CO5: Apply basic machine learning techniques for prediction and analysis
CO6: Develop end-to-end data analysis solutions using real-world datasets

Course Contents

Chapter 1	**Advanced Data Preprocessing & Wrangling**	**5 hours**

1.1 Data Preprocessing Concepts:
Data cleaning, transformation, normalization, handling inconsistencies.
1.2 Handling Missing and Noisy Data:
Imputation techniques (mean, median, mode), outlier handling.
1.3 Data Transformation Techniques:
Scaling, encoding (label, one-hot), feature transformation.
1.4 Advanced Data Wrangling using Pandas:
Merging, joining, concatenation, pivot tables.
1.5 Working with Large Datasets:
Efficient data handling and performance considerations

Chapter 2	**Advanced Data Visualization & Dashboarding**	**6 hours**

2.1 Advanced Visualization Concepts:

- Introduction to charts & Chart selection criteria
- Comparison chart - Bar chart, column chart
- Trend over time chart - Line chart, area chart
- Distribution chart - Histogram, box plot

- Relationship chart - Scatter plot, Pair plot
- Composition chart - Pie chart, stacked bar
- Correlation chart -Scatter plot, heatmap

2.2 Interactive Visualization:
Introduction to Plotly (interactive charts).
2.3 Dashboard Creation:
Introduction to dashboards and layout design.
2.4 Introduction to BI Tools:
Creating dashboards using Excel / Power BI (basic).

Chapter 3	**Statistical Analysis & Hypothesis Testing**	**7 hours**

3.1 Introduction of Descriptive Statistics:
Mean, median, variance, standard deviation.
3.2 Inferential Statistics:
Concept of sampling and probability, Probability rules , Random variables , Probability distributions -Normal distribution & Binomial distribution
3.3 Hypothesis Testing:
Null hypothesis, Alternative hypothesis, p-value, Errors in Hypothesis Testing- Type I Error, Type II Error
3.4 Statistical Tests:
Z-test, T-test, Chi-square test
3.5 Correlation and Regression Analysis:
Linear regression, Logistic Regression, Multiple Regression, Correlation interpretation.

Chapter 4	**Introduction to Machine Learning for Data Analysis**	**7 hours**

4.1 Machine Learning Overview:
Introduction of Machine Learning, Types of machine learning - Supervised , Unsupervised & Reinforcement machine learning, Machine Learning Workflow
4.2 Key concepts & Data Preparation for ML:
Basic concepts for analysis - Feature, Target, Training, Testing, Overfitting, Underfitting. Train-test split, feature selection.
4.3 Supervised Learning:
Linear Regression, Classification basics.
4.4 Unsupervised Learning:
Clustering (K-means concept).
4.5 Model Evaluation:
Regression Metrics :- Mean Absolute Error (MAE) , Mean Squared Error (MSE) , R^2 score
Classification Metrics : Accuracy, Precision, Recall, F1-score, Confusion matrix

Chapter 5	**Data Analysis Applications & Tools**	**5 hours**

5.1 Introduction to APIs for Data Analysis: Fetching data using APIs
5.3 Automation in Data Analysis: Scheduling scripts, report generation.
5.4 Introduction to Big Data Concepts and tools
5.5 Case Study:
End-to-end data analysis project (data cleaning → visualization → insights)

Reference Books:

1. Python for Data Analysis – Python for Data Analysis
2. Hands-On Machine Learning with Scikit-Learn & TensorFlow – Hands-On Machine Learning with Scikit-Learn and TensorFlow
3. Practical Statistics for Data Scientists – Practical Statistics for Data Scientists
4. Data Science from Scratch – Data Science from Scratch

E-Books and Online Learning Material

1. Python for Data Science Handbook (Online)- https://jakevdp.github.io/PythonDataScienceHandbook/
2. Data Analytics with Python- https://nptel.ac.in/courses/106107220
3. Python for Data Science- https://nptel.ac.in/courses/106106212

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT352MJ
Title: Software Testing

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Fundamental concepts of computers
2. Basic knowledge of algorithms, problem solving, expected inputs/outputs
3. Basics of Software Engineering.
4. Software Engineering Paradigms

Course Objectives: -

- To study fundamental concepts of software testing.
- To discuss various software testing issues.
- To learn to manage software problems and defects.
- To learn to generate a testing report.
- To provide the knowledge of software testing techniques
- To understand how testing methods can be used as an effective tools in quality assurance of software.
- To provide skills to design test case plan for testing software.
- To provide knowledge of latest testing methods

Course Outcomes: -

After completing the course, students will be able to:

CO1: CO1: Students will be able to apply software testing knowledge and engineering methods.
CO2: Students will be able to plan test cases.
CO3: Students will be able to design test cases.
CO4: Students will be able to design defect report and To design test cases and test plans, review reports of testing for qualitative software.
CO5: To understand various software testing methods and strategies.
CO6: To understand latest testing methods used in the software industries.

