Savitribai Phule Pune University, Pune

Four Year Degree Program
Bachelor of Science (Computer Applications)

(Faculty of Science and Technology)

Syllabi for
Third Year B. Sc. (Computer Applications)

(For Colleges Affiliated to the Savitribai Phule Pune University)

NEP – 2020 Compliant Choice Based Credit System (CBCS) Syllabus

With effect from Academic Year 2026-2027

Preamble

Dear Students, teachers and all stakeholders

The Savitribai Phule Pune University, Pune has taken a leading role in design and implementation of Programmes as per the guidelines and recommendations of National Education Policy (NEP) 2020. The university decided to offer UG and PG programmes with features recommended by NEP-2020 such as Multiple-entry/exit, inter and multi-disciplinary education, focus on skilling, on-job training/field projects, research, incorporation of Indian Knowledge System etc. for the holistic development of students. The university has adopted the guidelines provided by the state Sukanu Samittee and prepared the credit structure for this UG programmes.

The Ad-hoc Board of Studies in Computer Applications has prepared a structure for Bachelor of Science (Computer Applications) with following features

- The structure of the course is designed as per National Education Policy (NEP) 2020 and is in line with university guidelines.
- The total credits offered for the three years with six semesters are 132 credits with 22 credits assigned for each of the six semesters. Candidate has an option to continue with fourth year either for Hon. with research or Hon. degree, each with 176 credits
- The programme has Multiple Entry/exit feature: A candidate may exit the programme after first, second, third or fourth year and shall be awarded with UG Certification, UG Diploma, Degree and Hon. Degree with Research / Hon. Degree respectively
- Various types of courses such as Major Core (MJ), Mandatory Elective (ME), Open Electives (OE), Minor (MN), Ability Enhancement (AEC), Value education (VEC), Vocational Skill (VSC), Skill enhancement (SEC), Indian Knowledge System (IKS), Co-curricular (CC) courses as well as courses on On-job Training (OJT), Field Project (FP), Community Engagement Programmes (CEP), Research Methodology (RM) and Research Project (RP) have been included at FY, SY and TY B. Sc. (Computer Application) structure.

The detailed drafts for FY B. Sc. (Computer Applications) and SY B. Sc. (Computer Applications) were prepared and implemented by the board in AY 2024-25 and 2025-26 respectively. This document presents detailed draft for TY B. Sc. (Computer Applications) which will be implemented from June 2026.

I am thankful to Hon. Vice-Chancellor Prof. Dr. S W. Gosavi, Hon. Pro-Vice Chancellor Prof. Dr. Parag Kalkar, former Dean of FoS&T, Hon. Prof. Dr. P D Patil for their guidance. I am thankful to all board members Dr. A B Nimbalkar, Dr. Razak Sayyad, Prof. Dr. R M Sonar and Prof. Dr. Sachin Kadam, members of previous BoS, officers/employees from academic and examination sections for their valuable inputs. I am also thankful to all members of task force and faculty members from affiliated colleges for their active participation in preparing the draft syllabus for TY B. Sc. (Computer Applications).

Prof. Dr. S. S. Sane
Chairman, Ad-hoc Board of Studies in Computer Applications,
Faculty of Science and Technology, SPPU, Pune

Programme Outcomes

After successful completion of the Programme, the students shall be able to

PO 01: Demonstrate understanding of fundamental concepts in the field of Computing

PO 02: Design and develop computer-based applications.

PO 03: Analyze existing research reported in the literature

PO 04: Propose alternate solutions by undertaking research work.

PO 05: Create efficient, reliable, readable and maintainable code.

PO 06: Demonstrate a deeper understanding of the chosen domain.

PO 07: Select appropriate method/algorithm to solve the given problem

PO 08: Explain complex technical concepts clearly and effectively, both in written and oral forms.

PO 09: Demonstrate ability to collaborate effectively with team members, understand different perspectives, and contribute productively to become successful

PO 10: Demonstrate ability to work with integrity and a sense of social responsibility.

PO 11: Demonstrate self and life-long learning skills

PO 12: Solve computational problems innovatively

PO 13: Apply knowledge gained and critical thinking to develop real-world applications.

Table of Contents

Level 5.5 TY B. SC. (COMPUTER APPLICATIONS) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme Hrs/Week			Examination Scheme and Marks			Credits			
			TH	TU	PR	CE	EE	Total	TH	TU	PR	Total
CA-301 - PCC	PCC	Software Engineering and Testing	04	--	--	30	70	**100**	04	--	--	**04**
CA-302 - PCC		Fundamentals of Artificial Intelligence	02	--	--	15	35	**50**	02	--	--	**02**
CA-303 - PCCP		Lab course on CA-302-PCC	--	--	04	15	35	**50**	--	--	02	**02**
CA-304 - PCC		Fundamentals of Data Science	02	--	--	15	35	**50**	02	--	--	**02**
CA-305 – PCCP		Lab course on CA-304-PCC	--	--	04	15	35	**50**	--	--	02	**02**
CA-310- PEC	PEC	User Interface and User Experience (UI-UX) Design	02	--	--	15	35	**50**	02	--	--	**02**
CA-311- PCCP		Lab course on CA - 310- PEC	--	--	04	15	35	**50**	--	--	02	**02**
		OR										
CA-312- PEC		Cloud Computing	02	--	--	15	35	**50**	02	--	--	**02**
CA-313- PECP		Lab course on CA-312 - PEC	--	--	04	15	35	**50**	--	--	02	**02**
		OR										
CA-314- PEC		Cyber Security	02	--	--	15	35	**50**	02	--	--	**02**
CA-315- PECP		Lab course on CA-314-PEC	--	--	04	15	35	**50**	--	--	02	**02**
CA-321 VSEC	VSEC	Core JAVA Programming	--	--	04	15	35	**50**	--	--	02	**02**
CA-331 FP	FP	Field Project	--	--	04	15	35	**50**	--	--	02	**02**
	MN	Electronics or Mathematics	02	--	--	15	35	**50**	02	--	--	**02**
Total			**12**	**00**	**20**	**165**	**385**	**550**	**12**	**00**	**10**	**22**

Level 5.5 TY B. SC. (COMPUTER APPLICATIONS) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme Hrs/Week			Examination Scheme and Marks			Credits			
			TH	TU	PR	CE	EE	Total	TH	TU	PR	Total
CA-351-PCC	PCC	Software Project Management	02	–	–	15	35	**50**	02	–	–	**02**
CA-352-PCC		Web Programming	02	–	–	15	35	**50**	02	–	–	**02**
CA-353-PCCP		Lab course on CA-352-PCC	–	–	04	15	35	**50**	–	–	02	**02**
CA-354-PCC		Operating system Design	04	–	–	30	70	**100**	04	–	–	**04**
CA-355-PCCP		Lab course on CA-354-PCC	–	–	04	15	35	**50**	–	–	02	**02**
CA-360-PEC	PEC	Prompt and Generative AI	02	–	–	15	35	**50**	02	–	–	**02**
CA-361-PECP		Lab course on CA-360 - PEC	–	–	04	15	35	**50**	–	–	02	**02**
		OR										
CA-362-PEC		Big Data and Analytics	02	–	–	15	35	**50**	02	–	–	**02**
CA-363-PECP		Lab course on CA-362 - PEC	–	–	04	15	35	**50**	–	–	02	**02**
		OR										
CA-364-PEC		Mobile Application Development	02	–	–	15	35	**50**	02	–	–	**02**
CA-365-PECP		Lab course on CA-364 - PEC	–	–	04	15	35	**50**	–	–	02	**02**
CA-371-VSC	VSEC	Advanced JAVA Programming	–	–	04	15	35	**50**	–	–	02	**02**
CA-381-OJT	OJT	On-Job Training/ Internship	–	–	08	30	70	**100**	–	–	04	**04**
Total			**10**	**00**	**24**	**165**	**385**	**550**	**10**	**00**	**12**	**22**

Exit option: Award of B. Sc. (Computer Applications) degree with 132 credits OR else Continue with the 4th year for "Hon." Degree or "Hon. with Research" degree with 176 credits

Detailed Drafts
For
Level 5.5

TY B. Sc. (Computer Applications)

SEMESTER V

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-301-PCC– T: Software Engineering and Testing

Teaching Scheme **Theory: 04 Hours/Week**	**Credits: 04**	**Examination Scheme** **Continuous Evaluation: 30 Marks** **End Semester: 70 Marks**

Course Objectives:

- To study fundamental concepts of system and the software engineering.
- To understand models for software development.
- To learn process of system analysis and design using standard modeling and documentation tools.
- To be familiarize with principles, objectives, and life cycle of software testing.
- To know different software testing techniques, methods, and levels of testing.

Course Outcomes:

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

CO1: Define system and software engineering and process of development life cycle.
CO2: Compare different SDLC models and select suitable models for given problem scenario.
CO3: Analyze, and document software requirements using requirement engineering techniques.
CO4: Apply techniques and tools for system analysis and design and software testing.
CO5: Describe software quality factors, and software testing life cycle.

Course Contents

Unit I	**Introduction to System Engineering**	**08 Hours**

1.1 Introduction, Definition of Software
1.2 Elements of the System
1.3 Characteristics of the System
1.4 Definition of Software Engineering
1.5 Need for Software Engineering
1.6 Types of System
1.7 System Analyst
  1.7.1 Role of System Analyst
  1.7.2 Skill Set Required by an Analyst

Unit II	**Software Development Models and Requirement Engineering**	**14 Hours**

2.1 Introduction - A Generic Process Model
2.2 SDLC, and Umbrella Activities
2.3 Waterfall Model
2.4 Spiral Model
2.5 Prototyping
2.6 RAD
2.7 Incremental Model
2.8 Agile Model Principles
2.8.1 Agile Process
2.8.2 Scrum
2.9 Requirement Engineering tasks - Inception, Elicitation, Elaboration, Negotiation
2.9.1 Fact-Finding Techniques - Questionnaires, Interviews, Observation, Record Review
2.9.2 Feasibility study
2.10 SRS
2.10.1 Characteristics of SRS
2.11 Introduction to Object oriented modelling and design

Unit III	**System Analysis and Design Tools**	**14 Hours**

3.1 Introduction
3.2 Data Flow Diagram (Process Modeling)
3.3 E-R Model (Data Modelling)
3.4 Decision Table
3.5 Decision Tree
3.6 Input and Output Design
3.7 Coupling and Cohesion
3.8 Case Study on the above topics
3.9 Introduction to UML diagrams

Unit IV	**Introduction to Software Testing**	**08 Hours**

4.1 Introduction, Nature of errors,
4.2 Testing Objectives
4.3 Testing principles
4.4 Testing fundamentals,
4.5 Software reviews, Formal Technical reviews,
4.6 Inspection and walkthrough
4.7 Testing Life Cycle