Course Contents

Chapter 1	**Introduction to Software Testing**	**5 hours**

1.1 Introduction to Software testing
1.2 Testing objectives
1.3 Principles of testing
1.4 Testing fundamentals and debugging
1.5 V-V Model (Verification and Validation)

Chapter 2	**Testing Techniques**	**6 hours**

2.1 Introduction to :-

- White Box Testing
- Black Box Testing
- Gray Box Testing

2.2 Types of white box testing , black box testing
2.3 Differences between BBT & WBT

Chapter 3	Software Testing Strategies (Testing Levels)	8 hours

3.1 Software Testing Process
3.2 Testing Levels :-

- Unit Testing
- Integration Testing (Top-down, Bottom up)
- System Testing
- Acceptance Testing
- Regression Testing
- Smoke Testing

Chapter 4	Software Development Models	8 hours

Software Development Models

- Waterfall Model
- V-Model
- Agile Model
- Spiral Model

Software Development Life Cycle (SDLC)
Software Testing Life Cycle (STLC)

Chapter 5	Automation Testing	3 hours

Introduction to Automation

- Manual vs Automation Testing
- Automation Tools (e.g., Selenium)

Reference Books:

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705
2. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st edition, ISBN10: 8131705625, ISBN-13: 978-8131705629 Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th edition, ISBN-10: 9780132492645, ISBN-13: 978- 0132492645
3. Python Programming: A modular approach, Taneja Sheetal and Kumar Naveen, First edition, Pearson India, 2017, ISBN: 978-9332585348

E-Books and Online Learning Material

1. https://www.w3schools.com/python/
2. The Joy of Computing using Python - https://nptel.ac.in/courses/106/106/106106182/
3. Programming, Data Structures and Algorithms using Pythonhttps://nptel.ac.in/courses/106/106/106106145/

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT353MJ
Title: Advanced Java

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Core Java concepts

Course Objectives: -

- To know the concept of Java Programming.
- To understand how to use programming in day to day applications.
- To develop programming logic

Course Outcomes: -

After completing the course, students will be able to:

CO1 : Students will know the concepts of JDBC Programming
CO2 : Students will know the concepts of Spring and Hibernate
CO3: Students will develop the project by using JSP and JDBC.
CO4 : Students will develop applications in Spring and hibernate

Course Contents

Chapter 1	**Collection Framework**	**4 hours**

1.1 Introduction to the Collection framework
1.2 List ArrayList, LinkedList
1.3 Set - HashSet, TreeSet,
1.4 Map - HashMap and TreeMap
1.5 Interfaces such as Comparator, Iterator, ListIterator, Enumeration

Chapter 2	**Multithreading**	**5 hours**

2.1 Introduction to Multithreading.
2.2 Thread creation: Thread Class, Runnable Interface.
2.3 Life cycle of Thread.
2.4 Thread Priority.
2.5 Execution of Thread Application.
2.6 Synchronization and Inter thread communication

Chapter 3	**JDBC**	**6 hours**

3.1 Introduction
3.2 JDBC Architecture.
3.3 JDBC Process
3.4 Working with ResultSet Interface.
3.5 JDBC Metadata

Chapter 4	Servlet and JSP	7 hours

Servlet

5.1 Introduction to Servlet
5.2 Types of Servlet: Generic Servlet and Http Servlet
5.3 Life cycle of servlet
5.4 Session Tracking.
5.5 Servlet with database.

JSP

5.6 Introduction to JSP.
5.7 JSP Life Cycle.
5.8 Components of JSP.
5.9 JSP with Database

Chapter 5	Spring Framework	8 hours

6.1 Introduction of Spring framework
6.2 Spring Modules / Architecture
6.3 Spring Applications
6.4 Spring MVC
6.5 Spring MVC Forms, Validation
6.6 Hello World Example

Reference Books:

Text Books:

1. Programming with JAVA - E Balgurusamy
2. The Complete Reference – JAVA Herbert Schildt

References:

1. The Complete Reference – JAVA Herbert Schildt
2. Professional Hibernate, by Eric Pugh, Joseph D. Gradecki by Wiley Publishing, Inc., ISBN: 0- 7645-7677-1
3. Spring In Action, Craig Walls, Ryan Breidenbach, Manning Publishing Co., ISBN: 1- 932394- 35-4
4. Head First Servlets and JSP: Passing the Sun Certified Web Component Developer Exam -2nd Edition-Bryan Basham, Kathy Sierra, Bert Bates- O'REILLY

E-Books and Online Learning Material

1. https://www.w3schools.com/python/
2. The Joy of Computing using Python - https://nptel.ac.in/courses/106/106/106106182/
3. Programming, Data Structures and Algorithms using Python https://nptel.ac.in/courses/106/106/106106145/