4.8 Basic Metrics –size-oriented metric, Function –oriented metric
4.9 Cyclometic Complexity
4.10 Software Quality Assurance And Audit Trail
4.11 McCall's Quality Factors

Unit V	Software Testing Methods	08 Hours

5.1 White Box Testing and types of white box testing
5.2 Test Case Design
5.3 Black Box Testing and types of black box testing
5.4 Gray Box Testing
5.5 Software Testing Process
5.6 Unit Testing
5.7 Integration- Top-down, Bottom up
5.8 System Testing
5.9 Acceptance Testing (alpha, Beta Testing)
5.10 Validation and Verification
5.11 Performance Testing
5.12 Regression Testing
5.13 Smoke Testing
5.14 Load Testing

Unit VI	Testing Tools and Software Quality Assurance	08 Hours

6.1 JUnit, Apache JMeter, Selenium
6.2 Load runner, Rational Robot
6.3 Quality Concepts, Quality Movement, Background Issues, SQA activities
6.4 Formal approaches to SQA
6.5 Statistical Quality Assurance
6.6 Software Reliability
6.7 The ISO 9000 Quality Standards
6.8 SQA Plan
6.9 Six sigma

Reference Books:

1. Roger S. Pressman, Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", McGraw-Hill Education, 9th Edition, 2024.
2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing: Principles and Practices", Pearson Education, 1st Edition, 2007
3. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning, 5th Edition, 2018.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-302-PCC: Fundamentals of Artificial Intelligence

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To learn the core concepts of AI, evolution and different paradigms of AI
- To know the expert systems, knowledge bases and inference engines.
- To study the concepts in machine learning, including supervised, unsupervised and reinforcement learning.
- To understand fundamentals of game theory.

Course Outcomes:

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

CO1: Demonstrate understanding of the fundamentals of Artificial Intelligence, including its history, types, applications, intelligent agents, system structure, and ethical considerations.

CO2: Apply problem-solving techniques in AI using state-space search, knowledge representation, and reasoning methods.

CO3: Identify, analyze, and apply appropriate uninformed and informed search strategies, including constraint satisfaction techniques, for solving AI problems.

CO4: Use game theory concepts and game search algorithms, and evaluate their effectiveness and limitations under conditions of uncertainty, incomplete information, and computational complexity.

CO5: Describe the core concepts of Machine Learning and Deep Learning, including types, key terminology, and real-world applications across various domains.

Course Contents

Unit I	**Introduction to Artificial Intelligence**	**05 Hours**

1.1 Introduction and History of Artificial Intelligence
1.2 Applications and Techniques of Artificial Intelligence
1.3 Types of Artificial Intelligence (ANI, AGI, ASI)
1.4 Machine Learning, Deep Learning and Artificial Intelligence – Comparative Overview
1.5 Agents and Environments: Types of Agents
1.6 Structure of Intelligent Agents and Rationality
1.7 Ethics and Risks in Artificial Intelligence

Unit II	**Problem, Problem Space and Search**	**05 Hours**

2.1 Defining the problem as a State Space Search (e.g- Water Jug Problem)
2.2 Problem Characteristics
2.3 Heuristic Search, Hill Climbing Method
2.4 Game Playing: Min-Max algorithm, Alpha beta Pruning
2.5 Additional Problems: The Missionaries and Cannibal Problems, The Tower of Hanoi, Monkey Banana Problem

Unit III	**Game Theory**	**10 Hours**

3.1 Optimal Decisions in Games
3.2 Heuristic Alpha–Beta Tree Search
3.3 Monte Carlo Tree Search
3.4 Stochastic Games
3.5 Partially Observable Games
3.6 Limitations of Game Search Algorithms
3.7 Constraint Satisfaction Problems (CSP)

Unit IV	**Machine Learning**	**10 Hours**

4.1 Introduction to Machine Learning (Definition, Relationship between Artificial Intelligence and Machine learning, Need and Importance of Machine Learning)
4.2 Types of Machine Learning (Supervised, Unsupervised and Reinforcement Learning)
4.3 Key concept of Machine Learning (Dataset, Training Data, Testing Data, Features, Labels, Model, Learning Algorithm with example, prediction, Over fitting, Under fitting)
4.4 Deep Learning: Definition, Basic concepts, ANN, Structure of neural network, Activation function (concept only) Natural Language Processing, Computer Vision, Speech Recognition, Robotics, Generative AI.
4.5 Ethical issues in Machine Learning.
4.6 Applications: Healthcare, Banking and finance, education, E-commerce, Recommendation System

Reference Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall / Pearson, 3rd Edition, 2009.
2. Nilsson Nils J, "Artificial Intelligence: A New Synthesis", Morgan Kaufmann Publishers Inc., 1st Edition, 1998.
3. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley, 3rd Edition, 1992.
4. Tom M. Mitchell, "Machine Learning", McGraw-Hill, 1st Edition, 2017 (Reissue).

5. E. Alpaydin, "Introduction to Machine Learning", PHI Learning, 3rd Edition, 2015.
6. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Tata McGraw-Hill, 3rd Edition, 2009.
7. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education India, 1st Edition, 2015.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-303-PCCP: Lab course on CA-302-PCC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic knowledge of computers and programming concepts.
- Fundamental understanding of Python programming.
- Familiarity with basic concepts of machine learning and data handling.

Course Objectives:

- To understand the basic concepts and foundations of Artificial Intelligence using Python.
- To study different problem-solving methods, problem spaces and search techniques used in Artificial Intelligence.
- To learn the principles of Game Theory and decision-making strategies in intelligent systems.
- To understand Machine Learning fundamentals and data preprocessing techniques.
- To implement supervised learning algorithms for solving real-world problems.

Course Outcomes:

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

CO1: Describe the fundamental concepts and applications of Artificial Intelligence.

CO2: Apply problem representation methods and search algorithms to solve AI problems.

CO3: Analyze decision-making strategies using Game Theory concepts.

CO4: Perform data preprocessing and handling techniques for Machine Learning.

CO5: Implement and evaluate supervised learning models for prediction and classification tasks.

Operating Environment / Software –

- **Operating Environment:** Windows/Linux/Mac
- **Software:** Python 3.8+, Python Shell
  IDE: - Jupyter Notebook/ Google Colab

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Foundations of Artificial Intelligence using Python**	**02**
Assignment No 2	**Problems, Problem Spaces and Search**	**03**

Assignment No 3	**Game Theory**	**02**
Assignment No 4	**Machine Learning - Introduction to Data Preprocessing**	**02**
Assignment No 5	**Machine Learning - Supervised Learning**	**03**

Reference Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall / Pearson, 3rd Edition, 2009.
2. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents – Cambridge University Press
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 3rd Edition, 2022.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 1st Edition, 2012
5. E. Alpaydin, "Introduction to Machine Learning", PHI Learning, 3rd Edition, 2015.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-304-PCC–T: Fundamentals of Data Science

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To know the fundamental concepts, scope, and lifecycle of Data Science
- To understand different types of data, data sources, and data formats
- To study descriptive and inferential statistical techniques for data analysis
- To learn data preprocessing, wrangling, and transformation techniques
- To be familiarize with data visualizations and ethical issues in Data Science

Course Outcomes:

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

CO1: Explain the core concepts, scope, and lifecycle of Data Science
CO2: Identify and classify various types of data, data sources, and data formats
CO3: Apply descriptive and inferential statistical techniques to analyze datasets
CO4: Perform data preprocessing, wrangling, and data transformation tasks
CO5: Design and interpret effective data visualizations using appropriate tools
CO6: Recognize ethical, privacy, and security issues in Data Science applications

Course Contents

Unit I	**Introduction to Data Science**	**06 Hours**

1.1 Introduction to Data Science
1.1.1 Definition and scope of Data Science
1.1.2 Evolution of Data Science
1.1.3 Data Science vs Data Analytics vs Big Data
1.2 Data Science Lifecycle
1.2.1 Problem understanding
1.2.2 Data collection
1.2.3 Data preprocessing
1.2.4 Data analysis
1.2.5 Data visualization
1.2.6 Decision making and deployment
1.3 Types of Data

1.3.1 Based on Structure
1.3.1.1 Structured data
1.3.1.2 Semi-structured data
1.3.1.3 Unstructured data
1.3.2 Based on Nature
1.3.2.1 Qualitative data
1.3.2.2 Quantitative data
1.3.3 Based on Values
1.3.3.1 Discrete data
1.3.3.2 Continuous data
1.4 Data Sources
1.4.1 Primary data sources
1.4.2 Secondary data sources
1.4.3 Databases
1.4.4 Web data
1.4.5 APIs
1.4.6 Sensor and IoT data
1.4.7 Social media data
1.5 Data Formats
1.5.1 Text data
1.5.2 Numeric data
1.5.3 Time-series data
1.5.4 Image data
1.5.5 Audio and video data
1.5.6 Common file formats:
1.5.6.1 CSV
1.5.6.2 JSON
1.5.6.3 XML
1.5.6.4 Excel
1.5.6.5 Database tables

Unit II	**Statistical Data Analysis**	**06 Hours**

2.1 Introduction to Statistics
2.1.1. Importance of statistics in Data Science
2.1.2 Types of data in statistical analysis
2.2 Descriptive Statistics
2.2.1. Measures of Central Tendency
2.2.1.1. Mean

2.2.1.2. Median
2.2.1.3. Mode
2.2.2. Measures of Dispersion
2.2.2.1. Range
2.2.2.2. Variance
2.2.2.3. Standard Deviation
2.2.3. Measures of Position
2.2.3.1. Quartiles
2.2.3.2. Percentiles
2.2.4. Graphical representation of descriptive statistics
2.3 Inferential Statistics
2.3.1. Population and Sample
2.3.2. Sampling techniques
2.3.3. Concept of estimation
2.3.4. Hypothesis testing
2.3.5. Levels of significance
2.3.6. Type I and Type II errors
2.4. Measuring Data Similarity and Dissimilarity
2.4.1. Data Matrix versus Dissimilarity Matrix
2.4.2. Proximity Measures
2.4.2.1. Nominal Attributes
2.4.2.2. Binary Attributes
2.4.3. Dissimilarity measures
2.4.3.1. Euclidean distance
2.4.3.2. Manhattan distance
2.5. Concept of Outliers
2.5.1. Definition of outliers
2.5.2. Types of outliers
2.5.3. Detection of outliers
2.5.3.1 Statistical methods

Unit III	**Data Collection, Data Preprocessing and Data Transformation**	**06Hours**

3.1 Data Collection
3.1.1 Data collection methods
3.1.2 Data sources: databases, web data, APIs, sensors
3.2 Introduction to Data Preprocessing
3.2.1 Need for data preprocessing
3.2.2 Data quality issues
3.2.2.1 Missing values
3.2.2.2 Noisy data
3.2.2.3 Inconsistent data