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT354MJ
Title: Soft Computing

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Knowledge of Set Theory
2. Problem solving skills and critical thinking

Course Objectives: -

- to give the basic ideas behind soft computing methods including fuzzy logic, neural networks and genetic algorithms
- to gain knowledge about fuzzy set theory and how it may be used to solve problems in the real world.
- to impart understanding of artificial neural networks and their structures in order to address challenging issues.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Understand the basic concepts of soft computing and its components.
CO2: Apply fuzzy logic principles to solve real-life problems.
CO3 : understand the basic concepts of Neural Network
CO4: Understand and apply Genetic Algorithms for optimization problems.
CO5: Compare soft computing techniques with traditional computing methods

Course Contents

Chapter 1	**Introduction to Soft Computing**	**3 hours**

1.1 Introduction
1.2 Soft Computing Versus Hard Computing
1.3 Various Types of Soft Computing Techniques.
1.4 Applications of Soft Computing

Chapter 2	**Fuzzy Logic**	**15 hours**

2.1 Introduction
2.2 Overview of Conventional Set Theory
2.3 Fuzzy Sets, Properties of Fuzzy Sets,
2.4 Classical Sets, Properties of Classical Sets
2.5 Cartesian Product
2.6 Crisp Relations, Fuzzy Relations
2.7 Membership Functions, Features of the membership Function
2.8 Fuzzy Max-Min and Max-Product Composition,
2.9 Fuzzification, Defuzzification to Crisp Sets
2.10 λ-Cuts for Fuzzy Relations.
2.11 Fuzzy (Ruled-Based) system,
2.12 Applications of Fuzzy Logic

Chapter 3	**Neural Network**	**6 hours**
3.1 Introduction 3.2 Biological Neural Network, 3.3 Artificial Neural Network, 3.4 Comparison Between Biological Neuron and Artificial Neuron (Brain vs. Computer) 3.5 Neural Networks Architectures: Feedforward and Feedback, 3.6 Applications of Neural Network		
Chapter 4	**Genetic Algorithms**	**6 hours**
4.1 Introduction 4.2 How are Genetic Algorithms different from Traditional Methods?, 4.3 Basic terminologies in Genetic Algorithm 4.4 Operators in Genetic Algorithm 4.5 A simple Genetic Algorithm 4.6 Applications of Genetic Algorithms		
Reference Books:		
1. Fuzzy Logic With Engineering Applications, 3rd Edition By Timothy Ross , Wiley Publication 2. Neural Networks By Satish Kumar, Tata McGraw Hill 3. Introduction to Soft Computing by Deepa &Shivanandan, Wiley Publication 4. Genetic Algorithms in Search, Optimization and Machine Learning By David E.Goldberg,Pearson Education		
E-Books **https://pzs.dstu.dp.ua/logic/bibl/engineering.pdf (Fuzzy Logic Book)**		

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT355MJP
Title: Practical Based on Data Analysis Tools (IT351MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Fundamentals of computer operations and file handling
2. Basic understanding of Python programming (variables, loops, functions)
3. Introduction to data handling using Pandas
4. Basic concepts of statistics (mean, median, graphs)
5. Familiarity with MS Excel for simple data operations

Course Objectives: -

- To develop skills in data preprocessing and wrangling for real-world datasets.
- To enable students to create effective visualizations and interactive dashboards.
- To build understanding of statistical analysis and hypothesis testing for decision-making.
- To introduce fundamental concepts of machine learning for data analysis.
- To provide hands-on experience with modern data analysis tools, APIs, and automation techniques.
- To train students to perform end-to-end data analysis projects from data collection to insights.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Apply data preprocessing techniques for data cleaning and preparation.
CO2: Create and interpret visualizations and dashboards using modern tools.
CO3: Perform statistical analysis and hypothesis testing.
CO4: Implement basic machine learning models for prediction and classification.
CO5: Use APIs and automation for efficient data collection and processing.
CO6: Execute end-to-end data analysis projects to generate insights.

Practical Assignments

Assignment 1: Handling Missing Data

- Load a dataset and Identify missing values.
- Apply mean, median, and mode imputation.
- Compare the impact of each method.

Assignment 2: Outlier Detection

- Detect outliers using IQR and Z-score methods.
- Visualize outliers using box plots.
- Treat or remove outliers and justify your approach.

Assignment 3: Data Transformation

- Apply normalization (Min-Max scaling).
- Apply standardization.
- Compare results and explain differences.

Assignment 4: Encoding Techniques

- Perform label encoding on categorical data.
- Apply one-hot encoding.
- Compare both techniques with examples.

Assignment 5: Data Wrangling using Pandas

- Merge two datasets using different join types.
- Create pivot tables for analysis.
- Concatenate multiple datasets.

Assignment 6: Chart Selection & Creation

- Create bar, line, histogram, and scatter plots.
- Choose appropriate charts for different data scenarios.
- Provide justification for each chart.

Assignment 7: Correlation & Heatmap

- Compute correlation matrix.
- Visualize using heatmap.
- Interpret relationships between variables.

Assignment 8: Interactive Visualization

- Create interactive charts using Plotly.
- Add filters or hover effects.
- Compare static vs interactive charts.

Assignment 9: Dashboard Development

- Create a dashboard in Excel or Power BI.
- Include KPIs, charts, and slicers.
- Summarize insights from the dashboard.

Assignment 10: Descriptive Statistics

- Calculate mean, median, variance, and standard deviation.
- Plot distribution of data.
- Interpret results.

Assignment 11: Probability & Distribution

- Simulate a normal distribution.
- Perform a binomial experiment.
- Explain real-world applications.

Assignment 12: Hypothesis Testing

- Define null and alternative hypotheses.
- Perform a T-test or Z-test.
- Interpret p-value and conclusion.

Assignment 13: Regression Model

- Build a linear regression model.
- Evaluate using MAE, MSE, and R^2.
- Interpret results.

Assignment 14: Classification & Clustering

- Build a classification model.
- Evaluate using confusion matrix and F1-score.
- Apply K-means clustering and visualize clusters.

Assignment 15: End-to-End Project

- Collect data (CSV/API).
- Clean and preprocess data.
- Perform visualization and statistical analysis.
- Build a simple ML model.
- Create a dashboard.
- Present final insights and recommendations.

Reference Books:

1. Python for Data Analysis – Python for Data Analysis
2. Hands-On Machine Learning with Scikit-Learn & TensorFlow – Hands-On Machine Learning with Scikit-Learn and TensorFlow
3. Practical Statistics for Data Scientists – Practical Statistics for Data Scientists
4. Data Science from Scratch – Data Science from Scratch

E-Books and Online Learning Material

1. Python for Data Science Handbook (Online)- https://jakevdp.github.io/PythonDataScienceHandbook/
2. Data Analytics with Python- https://nptel.ac.in/courses/106107220
3. Python for Data Science- https://nptel.ac.in/courses/106106212

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT356MJP
Title: Practical Based on Advanced Java (IT353MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

Students should know basic programming concepts of JAVA

Course Objectives: -

- To learn implementation of object-oriented concepts with Java
- To understand collection
- To know the process of Web development using Graphical User Interface (GUI).
- Bringing uniformity in the way course is conducted across different colleges.
- Continuous assessment of the students.
- Advanced Java is designed to develo p web based, network centric, Enterprise level applications

Course Outcomes: -

After completing the course, students will be able to:

CO1: Learn database Programming using Java
CO2: Understand and Create dynamic web pages using Servlets and JSP.
CO3: Work with basics of framework to develop secure web applications.

Practical Assignments

Assignment 1 : Collection

- Study the Collection framework in java.
- To implement various Interfaces and classes through algorithms.
- To Demonstrate Cursor Objects (Enumeration, Iterator, List Iterator, Comparator)

Assignment 2: Database Connectivity

- To communicate with a database using java.
- To execute queries on tables.
- To obtain information about the database and tables.

Assignment 3 : Networking and Multithreading:

- Implementing client-server communication using Socket and ServerSocket.
- Developing multi-threaded server applications to handle multiple clients simultaneously.

Assignment 4: Servlet

- To understand server-side programming.
- Simple steps to create and execute servlets.
- How to pass parameters using doGet and doPost methods.
- Handling data from HTML to servlet .
- How to connect a servlet to a database .
- Use of various session tracking methods like Cookies.

Assignment 5 : Java Server Pages

- JSP life-cycle.
- Use of JSP implicit objects.
- JSP Directives.
- Use of Scripting Elements.
- To understand action tags in JSP.
- Understanding flow of JSP custom tags.

Assignments 6:- Spring Framework

- To create and understand the steps to develop Spring application

Text Books:

1. Programming with JAVA - E Balgurusamy
2. The Complete Reference – JAVA Herbert Schildt

References:

1. The Complete Reference – JAVA Herbert Schildt
2. Professional Hibernate, by Eric Pugh, Joseph D. Gradecki by Wiley Publishing, Inc., ISBN: 0- 7645-7677-1
3. Spring In Action, Craig Walls, Ryan Breidenbach, Manning Publishing Co., ISBN: 1- 932394- 35-4
4. Head First Servlets and JSP: Passing the Sun Certified Web Component Developer Exam -2nd Edition-Bryan Basham, Kathy Sierra, Bert Bates- O'REILLY

E-Books and Online Learning Material

1. https://www.w3schools.com/python/
2. The Joy of Computing using Python - https://nptel.ac.in/courses/106/106/106106182/
3. Programming, Data Structures and Algorithms using Python https://nptel.ac.in/courses/106/106/106106145/

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT357MJ
Title: Mobile Application Development

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

Knowledge of Java Programming Language and OOP Concept

Course Objectives: -

- To understand the Android Operating System
- To study Android Apps Development Cycle
- To learn to create Android Applications.