3.3 Data Cleaning
- 3.3.1 Handling missing values
- 3.3.2 Noise reduction techniques
- 3.3.3 Outlier handling
- 3.3.4 Removing duplicate data

3.4 Data Munging / Data Wrangling
- 3.4.1 Concept of data munging and wrangling
- 3.4.2 Data merging and joining
- 3.4.3 Data reshaping and restructuring
- 3.4.4 Filtering and sorting data
- 3.4.5 Feature selection and feature extraction

3.5 Data Transformation
- 3.5.1 Concept and need for data transformation
- 3.5.2 Rescaling methods
  - 3.5.2.1 Min–Max normalization
  - 3.5.2.2 Standardization (Z-score normalization)
- 3.5.3 Encoding Techniques
  - 3.5.3.1 Label Encoding
  - 3.5.3.2 One-Hot Encoding

3.6 Data Integration and Data Reduction
- 3.6.1 Data integration techniques
- 3.6.2 Data redundancy removal
- 3.6.3 Data reduction methods
  - 3.6.3.1 Dimensionality reduction
  - 3.6.3.2 Sampling

Unit IV	**Data Visualization**	**06 Hours**

4.1 Introduction to Data Visualization
- 4.1.1. Importance of data visualization
- 4.1.2. Role of visualization in Data Science
- 4.1.3. Data Visualization libraries

4.2. Types of Data Visualization
- 4.2.1. Comparison visualizations (bar chart, column chart)
- 4.2.2. Trend visualizations (line chart, area chart)
- 4.2.3. Distribution visualizations (histogram, box plot)
- 4.2.4. Relationship visualizations (scatter plot, bubble chart)
- 4.2.5. Composition visualizations (pie chart, stacked bar chart)
- 4.2.6. Geographical visualizations (maps, geo-plots)

4.3. Specialized Data Visualization Techniques
- 4.3.1. Heat maps
- 4.3.2. Tree maps

4.3.3. Geo-spatial visualizations (maps)
4.3.4. Network graphs
4.3.5. Time-series visualizations
4.3.6. Multivariate visualizations

Unit V	Data Science Tools, Ethics, Security and Case Studies	06 Hours

5.2 Data Science Tools
5.2.1. Programming languages for Data Science:
5.2.2. Python (overview)
5.2.3. R (overview)
5.3 Libraries and frameworks:
5.3.1. NumPy
5.3.2. Pandas
5.3.3. Scikit-learn (intro)
5.3.4. Development environments:
5.3.5. Jupyter Notebook
5.3.6. Google Colab
5.4 Ethics and Security
5.4.1. Data privacy and confidentiality
5.4.2. Data ethics
5.4.3. Bias in data and algorithms
5.4.4. Data security challenges
5.4.5. Legal and ethical issues in data handling
5.5 Case Studies and Applications
5.5.1. Predictive analytics case study
5.5.2. Recommendation systems (intro)
5.5.3. Fraud detection (concept)
5.5.4. Future trends and career opportunities in Data Science

Reference Books:

1. Gypsy Nandi, Rupam Sharma, "Data Science Fundamentals and Practical Approaches", BPB Publications, 1st Edition, 2020.

2. Field Cady, "The Data Science Handbook", John Wiley & Sons, Inc., 1st Edition, 2017.

3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 3rd Edition, 2012.

4. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 1st Edition, 2020.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-305-PCCP: Lab course on CA-304-PCC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Fundamental understanding of mathematics (especially statistics basics)
- Basic programming knowledge (preferably Python)
- Familiarity with data concepts such as tables, rows, and columns

Course Objectives:

- To learn the Data Science environment and tools
- To study statistical data analysis for extracting insights
- To understand techniques for data preprocessing and cleaning
- To know process of effective data visualizations
- To build a foundation for real-world data-driven problem solving

Course Outcomes:

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

CO1: Use data science environment using Python and relevant libraries.
CO2: Apply statistical methods to analyze and interpret datasets.
CO3: Perform data preprocessing including cleaning, transformation, and handling missing data.
CO4: Create and interpret various data visualizations for decision-making.
CO5: Demonstrate the ability to work with real-world datasets and derive meaningful insights.

Operating Environment / Software –

- **Operating Environment:** Windows 10/11, Linux (Ubuntu), or Mac
- **Software:** Python (Version 3.x)
  Development Tools / IDEs: Jupyter Notebook, Google Colab (online platform), VS Code / PyCharm

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**The data Science Environment**	**03**

Assignment No 2	**Statistical data Analysis**	**03**
Assignment No 3	**Data Preprocessing**	**03**
Assignment No 4	**Data Visualization**	**03**

Reference Books:

1. Gypsy Nandi, Rupam Sharma, "Data Science Fundamentals and Practical Approaches", BPB Publications, 1st Edition, 2020.
2. Field Cady, "The Data Science Handbook", John Wiley & Sons, Inc., 1st Edition, 2017.
3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 3rd Edition, 2012.
4. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 1st Edition, 2020.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-310-PEC: User Interface and User Experience (UI-UX) Design

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To study the fundamentals of User Interface (UI) and User Experience (UX) design.
- To understand user-centered design concepts and usability principles.
- To be familiarized with interaction design, visual design, and information layout concepts.
- To learn UI/UX tools, prototyping, and usability evaluation methods.

Course Outcomes:

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

CO1: Explain core concepts and principles of UI and UX design.

CO2: Enumerate user-centered design approaches and basic user research techniques.

CO3: Illustrate interaction design, wireframes, and user flow concepts.

CO4: List visual design principles and responsive interface.

CO5: Describe prototyping approaches and usability testing methods.

Course Contents

Unit I	**Introduction to UI and UX Design**	**05 Hours**

1.1 Overview of UI and UX

- 1.1.1 Definition and scope of UI and UX
- 1.1.2 Difference between UI and UX
- 1.1.3 Importance of UI/UX in software development

1.2 User-centered design process

- 1.2.1 Phases of User-centered Design
- 1.2.2 Benefits of User-centered Design
- 1.2.3 Stakeholder involvement in User-centered Design
- 1.2.4 Iterative design and continuous improvement

1.3 Roles of UI/UX designers

- 1.3.1 Role of UI Designer
- 1.3.2 Role of UX Designer
- 1.3.3 Collaboration between UI and UX Designers

Unit II	User Research and Information Architecture	07 Hours

2.1 Understanding users and user needs
- 2.1.1 Meaning of users and target audience
- 2.1.2 Identifying user goals, expectations, and problems
- 2.1.3 Importance of understanding users in UI/UX design
- 2.1.4 Relationship between user needs and product success

2.2 User research methods
- 2.2.1 Interviews
- 2.2.2 Surveys
- 2.2.3 Observations

2.3 Personas and empathy maps
- 2.3.1 Personas - fictional users based on research, User goals, behavior, skills, and challenges
- 2.3.2 Empathy maps - understand what users think, feel, say, and do, designing user-focused solutions

2.4 User journey mapping
- 2.4.1 Visual representation - user interaction with a system,
- 2.4.2 Displaying steps taken by users to achieve a goal,
- 2.4.3 Identifying pain points and opportunities for improvements
- 2.4.4 Improving overall user experience

2.5 Information architecture
- 2.5.1 Organization and structure of content
- 2.5.2 Navigation, menus, and content hierarchy
- 2.5.3 Usability and clarity of interface

2.6 Use cases and scenarios
- 2.6.1 Use cases - interactions between user and system
- 2.6.2 Scenarios - real-world situations of system usage
- 2.6.3 Functional requirements
- 2.6.4 Planning user flows and interactions

Unit III	UI and UX Design Principles	06 Hours

3.1 UI Design Principles
- 3.1.1 Visual design fundamentals
- 3.1.2 Color theory and typography
- 3.1.3 Layouts and grid systems

3.2 UI elements and components

3.2.1. Responsive and adaptive design
3.2.2 Design consistency
3.3 UX Design Principles
3.3.1. Interaction design fundamentals
3.3.2. Navigation design
3.3.3. Accessibility and inclusive design (WCAG overview)
3.4 Designing for multiple platforms
3.4.1 Designing for mobile, tablet, and desktop
3.4.2 Consistent user experience across devices
3.4.3 Layout adaptation for different screen sizes
3.4.4 Responsive and adaptive design
3.5 Wireframing techniques
3.5.1 Basic structure of user interface
3.5.2 Paper and digital wire framing methods
3.5.3 Planning layout and user flow
3.6 Introduction to gamification

Unit IV	**Prototyping and UI/UX Tools**	**06 Hours**

4.1 Low-fidelity and high-fidelity prototyping
4.1.1 Concept and purpose of prototyping
4.1.2 Characteristics of low-fidelity prototypes (paper sketches, basic wireframes)
4.1.3 Advantages and limitations of low-fidelity prototyping
4.1.4 Characteristics of high-fidelity prototypes (visual accuracy, interactivity)
4.1.5 Use cases and benefits of high-fidelity prototyping
4.1.6 Selection criteria for appropriate prototyping level
4.2 Wireframes vs prototypes
4.2.1 Definition and purpose of wire framing
4.2.2 Types of wireframes (low, mid, high fidelity)
4.2.3 Key differences between wireframes and prototypes
4.2.4 Role of wireframes and prototypes in UX documentation
4.3. Introduction to tools: Figma / Adobe XD
4.3.1 Overview and features of Figma and Adobe XD
4.3.2 Tools for wire framing and Prototyping
4.3.3 Benefits of using Figma / Adobe XD
4.4. Design handoff for developers
4.4.1 Importance of design handoff in product development
4.4.2 Preparing design specifications and assets
4.4.3 Exporting assets for development
4.4.4 Collaboration between designers and developers

4.4.5 Tools and best practices for efficient handoff

Unit V	Usability Testing and Evaluation	06 Hours

5.1 Importance of usability testing
- 5.1.1 Meaning and purpose of usability testing
- 5.1.2 Ensuring ease of use, efficiency, and user satisfaction
- 5.1.3 Identifying usability issues at early stages of design
- 5.1.4 Role of usability testing in improving product quality
- 5.1.5 Impact of usability testing on cost reduction and design validation

5.2 Types of usability testing
- 5.2.1 Formative testing
- 5.2.2 Summative testing
- 5.2.3 Moderated testing
- 5.2.4 Unmoderated testing
- 5.2.5 Remote usability testing

5.3 Collecting and analyzing user feedback
- 5.3.1 Feedback collected through surveys, interviews, and observation
- 5.3.2 Identify user difficulties and expectations, and Satisfaction levels.
- 5.3.3 Introduction to UX Matrices: Task Success Rate, Error Rate, Time Taken for completion, user satisfaction Score
- 5.3.4 Design improvements
- 5.3.5 Converting user feedback into actionable design changes

5.4 A/B testing basics
- 5.4.1 Concept of A/B testing
- 5.4.2 Comparison of two design versions (Version A and Version B)
- 5.4.3 Common use cases: layouts, buttons, and navigation structure
- 5.4.4 Role of A/B testing in improving user experience
- 5.4.5 Limitations of A/B testing

5.5 Iterative design process
- 5.5.1 Concept of iterative design in UI/UX
- 5.5.2 Continuous cycle of: Design, Test, Analyze, Redesign
- 5.5.3 Role of usability testing and feedback in iteration
- 5.5.4 Benefits of iterative design for user-centered solutions

Reference Books:

1. Don Norman, "The Design of Everyday Things", Basic Books, Revised & Expanded Edition, 2013.
2. Steve Krug, "Don't Make Me Think: A Common-Sense Approach to Web Usability", New Riders, 3rd Edition, 2014.
3. Alan Cooper, Robert Reimann, David Cronin, "About Face: The Essentials of Interaction Design", John Wiley & Sons, 4th Edition, 2014.
4. Nielsen Norman Group – UX Research Articles Google Material Design Guidelines

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-311-PECP: Lab course on CA - 310- PEC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Knowledge of computer operation and understanding of usability and accessibility concepts.
- Understanding HTML, CSS basics and how designs translate into real applications

Course Objectives:

- To develop skills for designing user-centered digital products.
- To provide hands-on experience with UI/UX design tools.
- To know wireframes, user flows, and visual layouts.
- To understand prototyping and usability evaluation of interfaces.