Course Outcomes: -

After completing the course, students will be able to:

CO1 : After successful completion of this course, learner will be able to:
CO2: Describe the process of developing mobile applications.
CO3: Create mobile applications on the Android Platform.
CO4 : Design and implement mobile applications involving data storage in SQLite database
CO5: Use location-based services while developing application

Course Contents

Chapter 1	**Introduction to Android**	**4 hours**

1.1 What is Android?
1.2 History
1.3 Features of Android
1.4 Architecture of Android
1.5 AndroidManifest.xml
1.6 Emulator-Android Virtual Device
1.7 Resources & R.java, Assets
1.8. Creating your first Android Application

Chapter 2	**Basic UI design**	**7 hours**

2.1. Basic UI Designing (Form widgets ,Text Fields , Layouts ,[dip, dp, sip, sp] versus px
2.2 Using Basic Views

- TextView
- Button,
- ImageButton,
- EditText,
- CheckBox
- Switch,
- ToggleButton,
- RadioButton, and RadioGroup Views
- ProgressBar View

2.3 Understanding the components of a screen

- Views and View Groups
- Linear Layout
- Absolute Layout
- Table Layout
- Relative Layout
- Frame Layout
- Scroll Layout
- Scroll View
- Constraint Layout

Chapter 3	**Activities and Intents**	**5 hours**

3.1 Introduction to Activities
3.2. Activity Lifecycle
3.3. Introduction to Intents
3.4. Linking Activities using Intents
3.5. Calling built-in applications using Intents
3.6. Toast

Chapter 4	Designing Your User Interface with Views	**3 hours**

4.1. Split Screen / Multi-Screen Activities
4.2. Using Picker Views

- TimePicker View
- DatePicker View

4.3. Using List Views to Display Long Lists

- ListView View
- Using the Spinner View
- GridView

Chapter 5	**Databases – SQLite**	**3 hours**

5.1. Introduction to SQLite
5.2. SQLite Open Helper and SQLite Database
5.3. Creating , opening and closing database
5.4. Working with cursors, Insert, Update, Delete
5.5. Building and executing queries

Chapter 6	**Messaging and E-mail and Google Map**	**05 hours**

6.1. SMS Messaging

- Sending SMS Messages Programmatically
- Sending SMS Messages Using Intent
- Receiving SMS Messages

6.2. Sending E-mail
6.3. Display Google Maps

- Creating the project
- Obtaining the Maps API Key
- Displaying the Map
- Displaying the Zoom Control

- Changing Views
- Navigating to a specific location
- Adding Markers
- Geocoding and Reverse Geocoding

6.4. Getting Location Data

Reference Books:

1. Beginning Android Application Development by Wei-Meng Lee Wiley
2. React Native for Mobile Development by Akshat Paul and Abhishek Nalway

E-Books and Online Learning Material

1. https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-ProgrammingCookbook.pdf
2. https://www.programming-book.com/download/?file=10988
3. http://projanco.com/Library/Android%20App%20Development%20in%20Android%20Studio%20-%20Java%20plus%20Android%20edition%20for%20beginners.pdf
4. https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1. The official site for Android developers - https://developer.android.com
2. https://www.tutorialspoint.com/android/index.htm
3. https://www.javatpoint.com/android-tutorial

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT358MJP
Title: Practical Based on Mobile Application Development (IT357MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

1. Knowledge of Java programming language and OOP concept

Course Objectives: -

- Creating robust mobile applications and learn how to integrate them with other services.
- Creating intuitive, reliable mobile apps using the android services and components

Course Outcomes: -

After completing the course, students will be able to:

CO1: Design and develop user interfaces for mobile apps using basic building blocks, UI components and application structure using Emulator

CO2: Build enterprise level mobile applications with on Android

CO3: Understand both the basic and advanced concepts of Android Programming

Practical Assignments

Assignments-1 Introduction to Android

1.Create android application to change Font Size, Color and Font Family of String.
2.Execute the Hello World Application on Physical Device.

Assignments-2 Activities and Intents

1. Create a Simple Application which shows the Life Cycle of Activity.
2. Create a Simple Application Which Send ―Hello! message from one activity to another with help of Button (Use Intent).
3. Create an Android Application to accept two numbers and find power and Average. Display the result on the next activity on Button click.
4. Create an Android App with Login Screen. On successful login, gives message go to next Activity (Without Using Database& use Table Layout).