Course Outcomes:

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

CO1: Apply user research techniques to identify user needs and requirements.
CO2: Design wireframes and user flows for digital products.
CO3: Create visually effective and responsive user interfaces.
CO4: Develop interactive prototypes using appropriate UI/UX tools.
CO5: Evaluate and improve UI/UX designs using usability testing methods.

Operating Environment / Software –

- **Operating Environment:** Windows 10/11, Linux (Ubuntu), or Mac
- **Software:** Design Tool (Figma) / Visual Studio Code

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Study of UI/UX Design and Design Tools**	**02**

- Study UI/UX design tools such as wire framing, mockups, and prototyping using Figma (free version).
- Identify different user types for a selected product/system and suggest improvements for better Usability and accessibility.

Assignment No 2	**User Research and Personas**	**02**

- Identify user needs and pain points.
- Design user personas for the selected product/system.

Assignment No 3	**Wireframes and Interface Design**	**02**

- Create low-fidelity wireframes using paper or digital tools focusing on layout and structure.
- Convert low-fidelity wireframes into high-fidelity wireframes using Figma.
- Apply visual hierarchy, typography, and spacing principles.

Assignment No 4	**Responsive and Visual Design**	**02**

- Create wireframes and mockups for a web application considering both desktop and mobile views.
- Apply responsive design principles for layout and navigation.

Assignment No 5	**Application Interface Design**	**02**

- Design a user interface for a recipe finder application.
- Allow users to search recipes based on ingredients and categories.

Assignment No 6	**UI/UX Evaluation and Collaborative**	**02**

- Work in a team using Figma's collaboration features.
- Assign tasks such as wire framing, UI design, and prototyping. Coordinate and provide feedback to improve the design.
- Collect user feedback, identify usability issues, and suggest design improvements

Reference Books:

1. Don Norman, "The Design of Everyday Things", Basic Books, Revised & Expanded Edition, 2013.
2. William Lidwell, Kritina Holden, Jill Butler, "Universal Principles of Design", Rockport Publishers, Revised Edition, 2010.
3. Brad Frost, "Atomic Design", Brad Frost (Self-Published), 1st Edition, 2016.
4. Refactoring UI by Adam Wathan, Steve Schoger

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-312-PEC–T: Cloud Computing

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To understand the fundamental concepts, architecture, and service models of cloud computing
- To be familiarized with cloud deployment models such as public, private, hybrid, and community cloud.
- To learn cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
- To gain knowledge of virtualization, and scalability in cloud environments
- To study issues such as cloud security, data privacy, and compliance challenges
- To know recent trends in cloud computing

Course Outcomes:

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

CO1: Explain the basic concepts, characteristics, and architecture of cloud computing

CO2: Identify and differentiate between cloud deployment models and service models (IaaS, PaaS, SaaS)

CO3: Demonstrate understanding of virtualization techniques and resource management in cloud environments

CO4: Describe cloud security issues, data privacy concerns, and risk management techniques.

Course Contents

Unit I	**Introduction to Cloud Computing**	**06 Hours**

1.1 Overview and Evolution

1.1.1 What is computing?

1.1.2. Types of computing Distributed Computing, Grid Computing, Cluster Computing, Utility Computing

1.2 Introduction to Cloud Computing

1.2.1 Features/Characteristics of a cloud

1.2.2 Advantages and Disadvantages of Cloud Computing

1.2.3 Deployment Models (Types of Cloud) - Public, Private, Hybrid and Community

1.3 Cloud Architecture

1.3.1 Deployment Models Public, Private, Hybrid and Community Cloud

1.3.2 Service Models Infrastructure as a Service, Platform as a Service, Software as a Service, Everything as a Service.

1.4 Cloud Service providers

1.5 Data center technology

1.6 Multitenant technology

1.7 Challenges of cloud computing

Unit II	**Abstraction and Virtualization**	**06 Hours**

2.1 Virtualization Technologies

2.1.1. Introduction to virtualization

2.1.2 Types of Virtualizations

2.1.3 Benefits and Disadvantages of Virtualization

2.2 Load Balancing ad Virtualization

2.2.1 What is Load Balancing

2.2.2 Working of Load Balancers

2.2.3 Advantages of Load Balancing

2.3 Hypervisors

2.3.1 What is Hypervisors

2.3.2 Types of Hypervisors

2.4 VM Migration

2.5 Virtual Machine Provisioning

2.6 Virtual Machine Life Cycle/ VM Provisioning Process

Unit III	**Programming Environment and Cloud Technologies**	**06 Hours**

3.1 Programming support for Google App Engine

3.2 Programming with Amazon AWS

3.3 Programming with Microsoft Azure

3.4 Programming with Google Cloud

3.5 Emerging Cloud software Environments

Unit IV	Emerging trends in cloud computing	06 Hours

4.1 Multi-Cloud Vs Omni-Cloud
4.2 Integrated Block chain technology
4.3 Kubernetes
4.4 Cloud AI
4.5 Intelligent SaaS
4.6 Docker
4.7 Google Vertex AI Agent Builder

Unit V	Cloud Security	06 Hours

5.1 Overview of Cloud Security
5.2 Cloud Security Threats
5.3 Cloud Security Challenges and Risk
5.4 Security Governance
5.5 Identity Management and Access Control
  5.5.1 Identity Management Multi-Factor Authentication(MFA)
  5.5.2 Identity Verification
  5.5.3 Authentication, Authorization, and Accountability (AAA)
5.5 Disaster Recovery in Clouds.

Reference Books:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", John Wiley & Sons, 1st Edition, 2011.
2. Brian J.S. Chee, Curtis Franklin Jr., "Cloud Computing Technologies and Strategies of the Ubiquitous Data Center", CRC Press, 1st Edition, 2010.
3. Barrie Sosinsky, "Cloud Computing Bible", Wiley India / John Wiley & Sons, 1st Edition, 2010.
4. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley India, 1st Edition, 2010.
5. Maveric Koston, "AWS: The Ultimate Guide from Beginners to Advanced", Independent Publishing, 1st Edition, 2020.
6. Anthony Puca, Mike Manning, et al., "Microsoft Azure: Planning, Deploying, and Managing Your Data Center in the Cloud", Microsoft Press, 1st Edition, 2015.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-313-PECP: Lab course on CA - 312- PEC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic knowledge of Cloud Computing (IaaS, PaaS, SaaS)
- Basic Linux commands
- Basic of AWS/Microsoft Azure
- Basics of Virtualization (VMware Basics)

Course Objectives:

- To Understand the SaaS, PaaS and IaaS
- To Learn Virtualization techniques.
- To know Cloud Platform such as AWS, Microsoft Azure.
- To become familiarized with Cloud and Containerization Fundamentals.
- To study cloud security concepts.

Course Outcomes:

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

CO1: Implement the cloud service Models.
CO2: Use Virtualization using Virtual Box.
CO3: Deploy the application on PaaS using Google App Engine.
CO4: Manage Cloud Infrastructure on AWS and Azure.
CO5: Apply Docker and Containerization.

Operating Environment / Software –

- **Operating Environment:** Windows 10/11 /Ubuntu
- **Software:** Oracle Virtual Box, VMware Workstation, Docker Desktop and Docker Compose, Google cloud SDK, AWS, Azure, PuTTY Visual Studio Code, Notepad++, Eclipse

List of Assignments

Assignment No	**Title**	**No. of Session (12)**

Assignment No 1	**Working and implementation of Software as Service (SAAS)**	**03**
Assignment No 2	**Understanding Virtualization using Virtual box**	**02**
Assignment No 3	**Introduction to PAAS Using Google App Engine**	**02**
Assignment No 4	**Introduction to cloud Platform AWS & Microsoft Azure**	**03**
Assignment No 5	**Containerization using Docker**	**02**

Reference Books:

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", John Wiley & Sons, 1st Edition, 2011.Arshdeep Bahga & Vijay Madisetti: Cloud Computing: A Hands-On Approach
2. Dan Sanderson, "Programming Google App Engine", O'Reilly Media, Inc., 2nd Edition, 2012.
3. Joakim Verona, "Practical DevOps", Packt Publishing, 1st Edition, 2016.
4. Dan C. Marinescu, "Cloud Computing: Theory and Practice", Morgan Kaufmann, 3rd Edition, 2022.

Free Online Resources (Practical Reference)

1. AWS → docs.aws.amazon.com
2. Azure → learn.microsoft.com
3. Google Cloud → cloud.google.com/docs
4. Docker → docs.docker.com
5. VirtualBox → virtualbox.org/wiki/Documentation

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-314-PEC-Cyber Security

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To understand the fundamental concepts, principles, and terminology of cyber security.
- To study various types of cyber threats, attacks, and vulnerabilities affecting information systems.
- To know security requirements for computer systems, networks, and applications.

Course Outcomes:

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

CO1: Explain basic concepts of cyber security, cybercrimes, CIA triad, and cyber threats.

CO2: Classify cyber offenses and cyber stalking and analyze their impact.

CO3: Enumerate cybercrime tools and techniques including malware, phishing, and network attacks.

CO4: Apply basic cryptographic concepts and encryption techniques for secure communication.

CO5: Describe fundamentals of cyber forensics, digital evidence, and investigation tools.