Assignments-3 User Interface with Views

1. Create an Android Application that Demonstrate Alert Dialog Box.
2. Create an Android Application to demonstrate the Simple calculator.
3. Create an application to demonstrate date and time picker.
4. Demonstrate Array Adapter using List View to display list of Country.
5. Create an Android application to demonstrate Progress Dialog Box .

Assignments-4 Pictures and UI design

1. Construct an Android Application to accept a number and calculate Factorial, Sum of Digits of a given number using Context Menu.
2. Create gallery application to display all images.
3. Create a Android Application to demonstrate Vertical Scroll Bar
4. Android User Interface Design following-add a border to an Android Layout

Assignments-5 Databases – SQLite

1. Demonstrates the basics of ListActivity. Use a SQLite database to store the notes.
2. Create an android Application for performing the following operation on the table Customer (id, name, address, phno). (use SQLite database)
   i. Insert New Customer Details.
   ii. Show All the Customer Details on Toast Message.

Assignments-6 Messaging, E-mail and Google Map

1. Create application to send and receive messages.
2. Create an Android application to send email.
3. Create an Android Application to perform Zoom In, Zoom Out operation and display Satellite view, on Google Map.

Reference Books:

1. Beginning Android Application Development by Wei-Meng Lee Wiley
2. React Native for Mobile Development by Akshat Paul and Abhishek Nalwaya

E-Books and Online Learning Material

1. Beginning Android Application Development by Wei-Meng Lee Wiley
2. React Native for Mobile Development by Akshat Paul and Abhishek Nalwaya

E-Books:

1. https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-ProgrammingCookbook.pdf
2. https://www.programming-book.com/download/?file=10988
3. http://projanco.com/Library/Android%20App%20Development%20in%20Android%20Studio%20-%20Java%20plus%20Android%20edition%20for%20beginners.pdf
4. https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1. The official site for Android developers - https://developer.android.com
2. https://www.tutorialspoint.com/android/index.htm
3. https://www.javatpoint.com/android-tutoria

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT359MJ
Title: Go Programming

Teaching Scheme	No. of Credits	Examination Scheme
2 hours/week	2	CE:15 marks EE:35 marks

Prerequisites :

Basic programming knowledge (C / Java / Python preferred)

Course Objectives: -

1. Introduce students to Go programming language fundamentals and its design philosophy.
2. Enable learners to develop efficient, readable, and concurrent programs using Go.
3. Familiarize students with Go data types, functions, packages, and error handling.
4. Develop skills in concurrency using goroutines and channels.
5. Apply Go for real-world applications and mini projects following best practices.
6.

Course Outcomes: -

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

CO1: Understand Go language features and program structure.
CO2: Write Go programs using control structures, functions, arrays, slices, maps, and structures.
CO3: Implement modular programs using packages and interfaces.
CO4: Handle errors and files effectively in Go.
CO5: Develop concurrent programs using goroutines and channels.
CO6: Design simple applications using Go best practices.

Course Contents

Chapter 1	**Introduction to Go Language**	**5 hours**

1.1 History and features of Go
1.2 Go vs C / Java / Python
1.3Installation and Go environment setup
1.4 Go program structure
1.5 Tokens, keywords, identifiers
1.6 Variables and constants
1.7 Data types
1.8 Type inference
1.9 Input / Output operations

Chapter 2	**Control Structures & Functions**	**6 hours**

2.1 Operators and expressions
2.2 Conditional statements (if, switch)
2.3 Looping (for, range)
2.4 Functions: Declaration and calling, Multiple return values,Named return values,Recursion
2.5 Anonymous functions and closures
2.6 defer keyword

Chapter 3	Data Collections & Structures	6 hours

3.1 Arrays
3.2 Slices (creation, slicing, append)
3.3 Maps
3.4 Structures
3.5 Pointers in Go
3.6 Methods and receivers
3.7 Introduction to Interfaces
3.8 Interface implementation

Chapter 4	Packages, Error Handling & File I/O	10 hours

4.1 Go packages and modules
4.2 Creating and using custom packages
4.3 Standard packages (fmt, math, strings, time)
4.4 Error handling: error interface, errors.New()
4.5 File handling:Reading and writing files,Working with directories
4.6 Command-line arguments

Chapter 5	Concurrency	6 hours

5.1 Introduction to concurrency
5.2 Goroutines
5.3 Channels:
5.4 Buffered & unbuffered channels
5.5 select statement
5.6 Basic synchronization concepts
5.7 Go coding best practices

Reference Books:

1. The Go Programming Language: *Alan A. A. Donovan & Brian W. Kernighan,* Addison-Wesley
2. Go in Action: *William Kennedy with Brian Ketelsen & Erik St. Martin,* Manning Publications
3. Learning Go – Jon Bodner, O'Reilly
4. Introducing Go – Caleb Doxsey
5. Head First Go – Jay McGavren, O'Reilly