Course Contents

Unit I	**Introduction to Cyber Security**	**05 Hours**

1.1 Definition and Importance of Cyber Security

1.2 Cyber Space and Cyber Crime

1.3 Who are Cybercriminals?

1.4 Classifications of Cybercrimes: E-Mail Spoofing, Spamming, Cyber defamation, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling, Forgery, Web Jacking, Newsgroup, Online Frauds, Computer Sabotage, Email Bombing/Mail Bombs, Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft

1.5 Security Goals: (CIA Triad)

1.6 Types of Cyber Threats:

1.6.1 Malware (Virus, Worm, Trojan, Ransom ware, Spyware)

1.6.2 Phishing and Social Engineering

1.6.3 Insider Attacks

1.7 Cyber Security Challenges in AI and Modern Systems
1.8 Introduction to use of AI in Security

Unit II	Cyber Offenses and Cyber Stalking	07 Hours

2.1 Introduction to Cyber Offenses: Meaning and scope of cyber offenses, Difference between traditional crime and cybercrime, Evolution of cybercrime in the digital era, Impact on individuals, organizations, and society

2.2 Techniques Used in Cyber Offenses: Password attacks (brute force, credential stuffing), Network based attacks: MITM, packet sniffing

2.3 Cyber Stalking: Definition and Characteristics of cyber stalking, Key behaviours: persistent monitoring, unwanted contact, intimidation, Types of Cyber Stalking: Email harassment, social media stalking, Impersonation and fake profiles, Continuous monitoring of online activity, Real-Life Incident of Cyber stalking

2.4 Tools and Methods Used by Stalkers: Tracker links and IP grabbers, Misuse of social network features, GPS/geolocation misuse, Account takeover techniques

Unit III	Tools and Methods Used in Cybercrime	07 Hours

3.1 Introduction
3.2 Proxy Servers and Anonymizers
3.3 Phishing
3.4 Password Cracking
3.5 Keyloggers and Spywares
3.6 Trojan Horses and Backdoors
3.7 Steganography
3.8 DoS and DDoS Attacks
3.9 Attacks on Wireless
3.10 SQL Injection

Unit IV	Cryptography and Encryption	05 Hours

4.1 Data Encryption standards.
4.2 Symmetric and Asymmetric Encryption
4.3 RSA Cryptosystem, ECC Cryptography, SSL and TLS in cryptography
4.4 Digital Signature
4.5 Block Cipher
4.6 Types of Encryption methods
4.7 Process of Encrypting and Decrypting data

Unit V	Cyber Forensics	06 Hours

5.1 Introduction to Cyber Forensics:-

5.1.1 Meaning, Objectives and importance of cyber forensics

5.1.2 Scope and application of cyber forensics

5.2 Cyber Crimes and Digital Evidence: -

5.2.1 Types of Cyber Crimes: -Hacking, Identity theft, Cyber stalking

5.2.2 Concept of Digital Evidence

5.2.3 Types of Digital Evidence - Volatile evidence, on-volatile evidence

5.3 Cyber Forensics Investigation Process: -

5.3.1 Phases of Cyber Forensic Investigation

5.4 Cyber Forensics Tools and Techniques

5.4.1 Software Tools: -EnCase, FTK (Forensic Toolkit), Autopsy

5.4.2 Hardware Tools: Write blockers

5.4.3 Basic forensic techniques: -Disk imaging, Data recovery, Log analysis

Reference Books:

1. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India, 1st Edition, 2011.

2. Paul Bocij, "Cyber Stalking: Harassment in the Internet Age and How to Protect Your Family", Praeger Publishers, 1st Edition, 2004.

3. Yuri Diogenes, Erdal Ozkaya, "Cyber Security – Attack and Defense Strategies", Packt Publishing, 2nd Edition, 2019.

4. Don Franke, "Cyber Security Basics: Protect your organization...", Independent Publishing, 1st Edition, 2019.

5. Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security", Cengage Learning, 3rd Edition, 2011.

6. William Stallings, "Cryptography and Network Security: Principles & Practice", Pearson Education, 6th Edition, 2014.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-315-PECP: Lab course on CA-314-PEC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic Python programming, understanding of data hiding techniques
- Understanding of data hiding techniques, Basic networking (TCP/IP, HTTP, DNS), Cryptography

Course Objectives:

- To understand and evaluate system security policies and identify phishing attacks.
- To study security programs like phishing simulation and hashing using Python.
- To know password cracking methods (dictionary vs brute force) and apply prevention techniques.
- To learn steganography and memory forensics to hide, extract, and analyze digital data.
- To be familiarized with creating digital evidence using forensic tools

Course Outcomes:

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

CO1: Describe basics of digital forensics, legal issues, and chain of custody.
CO2: Use forensic tools like Autopsy and FTK Imager to collect and analyze evidence.
CO3: Evaluate anonymity tools and steganography for data hiding and security.
CO4: Identify and prevent phishing, social engineering, and password attacks.
CO5: Apply security practices to protect against cyber threats.

Operating Environment / Software –

- **Operating Environment:** Windows/Linux/Mac
- **Software:** Python 3.x - Text editor / IDE (VS Code, PyCharm), FTK Imager (Lite), Autopsy, Wireshark, USBDeview, LastActivityView.

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Check the security policies in the system Identify phishing emails**	**01**

- Write a Python program for Phishing Simulation.
- Write a Python Program to Simple Hash Simulation.

Assignment No 2	**Case Study**	**02**

- Investigating Password Cracking methods (Dictionary vs. Brute Force)

Assignment No 3	**Demonstration of Steganography tools to hide and retrieve data within image files**	**01**
Assignment No 4	**Capture and analyze RAM to extract processes, network connections, and user sessions.**	**02**
Assignment No 5	**Create Forensic Image using FTK Imager/Encase Imager and Check Integrity of Data**	**02**
Assignment No 6	**Analyze a PCAP file to detect malicious network activity**	**02**
Assignment No 7	**Encrypt and Decrypt and RSA Algorithm**	**02**

- Implement the Caesar Cipher to encrypt and decrypt a given message.
- Implement the RSA Algorithm to encrypt and decrypt a numeric message.

Reference Books:

1. Nihad A. Hassan, "Digital Forensics Basics: A Practical Guide Using Windows OS", Apress, 1st Edition, 2019.
2. Niranjan Reddy, "Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations", Apress, 1st Edition, 2019
3. Yuri Diogenes, Erdal Ozkaya, "Cyber Security – Attack and Defense Strategies", Packt Publishing, 2nd Edition, 2019.
4. Don Franke, "Cyber Security Basics: Protect your organization...", Independent Publishing, 1st Edition, 2019
5. Michael E. Whitman, Herbert J. Mattord, "Principles of Information Security", Cengage Learning, 3rd Edition, 2011.
6. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education, 6th Edition, 2014.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-321-VSEC: Core Java Programming

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites:

- Basic Programming Knowledge and logic building.
- Understanding of Object-Oriented Programming (OOP) Concepts.

Course Objectives:

- To learn implementation of object-oriented concepts with Java.
- To understand implementation interfaces and packages.
- To know the process of exception handling and file handling.
- To acquire knowledge of collections in Java.
- To study multithreading implementation.

Course Outcomes:

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

CO1: Identify classes, objects, class members and relationships for a given problem.
CO2: Design end to end applications using object oriented constructs.
CO3: Apply collection classes for storing java objects.
CO4: Use Java APIs for program development.
CO5: Handle abnormal termination of a program using exception handling.

Operating Environment / Software –

- **Operating Environment:** Windows/Linux/Mac
- **Software:** JDK (OpenJDK or Oracle JDK)/Visual Studio Code/ Eclipse IDE /Notepad++

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Basics of Java, Classes and Objects Classes and objects, Array of objects, Static keyword, Constructor**	**04**
Assignment No 2	**Inheritance , Interface and Packages**	**03**
Assignment No 3	**Exception Handling and I/O**	**02**

Assignment No 4	**Collections: List, Set, Map interface related classes**	**02**
Assignment No 5	**Applet Programming and Threading**	**01**

Reference Books:

1. Kathy Sierra, Bert Bates, "Head First Java", O'Reilly Media, 3rd Edition, 2022.
2. Herbert Schildt, "Java: A Beginner's Guide", McGraw-Hill Education, 9th Edition, 2022.
3. Bruce Eckel, "Thinking in Java", Prentice Hall, 4th Edition, 2006.
4. E. Balagurusamy, "Object-Oriented Programming with Java", McGraw-Hill Education India, 6th Edition, 2019.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-331-FP: Field Project

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To provide exposure to students and sensitize them to real-world field issues and societal problems.
- To know appropriate methodologies for conducting field work and data-driven analysis.

Course Outcomes:

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

CO1: Identify and define real-world problems in community, organizational, or industrial settings using systematic field investigation methods.

CO2: Design and implement appropriate fieldwork methodology including survey design, data collection techniques, documentation, and use of analytical tools.

CO3: Analyze and interpret collected data using suitable IT tools and techniques to derive meaningful insights.

CO4: Develop and propose feasible technology-based solutions (software prototype, database system, web/mobile application, automation model, etc.) to address the identified problem.

CO5: Communicate findings effectively through structured documentation, presentation, and professional reporting practices.

Guidelines for the faculty

- A faculty member shall be assigned as a guide for each group of 3–4 students.
- The assigned guide shall assist the group in:
  - Identifying an appropriate topic/area (from the suggested list or beyond).
  - Defining objectives, problem statement and expected outcomes.
  - Designing questionnaires or strategy for data collection.
  - Selecting appropriate technologies and analytical tools.
  - Suggesting feasible IT-based solutions.
  - Structuring and reviewing the project report.
- The guide shall continuously monitor, track, mentor, and assess the progress of the group throughout the semester.
- Regular review meetings must be conducted and documented.

Guidelines for Students

- Students shall work in groups of 3 or 4.
- Each group shall select a topic in consultation with the assigned guide.
- The group shall finalize:
    - Objectives
    - Problem statement
    - Expected outcomes
    - Methodology
    - Data collection techniques (survey, interviews, observation, case study, etc.)
    - Tools for analysis (Excel, Power BI, Python, SPSS, Database tools, etc.)
        - The project plan must be approved by the guide before execution.
        - Field work to be conducted during free slots, before/after college hours, weekends, or holidays.
        - Each student must maintain an individual Daily Diary/Log Book recording:
    - Tasks performed
    - Observations
    - Field visit details
    - Learning reflections

Suggested Timeline

- Week 1: Identification of Organization
- Week 2: Define Objectives, problem statement, outcomes and Obtain Approval
- Week 3–7: Execution of Field Tasks and Daily Diary Maintenance
- Week 8–9: Report Compilation and Documentation
- Week 10: Final Presentation and Submission

Criteria for Continuous Evaluation and end semester evaluation	
Sr. No.	**Criteria**
1	**Attendance and Participation**
2	**Daily Diary / Log Book**
3	**Report writing and contents**
4	**Presentation and Viva**
5	**Industry Supervisor Feedback**

FP Activities

Students are expected to engage in practical IT-oriented tasks such as:

- Software/Application Development
- Website Design & Development
- Database Design and Automation
- Data Analysis and Visualization
- Testing and Debugging
- IT Support and System Maintenance
- Digital Marketing / Content Management
- Requirement Analysis and Documentation
- Any domain-specific IT-related implementation work

Note:

- The Field Project must be distinct from CEP/NSS/NCC activities.
- Students should preferably work on real-world problems or live projects.
- Online field work may be permitted but with proper verification and monitoring.
- Students are encouraged to adopt interdisciplinary approaches and innovative technologies.

Project Report Structure:

The FP report should include:

- Title Page
- Certificate from Organization
- Acknowledgement
- Abstract
- Organization Profile
- Objectives of the project
- Technologies Used
- Work Done / Tasks Performed
- Learning Outcomes
- Challenges Faced
- Solutions Implemented
- Conclusion
- Annexure (Screenshots, Code, Certificates, etc.)

Reference Books:

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.
3. Design Thinking for Social Innovation. IDEO Press, 2015.
4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

Detailed Drafts For Level 5.5

TY B. Sc. (Computer Applications)

SEMESTER VI

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-351-PCC: Software Project Management

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 35 Marks** **End Semester: 15 Marks**

Pre-requisite Course:

- Software Engineering

Course Objectives:

- To understand the fundamentals of Software Project Management
- To learn tools for Software project planning and management
- To study software project scheduling and tracking
- To know the agile project management

Course Outcomes:

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

CO1: Comprehend Software Project Management Concepts

CO2: Use tools for Software Project Management

CO3: Track a project and manage changes

CO4: Apply Agile Project Management concepts

Course Contents

Unit I	**Introduction to Software Project Management**	**06 Hours**

1.1 Project Definition
1.2 Project versus Flow type work
1.3 Project Lifecycle
1.4 Processes and Knowledge Areas in Project Management (PM)
1.5 Build or Buy decision
1.6 Work Breakdown Structure (WBS) and its types
1.7 Introduction to PMBOK
1.8 Program and Portfolio Management

Unit II	**Project Planning and Project Management Tools**	**06 Hours**

2.1 Project Planning
2.2 Steps for Project Planning,
2.3 PERT and Gantt Charts
2.4 Introduction to Project Management using Gantt Project
2.5 Objectives of Activity planning
2.6 Project Schedules, Activities, Sequencing and Scheduling
2.7 Network Planning Models,
2.8 Formulating Network Model.

Unit III	Activity based Scheduling	06 Hours

3.1 Introduction
3.2 Objectives of Activity Planning
3.3 Activity relationships (FS, SF, SS, FF)
3.4 Forward Pass technique
3.5 Backward Pass techniques
3.6 Critical Path concept and remedies

Unit IV	Project Tracking and Control	06Hours

4.1 Introduction
4.2 Collection of Project data
4.3 Visualizing progress
4.4 Cost monitoring
4.5 Earned Value Analysis
4.6 Project tracking
4.7 Change Control
4.8 Software Configuration Management
4.9 Managing contracts and Contract Management.

Unit V	Agile Project Management	06Hours

5.1 Predictive versus Empirical Management
5.2 Comparison between Non-Agile and Agile Project
5.3 Three stages of Agile Project
5.4 Estimation
5.5 Scope Management

5.6 Role and Responsibilities
5.7 Scheduling and Tracking

Reference Books:

1 Ken Schwaber, "Agile Project Management", Microsoft Press, 1st Edition, 2004.

2 Walker Royce, "Software Project Management", Addison-Wesley, 1st Edition, 1998.

3 Pankaj Jalote, "Software Project Management in Practice", Addison-Wesley Professional, 1st Edition, 2002.

4 Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", Project Management Institute, 7th Edition, 2021.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-352-PCC: Web Programming

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To learn how to build dynamic web pages using client-side and server-side web technologies.
- To understand architecture of WWW, Internet
- To know use of SQL/PLSQL programming in data driven website development
- To know Client-side and Server-side programming concepts and techniques.
- To be familiarized with the process of testing and debugging of web pages.

Course Outcomes:

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

CO1: Describe the role of Java Script in web programming.

CO2: Build Dynamic web pages.

CO3: Write PHP scripts to interact with users and handle form data.

CO4: Develop simple data-driven web applications.

Course Contents

Unit I	**Client-Side Web Programming**	**06 Hours**

1.1 Introduction to JavaScript: Overview of JavaScript, Need and applications, Advantages and Limitations

1.2 Using JavaScript in HTML: Embedded JavaScript, External JavaScript

1.3 JavaScript Basics: Variables, Data types

1.3 Control Structures: if–else statement, switch case

1.4 Loop Control Statements: for loop, while loop, “for..in” loop

1.5 Functions and Dialog Boxes: Functions, Alert, Confirm, Prompt boxes

1.6 Events and Cookies: JavaScript events, Cookies.

Unit II	**Server-Side Web Programming - PHP**	**07Hours**

2.1 Introduction to server-side scripting, Role of server-side scripting vs client-side
2.2 Introduction to PHP, PHP - Lexical structure, Language basics.
2.3 Control Structures
2.4 Defining and calling a function, Function parameters, String Functions
2.5 Indexed Vs Associative Arrays, identifying elements of an array, storing data in array, Multidimensional arrays, Extracting multiple values, Traversing arrays

Unit III	Core OOP Concepts in PHP	8Hours

3.1 Classes and Objects: Defining classes and creating objects, Class templates vs object instances Using $this keyword
3.2 Properties and Methods: Public, private, and protected members, Static properties and methods
3.3 Constructors and Destructors: construct () and destruct () functions
3.4 Encapsulation: Data hiding and access modifiers, Getters and setters.
3.5 Inheritance: Extending classes (extends), Parent vs child behavior.
3.6 Polymorphism and Method Overriding, Use in class hierarchies
3.7 Abstract Classes and Interfaces: Abstract classes, Interfaces and contract-based design

Unit IV	Database Connectivity	05 Hours

4.1 Introduction to relational databases (MySQL)
4.2 CRUD operations: SELECT, INSERT, UPDATE, DELETE
4.3 PHP-MySQL integration: connecting to database, executing queries
4.4 Displaying database results in web pages

Unit V	Introduction to XML	04Hours

5.1 Introduction to XML
5.2 Uses of XML
5.3 Simple XML examples
5.4 XML key components
5.5 DTD and Schemas
5.6 Using XML in web applications.

Reference Books:

1. Steven Holzner, "HTML Black Book", Dreamtech Press, 1st Edition, 2000.
2. Kogent Learning Solutions Inc., "Web Technologies Black Book", Dreamtech Press, 1st Edition, 2014.
3. Craig Knuckles, David Yuen, "Web Applications: Concepts and Real World Design", John Wiley & Sons, 1st Edition, 2006.
4. Paul Deitel, Harvey Deitel, "Internet and World Wide Web How to program", Pearson, 5th Edition, 2012.
5. Rasmus Lerdorf, Kevin Tatroe, Peter MacIntyre, "Programming PHP", O'Reilly Media, 4th Edition, 2020.
6. Welling, Luke and Laura Thomson. Beginning PHP5. Wrox Publication, 2004.
7. Ullman, Larry. PHP Web Services. Wrox Publication, 2006.
8. Nixon, Robin. Mastering PHP. BPB Publications, 2010.
9. Sklar, David and Adam Trachtenberg. PHP Cookbook. 2nd Edition, O'Reilly Media, 2006.
10. Vaswani, Vikram. PHP for Beginners. SPD Publications, 2008.
11. Sebesta, Robert W. Programming the World Wide Web. 3rd Edition, Pearson Education, 2007.
12. Shenoy, Aravind. Thinking in HTML. SPD Publications, 2011.
13. Myers, Mark. Learn HTML and CSS Faster. 1st Edition, CreateSpace Independent Publishing, 2015.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-353-PCCP: Lab course on CA-352-PCC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- VSEC-101-CA -HTML and Web Page Designing

Course Objectives:

- To be familiar with basics of the Web Programming.
- To acquire knowledge and skills for creation of website using client and server side programming
- To understand process of developing responsive web applications
- To explore different web extensions and web services standards

Course Outcomes:

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

CO1: Design and implement static and dynamic web sites using appropriate client side and server-side technologies

CO2: Build Dynamic web site using PHP Programming and Database connectivity.

CO3: Create applications using XML and web services.

Operating Environment / Software –

- **Operating Environment:** Windows
- **Software:** WAMP/XAMPP

List of Assignments

Assignment No	Title	No. of Session (12)
Assignment No 1	PHP Programming	02
Assignment No 2	Class and Object	02
Assignment No 3	Use of Functions, Arrays	02
Assignment No 4	Use of Inheritance and Interfaces	02

Assignment No 5	**Accessing Databases**	**02**
Assignment No 6	**Use XML**	**02**

Reference Books:

1. Steven Holzner, "HTML Black Book", Dreamtech Press, 1st Edition, 2000.
2. Kogent Learning Solutions Inc., "Web Technologies Black Book", Dreamtech Press, 1st Edition, 2014.
3. Craig Knuckles, David Yuen, "Web Applications: Concepts and Real World Design", John Wiley & Sons, 1st Edition, 2006.
4. Paul Deitel, Harvey Deitel, "Internet and World Wide Web How to program", Pearson, 5th Edition, 2012.
5. Rasmus Lerdorf, Kevin Tatroe, Peter MacIntyre, "Programming PHP", O'Reilly Media, 4th Edition, 2020.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-354-PCC: Operating system Design

Teaching Scheme **Theory: 04 Hours/Week**	**Credits: 04**	**Examination Scheme** **Continuous Evaluation: 30 Marks** **End Semester: 70 Marks**

Course Objectives:

- To understand the concept of operating system.
- To study the various functions and services provided by operating system
- To learn algorithms for CPU/process scheduling and disk scheduling
- To be familiar with process synchronization, deadlocks and memory management

Course Outcomes:

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

CO1: Apply algorithms for Processes, CPU and Disk scheduling

CO2: Describe process synchronization and deadlocks

CO3: Compare and contrast techniques for memory management.

CO4: Define operating system services

Course Contents

Unit I	**Introduction to Operating System**	**12 Hours**

1.1 Operating Systems Overview- System Overview and Functions of operating systems
1.2 What does an OS do?
1.3 Operating system Operations
1.4 Operating system structure
1.5 Protection and security
1.6 Computing Environments- Traditional, mobile, distributed, Client/server, peer to peer computing
1.7 Open-source operating System
1.8 Booting
1.9 Operating System services
1.10 System calls Types of System calls and their working.