E-Books and Online Learning Material

- Go Official Documentation: https://go.dev/doc/
- Go Tour (Interactive Learning): https://go.dev/tour/
- Go by Example (Concept-wise Examples): https://gobyexample.com/
- Learn Go with Tests: https://quii.gitbook.io/learn-go-with-tests/
- W3Schools Go Tutorial: https://www.w3schools.com/go/
- https://nptel.ac.in
- YouTube Channels:
  1. Golang Dojo
  2. TechWorld with Nana
  3. FreeCodeCamp Go tutorials
- Playground (Run Go online)
  https://go.dev/play/
  LeetCode (Go Language Practice)
  HackerRank (Go Track)

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT360MJP
Title: Practical Based on Go Programming (IT359MJ)

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites

Fundamental knowledge of Programming language like c/ Java/ Python

Course Objectives: -

- Reinforce theoretical Go programming concepts through hands-on coding
- Develop logical thinking and problem-solving skills
- Gain confidence in writing, debugging, and executing Go programs
- Introduce basic concurrency and real-world application design

Course Outcomes: -

After completing the course, students will be able to:

CO1: Able to write, compile, and execute a basic Go program and understand program structure.
CO2: Able to apply conditional statements to decision-making problems.
CO3: Able to define and use functions with multiple return values.
CO4: Able to apply recursion and deferred execution in Go programs.
CO5: Able to apply interfaces to achieve abstraction and polymorphism.

Course Contents

Assignment 1:

Write a Go program to display:

- "Welcome to Go Programming"
- Your name, class, and institute information.

Assignment 2

Write a Go program to:

- Declare variables of different data types
- Demonstrate type inference and constants
- Display values and their data types.

Assignment 3

Write a Go program to:

- Accept two numbers from the user
- Perform arithmetic operations (addition, subtraction, multiplication, division).

Assignment 4

Write a Go program to Check whether a number is positive, negative, or zero using `if-else`.

Assignment 5

- Write a Go program using a switch statement to display the day of the week based on user input (1–7).
- Write a Go program to Print Fibonacci series up to n terms using for loop.

Assignment 6

Write a Go program to:

- Define a function that returns multiple values
- Perform swapping of two numbers.

Assignment 7

Write a Go program that demonstrates:

- Recursive function to calculate factorial
- Use of `defer` keyword.

Assignment 8

Write a Go program to:

- Store marks of students in an array
- Calculate total and average marks.

Assignment 9

Write a Go program to:

- Demonstrate slice operations (append, copy, slicing)
- Display length and capacity of slices.

Assignment 10

Write a Go program to:

- Create a map to store student roll number and name
- Add, delete, and search elements in a map.

Assignment 11

Write a Go program using **structures** to:

- Store employee details (ID, Name, Salary)
- Display sorted salary details.

Assignment 12

Write a Go program to:

- Define an interface
- Implement the interface using different structures
- Demonstrate polymorphism.

Assignment 13

Write a Go program to:

- Create and use a **custom package**
- Import and call functions from it.

Assignment 14

Write a Go program to:

- Handle errors using `errors.New()` and `error` interface
- Demonstrate user-defined error handling.

Assignment 15

Write a Go program to:

- Create a text file
- Write data into the file
- Read data from the file and display it.

Assignment 16

Write a Go program to:

- Create and execute multiple goroutines
- Observe concurrent execution.

Assignment 17

Write a Go program to:

- Communicate between goroutines using channels
- Demonstrate buffered and unbuffered channels.

Assignment 18

Write a Go program using select statements to handle multiple channels.

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT371VSCP
Title: Practical Based on Web Application Development ((IT321VSC))

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE:15 marks EE:35 marks

Prerequisites : Fundamental concepts of Web, Web server.

Course Objectives: -

- To learn and design HTML pages and CSS.
- To know the process of Web development using Graphical User Interface (GUI).
- To understand the database connection.