Unit II	**Process and Process Scheduling**	**12 Hours**

2.1 Process Concept – The processes, Process states, Process control block.
2.2 Process Scheduling – Scheduling queues, Schedulers, context switch
2.3 Operations on Process – Process creation with program using fork (), Process termination
2.4 Basic Concept - CPU I/O Burst Cycle, Scheduling Criteria, CPU Schedular, Preemptive Scheduling, Dispatcher
2.5 Scheduling Algorithm – FCFS, SJF, Priority Scheduling, Round-Robin Scheduling, Multiple Queue Scheduling, Multilevel Feedback Queue Scheduling

Unit III	Synchronization	7 Hours

3.1 Background
3.2 Critical Section Problem
3.3 Semaphores: Usage, Implementation
3.4 Classic Problems of Synchronization – The bounded buffer problem, The reader writer problem, The dining philosopher problem

Unit IV	Deadlock	10 Hours

4.1 What is deadlock?
4.2 Deadlock Characterization – Necessary Conditions
4.3 Resource Allocation Graph
4.4 Deadlock Prevention
4.5 Deadlock Avoidance - Safe state, Resource-Allocation-Graph Algorithm, Banker's Algorithm
4.6 Deadlock Detection
4.7 Recovery from Deadlock – Process Termination, Resource Preemption

Unit V	Memory Management	12 Hours

5.1 Background – Basic Hardware, Address Binding, Logical Versus Physical Address Space, Dynamic Loading, Dynamic Linking and Shared Libraries, Overlays
5.2 Swapping
5.3 Contiguous Memory Allocation – Memory mapping and protection, Memory allocation, Fragmentation
5.4 Paging – Basic Method, Hardware support, Protection, Shared Pages
5.5 Segmentation – Basic concept, Hardware
5.6 Virtual Memory Management – Demand paging, Performance of demand paging, Page replacement – FIFO, Optimal, LRU, Second Chance Algorithm

Unit VI	File System Management and Disk Scheduling	12 Hours

5.1 Basic Concepts: File, File attributes, File operations.
5.2 Allocation Methods – Contiguous allocation, Linked allocation, Indexed allocation
5.3 Free Space Management and Disk Structure–Free space management techniques: Bit vector, linked list, Grouping, Counting.
5.4 Disk structure
5.5 Introduction to Disk Scheduling- Need of disk scheduling, Disk access time components (Seek time, Rotational latency, Transfer time)
5.6 Goals of disk scheduling-Minimize seek time, maximize throughput, Fairness, Reduce response time.
5.7 Disk Scheduling Algorithms- First Come First Serve (FCFS), Shortest Seek Time First (SSTF), SCAN (Elevator Algorithm), C-SCAN (Circular SCAN), LOOK, C-LOOK
5.8 Performance Evaluation-Head movement calculation, Average seek time, Comparison of disk scheduling algorithms, Numerical problems based on (Total head movement and Average seek time)
5.9 Disk Management (Basic Concepts)-Disk formatting, Disk partitioning, Booting from disk.

Reference Books:

1. Avi Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", John Wiley & Sons (Wiley Asia), 10th Edition, 2018.

2. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning, 2nd Edition, 2015.

3. Andrew S. Tanenbaum, Herbert Bos, "Modern Operating Systems", Pearson, 4th Edition, 2014.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-355-PCCP: Lab course on CA-354-PCC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic knowledge of Operating System
- Understanding of System calls
- Familiarity with Process and Process Scheduling.
- Basic concept of Deadlock, Memory Management

Course Objectives:

- To know in detail System Calls
- To implement the Process Scheduling algorithms
- To understand concept of Deadlock
- To know the working of Page replacement algorithms
- To implement Disk Scheduling algorithms

Course Outcomes:

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

CO1: System calls on Operating System.
CO2: Process and Scheduling algorithms.
CO3: Deadlock and Bankers algorithm.
CO4: To Know the details of Memory Management.
CO5: Disk Scheduling Algorithms.

Operating Environment / Software –

- **Operating Environment:** Windows/Linux/Mac
- **Software:** VS Code / TurboC

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Operating system commands, useful utilities**	**03**
Assignment No 2	**Process Scheduling**	**02**
Assignment No 3	**Deadlock Handling**	**02**

Assignment No 4	**Memory Management**	**03**
Assignment No 5	**Disk Scheduling**	**02**

Reference Books:

1. Operating System Concepts, Avi Silberschatz, Peter Galvin, Greg Gagne, Student Edition, Wiley Asia
2. Operating Systems: Internals and Design Principles, William Stallings, Prentice Hall of India.
3. The 'C' Odyssey, UNIX-the open boundless C, Meeta Gandhi, Tilak Shetty, Rajiv Shah, BPB publication

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-360-PEC: Prompt and Generative AI

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To understand fundamental concepts of Generative Artificial Intelligence.
- To study generative AI applications, including chatbots and automated content generation workflows.
- To learn how AI tools like ChatGPT work at a conceptual level.
- To know ethical, legal, and societal implications of AI

Course Outcomes:

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

CO1: Use prompt engineering on large language models.

CO2: Describe concepts of Generative AI and Large Language Models

CO3: Evaluate AI-generated responses for clarity, correctness, bias, and usefulness.

CO4: Create small AI-assisted applications/projects

CO5: Apply generative AI techniques for idea generation, documentation, summarization etc..

Course Contents

Unit I	**Fundamental of Prompt Engineering**	**05 Hours**

1.1 Introduction

1.2 What is a prompt? Why prompts are important?

1.3 Types of prompts

- 1.3.1 Simple prompts
- 1.3.2 Instruction prompts
- 1.3.3 Role-based prompts

1.4 Prompt structure or Prompt Components

- 1.4.1 Context
- 1.4.2 Task
- 1.4.3 Input / Output format

1.5 Good vs Bad prompts

Unit II	Advanced Prompting Techniques	07 Hours

2.1 Prompt Refinement and Optimization

2.2 Advanced Prompt Techniques

- 2.2.1 Chain-of-Thought Prompting
- 2.2.2 Role-Based Prompting
- 2.2.3 Tree of Thought (ToT) Prompting

2.3 Image Generation

- 2.3.1 Text-to-Image Models
- 2.3.2 Prompting for Image Quality

2.4 Code Generation using AI

2.5 AI for Data Analysis and Summarization

2.6 Prompt Evaluation Techniques

Unit III	Introduction to Generative AI	06 Hours

3.1 What is Generative AI?

3.2 History and Evolution of Generative Models

3.3 Artificial Intelligence vs Machine Learning vs Deep Learning

3.4 Types of Generative Models

- 3.4.1 Rule-based Systems
- 3.4.2 Neural Networks

3.5 Transformer Models

3.6 Applications of Generative AI

Unit IV	Large Language Models (LLMs) and Prompting Strategies	07Hours

4.1 Introduction to Large Language Models (LLMs)

4.2 Architecture of Transformer Models

4.3 Tokens, Embeddings, Attention Mechanism

4.4 Advantages and Disadvantages and Application of LLM's

4.5 Prompting for Code Generation

4.6 AI-assisted Debugging and Optimization

4.7 Prompting for Research and Documentation

4.8 Prompting for Data Analysis

Unit V	Ethical, Legal and Social Aspects of AI	05 Hours

5.1 Ethical Issues in Generative AI

5.2 Responsible AI and AI Ethics

5.3 Data Privacy and Security

5.4 Copyright and Plagiarism Issues

5.5 AI Bias and Fairness

5.6 Misuse of Generative AI

5.7 Responsible AI Guidelines and Future Scope

Reference Books:

1. Russell, Stuart J. and Peter Norvig. Artificial Intelligence: A Modern Approach. 4th Edition, Pearson Education, 2021.
2. Rich, Elaine and Kevin Knight. Artificial Intelligence. 2nd Edition, McGraw-Hill Education, 1991.
3. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. 3rd Edition, O'Reilly Media, 2022.
4. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. 1st Edition, MIT Press, 2016.
5. DAIR.AI. Prompt Engineering Guide. Online Resource, DAIR.AI, 2023.
6. Mollick, Ethan. Co-Intelligence: Living and working with AI. 1st Edition, Portfolio/Penguin Random House, 2024.
7. OpenAI Official Documentation. OpenAI, Online Resource, 2025.
8. Research Articles on Generative AI published in journals and conference proceedings including IEEE, Springer, Elsevier, and ACM Digital Library, 2020–2025.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-361-PECP: Lab course on CA-360-PEC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic knowledge of computers and internet usage
- Fundamentals of programming concepts
- Basic understanding of artificial intelligence concepts.

Course Objectives:

- To study Generative AI tools and their practical usage.
- To know skills in prompt writing and prompt optimization.
- To learn to generate and analyze AI-based outputs.
- To be familiar with different prompting techniques.
- To understand prompt engineering concepts for creative and technical tasks.

Course Outcomes:

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

CO1: Use Generative AI tools for basic text generation tasks.

CO2: Design effective prompts for structured and role-based outputs.

CO3: Apply zero-shot, one-shot, and few-shot prompting techniques.

CO4: Perform summarization, paraphrasing, and reasoning-based tasks using AI tools.

CO5: Generate and debug simple programs using prompt engineering techniques.

Operating Environment / Software –

- **Operating Environment:** Windows/Linux/macOS
- **Software:** Python 3.11.x / Visual Studio Code - version 1.85 or later / Jupyter Notebook 7.x

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Basics of Prompting**	**01**

- Create instruction-based prompts for writing an email explaining a technical concept and Generating a checklist etc.

Assignment No 2	**Prompt Refinement and Optimization**	**02**
• Apply prompt optimization techniques • Basic Text Generation Using Simple Prompts		
Assignment No 3	**Advanced Prompting Techniques**	**02**
• Implement Chain-of-Thought Prompting • Design Role-Based Prompts		
Assignment No 4	**Introduction to Generative AI**	**02**
• Identify real-world applications of Generative AI • Explore different generative models		
Assignment No 5	**Large Language Models and Code Generation**	**02**
• Analyze effect of prompt specificity on code quality. • Text Summarization Using Prompts		
Assignment No 6	**AI-assisted Debugging and Optimization**	**01**
• Provide buggy code and prompt AI to Identify errors and fix the code • Prompt AI for Best practices and Code comments and documentation and Text Paraphrasing Using Prompt		
Assignment No 7	**Prompting for Research and Data Analysis**	**01**
• Use prompts for Literature review summary and Research paper outline • Generate structured reports using output formatting prompts.		
Assignment No 8	**Ethical, Legal and Social Aspects of AI**	**01**
• Case study on AI bias, Copyright infringement, Data privacy • Identify examples of misuse of Generative AI.		

Reference Books:

1. Generative AI Basics and Applications. 1st Edition, Springer Publications, 2023.
2. DAIR.AI. Prompt Engineering Guide. Online Resource, DAIR.AI, 2023.
3. Russell, Stuart J. and Peter Norvig. Artificial Intelligence: A Modern Approach. 4th Edition, Pearson Education, 2021.
4. McKinney, Wes. Python for Data Analysis. 3rd Edition, O'Reilly Media, 2022.
5. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. 3rd Edition, O'Reilly Media, 2022.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-362-PEC: Big Data and Analytic

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To study the characteristics and applications of big data.
- To understand processing of available data and prediction of outcomes.
- To learn tools for big data.