Course Outcomes: -

After completing the course, students will be able to:

CO1: Able to build Functional Web Applications
CO2: Understand Client–Server Interaction.
CO3: Implement Work with Databases

Practical Assignments

Assignment 1: HTML, HTML5 and CSS

1. HTML Basics
2. Header and Footer
3. Example of All basic HTML Tags
4. Table Tag, Form Tag(Forms and different types of Input element details)
5. New input types in HTML5

Assignment 2: CSS

1. Introduction of CSS.
2. How does CSS work? (The basic CSS syntax)
3. BOX Model in CSS
4. CSS Navigation Bar
5. Examples of CSS

Assignment 3: Introduction to PHP

1. Introduction to PHP
2. Basic PHP Syntax, Comments in PHP, Creating (Declaring) PHP Variables
3. PHP Data types
4. PHP Arithmetic Operators, PHP Comparison Operators, Increment / Decrement Operators, PHP Logical Operators
5. PHP Control Statement

Assignment 4: Functions and Strings

1. PHP Strings, PHP String Functions
2. PHP Functions
3. PHP Regular Expressions

Assignment 5: Arrays

1. Introduction (Syntax, Example)
2. Types of Arrays in PHP (Indexed Array, Associative Array, Multidimensional Array)
3. Array Functions with syntax and example

Assignment 6: File Handling

1. Introduction
2. File Functions

Assignment 7: Database Connectivity

1. PHP application can be connected with database in two ways : 1. mysqli 2. PDO. ACCESSING MYSQL .USING MYSQL CLIENT AND USING PHPMYADMIN
2. Installation process and steps.
3. Basic Commands for DDL,DML
4. MYSQLi Function or (Establishing a Connection, Executing Queries, Fetching data, Handling Error, Closing Connection
5. Retrieving Query Results Functions
6. Counting Returned Records
7. Updating Records

Note: Students can Use any types of database or Technique (Mysqli -> Object oriented or procedure oriented, PDO:- Any database)

Reference Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications.
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley Publications.
3. Jon Duckett, PHP & MySQL: Server-Side Web Development, Wiley Publications.
4. Julie C. Meloni, Sams Teach Yourself HTML, CSS, and JavaScript All in One, Pearson.
5. DT Editorial Services, HTML5 Black Book, Dreamtech Press.

E-Books and Online Learning Material

1. https://www.w3schools.com/
2. Introduction to Modern Application Development - https://nptel.ac.in/courses/106106156
3. Modern Application Development-https://nptel.ac.in/courses/106106222

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
Subject Code: IT381OJT
Title: On Job Training

Teaching Scheme	No. of Credits	Examination Scheme
8 hours/week	4	CE:30 marks EE:70 marks

Prerequisites

- Basic knowledge of Programming concepts (C / Java / Python),Database fundamentals, Web technologies (HTML, CSS, basic scripting)
- Understanding of Software Development Life Cycle (SDLC), Basic computer networks and operating systems
- Willingness to follow industry ethics and professional conduct.

Course Objectives: -

The objectives of the On-the-Job Training course are to:

1. Provide students with hands-on industry exposure relevant to Information Technology.
2. Enable learners to apply theoretical knowledge to real-world IT problems.
3. Develop professional skills such as teamwork, communication, and time management.
4. Familiarize students with industry tools, technologies, and workflows.
5. Enhance employability and career readiness through practical experience.

Course Outcomes: -

After successful completion of OJT, the student will be able to:

CO1: Apply IT theories and concepts to solve real-time organizational problems.
CO2: Use appropriate software tools, technologies, and platforms used in the IT industry.
CO3: Analyze requirements, design solutions, and implement applications under guidance.
CO4: Demonstrate professional behavior, communication skills, and teamwork.
CO5: Prepare technical documentation and present work effectively.
CO6: Evaluate organizational practices, ethics, and real-world IT workflows.

Guidelines

1. Duration: 4–6 Weeks (Minimum 120–160 Hours)
2. Nature: Mandatory / Skill-based / Industry-oriented
3. IT Companies / Software Firms
    - Startups / MSMEs
    - Government or Private Organizations (IT departments)
    - Research Institutes / Incubation Centers
    - Recognized Training Centers with industry projects
4. Training must be relevant to Information Technology.
5. AREAS OF OJT

- Software Development
- Web Application Development
- Mobile App Development
- Database Management
- Networking & System Administration
- Cloud Computing
- Cyber Security

- Data Analytics / AI basics
- IT Support & Maintenance

INTERNAL ASSESSMENT (30 MARKS)

Internal assessment shall be conducted by the internal faculty coordinator.

Component	Marks
Attendance & Discipline	05
Weekly Progress Report / Logbook	10
Guide / Industry Supervisor Feedback	10
Presentation / Review	05
Total Internal Marks	**30**

EXTERNAL ASSESSMENT (70 MARKS)

External evaluation shall be conducted by an external examiner appointed by the university.

Component	Marks
OJT Final Report (Documentation & Format)	20
Project / Task Implementation	25
Viva-Voce (External Examiner)	15
Industry Exposure & Learning Outcome	10
Total External Marks	**70**

OJT REPORT CONTENTS

1. Certificate from Organization
2. Student Declaration
3. Organization Profile
4. Objectives of OJT
5. System / Project Overview
6. Weekly Work Description
7. Tools & Technologies Used
8. Learning Outcomes
9. Screenshots / Code Samples (if applicable)
10. Challenges & Solutions
11. Conclusion
12. References