Course Outcomes:

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

CO1: Demonstrate understanding of Big Data and its challenges, opportunities, and applications

CO2: Comprehend concepts of MapReduce and functional programming

CO3: Describe architecture and modelling techniques.

Course Contents

Unit I	**Introduction to Big data**	**06Hours**

1.1 Big Data: Definition and taxonomy
1.2 Sources of Big Data
1.3 Big Data Architecture
1.4 3V's of Big Data (need for Hadoop
1.5 Varying data structures
1.6 Characteristics of Big Data
1.7 Applications of Big Data
1.8 Challenges in Big Data
1.9 Big Data Implications for Industries, Big Data Analytics for Telecom/Banking/Retail/HealthCare/IT/Operations

Unit II	**Emerging Database Landscape**	**03 Hours**

2.1 Scale-Out Architecture, RDBMS Vs Non-Relational Database
2.2 Database Workload and its Characteristics
2.3 Implication of Big Data Scale on Data Processing

Unit III	Application Architecture and Data Modeling for Big Data and Analytics	06Hours

3.1 Big Data Warehouse and Analytic

3.2 Life Cycle Phases of Big Data

3.3 Big data Warehouse System requirements and Hybrid Architectures

3.4 Enterprise Data Platform Ecosystem

3.5 Big Data and Master Data Management

3.6 Understanding data integration Pattern

3.7 Big Data Workload Design Approaches

3.8 Map-Reduce patterns, Algorithms and Use Cases

Unit IV	The Hadoop Ecosystem	08Hours

4.1 Introduction to Hadoop
4.2 Hadoop Architecture
4.3 History of Hadoop-Facebook, Dynamo, Yahoo, Google
4.4 Hadoop Components: HDFS, MapReduce
4.5 Introduction to Pig, Hive, HBase, Mahout
4.6 Installation of single node cluster- installation of java Hadoop configuration

Unit V	Extracting Value from Big Data	07Hours

5.1 Real Time Analytics
5.2 Data Sample- Definition, Advantage and Challenges of data sampling, Types, Method Process
5.3 In-Memory Data Grid for real Time Analysis
5.4 Map reduce & Real Time Processing, Use Cases
5.5 Big Data Analytics Methodology- Analyze and evaluate business cases
5.6 Develop Business Hypothesis –Analyze outcomes, Build and Prepare Data Sets, Select and Build Analytical Model Design for Big Data scale, build production ready system, setting up the Big Data Analytics system, Gathering data, measure and monitor

Reference Books:

1. Jagdeesh, Madhu, Soumendra Mohanty, and Harsha Srivatsa. Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics. 1st Edition, Apress Publications, 2013.
2. Ohlhorst, Frank J. Big Data Analytics: Turning Big Data into Big Money. 1st Edition, Wiley Publications, 2012.
3. Molaro, Cristian, Surekha Parekh, and Terry Purcell. DB2 11: The Database for Big Data and Analytics. 1st Edition, MC Press Online, 2013.
4. White, Tom. Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale. 4th Edition, O'Reilly Media/SPD Publications, 2015.
5. DT Editorial Services. Big Data Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization. 1st Edition, Dreamtech Press, 2015.
6. Marr, Bernard. Big Data in Practice: How 45 Successful Companies Used Big Data Analytics to Deliver Extraordinary Results. 1st Edition, Wiley Publications, 2016.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-363-PECP: Lab course on CA-362-PEC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic knowledge of C/CPP programming
- Basic understanding of data structures
- Basic knowledge of statistics

Course Objectives:

- To understand R programming concepts
- To implement data structures in R
- To perform data visualization
- To understand big data tools like Hadoop
- To apply analytical techniques on data

Course Outcomes:

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

CO1: Understand R programming basics.
CO2: Apply data structures in R.
CO3: Perform data visualization.
CO4: Install and use Hadoop.

Operating Environment / software –

- **Operating Environment:** Windows/Linux/macOS
- **software:** Python (Jupiter/Anaconda) / R Software

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**R Programming Basics, List, Matrix, String, Factors, Data Frame and Visualization.**	**04**
Assignment No 2	**Installation and using Hadoop**	**02**
Assignment No 3	**String and Functions in R**	**02**

Assignment No 4	Decision Making and Loop Control in R	04

Reference Books:

1. Jagdeesh, Madhu, Soumendra Mohanty, and Harsha Srivatsa. *Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics*. 1st Edition, Apress Publications, 2013.
2. Ohlhorst, Frank J. *Big Data Analytics: Turning Big Data into Big Money*. 1st Edition, Wiley Publishers, 2012.
3. Molaro, Cristian, Surekha Parekh, and Terry Purcell. *DB2 11: The Database for Big Data and Analytics*. 1st Edition, MC Press, 2013.
4. White, Tom. *Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale*. 4th Edition, O'Reilly Media/SPD Publications, 2015.
5. DT Editorial Services. *Big Data Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization*. 1st Edition, Dreamtech Press, 2015.
6. Marr, Bernard. *Big Data Case Studies: Examples of Big Data in Real Life*. 1st Edition, Wiley Publications, 2015.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-364-PEC: Mobile Application Development

Teaching Scheme **Theory: 02 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Course Objectives:

- To Understand the fundamental concepts of mobile technologies, tools and Android programming.
- To study the process of develop and deploy Android applications.
- To Learn the Android architecture framework.
- To know SQLite, Location based features for development of mobile applications.

Course Outcomes:

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

CO1: Comprehend the fundamentals of mobile technology, tools and Android programming

CO2: Use appropriate techniques and modern Android development tools

CO3: Design and create visually appealing and user-friendly Android application interfaces using UI components, layouts, and Android design principles.

CO4: Develop Android applications with data storage and management capabilities using SQLite and analyze data handling requirements.

CO5: Design, develop, and deploy advanced Android applications incorporating location-based services and phone features such as calls, SMS, and email.

Course Contents

Unit I	**Basics of Mobile Technologies and Android Programming**	**05 Hours**

1.1 Introduction to Mobile Computing.

1.1.1 Need,

1.1.2 Features,

1.1.3 Advantages and Disadvantages

1.1.4 Applications

1.2 Factors in Developing Mobile Applications.

1.3 Concept of Mobility, Portability and Hand off.

1.4 Types of Mobile Applications.

1.5 Introduction to Mobile Operating System.

(IOS, Black Berry, Android, Windows Phone, Palm OS, Symbian OS, Phone Gap.)

1.6 Introduction to Android:

1.6.1 Evolution

1.6.2 Features of Android

1.6.3 Applications of Android

1.7 Architecture of Android.

1.8 Android development Environment Setup

1.8.1 Android - SDK

1.8.2 Eclipse

1.8.3 Emulators /Android AVD

Unit II	**Fundamentals of Android Programming**	**06 Hours**

2.1 Activities and Services.

2.1.1 Activity Lifecycle

2.1.2 Service Lifecycle

2.2 Overview of Resources and Manifest File

2.3 Creating your first Android Application

2.4 Broadcast Receivers and Content providers.

2.5 Intents:

2.5.1 Types

2.5.2 Linking Activities using Intents.

2.5.3 Calling built-in applications using Intents

2.6 Fragments:

2.6.1 Adding Fragments Dynamically

2.6.2 Lifecycle of Fragment

2.7 Toast:

2.7.1 Overview

2.7.2 Purpose

Unit III	Android User Interface Designing	10 Hours

3.1. Layout Manager and View Groups:

3.1.1 Layouts - Linear Layout, Absolute Layout, Table Layout, Relative Layout, Frame Layout, Scroll Layout, Constraint Layout.

3.1.2 Views and View Groups - Scroll View, Web View, List View, Grid View, Image View

3.2 Android UI Components:

3.2.1 Text Fields- TextView, EditText, AutoCompleteTextView

3.2.2 Dialog box- Alert Dialog box, Custom Dialog box, Date Picker, Time Picker.

3.2.3 Buttons: Simple Button, ImageButton, ToggleButton, CheckBox, RadioButton, RadioGroup, Spinner.

3.2.4 : Bar Types: ProgressBar, SeekBar, RatingBar.

3.3 Event-driven Programming

3.3.1 List, Menu

3.3.2 Split Screen / Multi-Screen Activities

3.3.3 Adaptors

3.4 Android Styles and Themes

Unit IV	Databases- SQLite, Messaging, E-mail, and Location Based Services	05 Hours

4.1 Android Database – SQLite

- Introduction to SQLite
- SQLiteOpenHelper Class – Creating and Managing Databases
- Creating, Opening and Closing Database
- Building and Executing SQL Queries
- CRUD Operations – Insert, Update, Delete, Query
- Working with Cursors
- Content Providers – SQLite Programming

4.2 Accessing Phone Services

- Introduction to Phone Services
- Making Phone Calls using Intent
- SMS Messaging – Basic Concepts
- Sending SMS using Intent
- Receiving SMS Messages
- Required Permissions

4.3 E-mail Services

- Introduction to E-mail in Android
- Sending E-mail using Intent
- Sending E-mail with Attachments

Unit V	Location-Based Services and Google Map	04 Hours

5.1 Location Based Services

5.1.1 Introduction to Location Services

5.1.2 Getting Current Location (GPS / Network)

5.1.3 Displaying Location on Google Map (Basic)

5.2 Display Google Maps

5.2.1 Creating the project

5.2.2 Obtaining the Maps API Key

5.2.3 Displaying the Map

5.2.4 Displaying the Zoom Control

5.2.5 Changing Views

5.2.6 Navigating to a specific location

5.2.7 Adding Markers

5.2.8 Getting the location that was touched

5.3 Getting Location Data

5.4 Monitoring a Location

Reference Books:

1. Reto Meier, "Professional Android 4 Application Development", John Wiley & Sons / Wrox, 4th Edition, 2012.

2. Ian F. Darwin, "Android Cookbook: Problems and Solutions for Android Developers", O'Reilly Media, 2nd Edition, 2017.

3. Wei-Meng Lee, "Beginning Android 4 Application Development", John Wiley & Sons, 1st Edition, 2012.

4. Sayed Y. Hashimi, Satya Komatineni, "Professional Android", Wiley India Pvt Ltd, 1st Edition, 2009.

5. Mike McGrath, "Building Android Apps in Easy Steps", In Easy Steps Limited, 2nd Edition, 2016.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-365-PECP: Lab course on CA-364 - PEC

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Basic knowledge of Java programming.
- Understanding of OOP concepts.
- Familiarity with mobile applications.
- Installed Android Studio and emulator/device setup.
- Basic knowledge of XML

Course Objectives:

- To understand life cycle for Android application development
- To learn steps to build and test real-world Android applications
- To study UI components and layouts
- To know Android components like Activities, Intents, Services
- To be familiar with SQLite databases, phone services and location-based features

Course Outcomes:

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

CO1: Apply modern tools and techniques for mobile application development.
CO2: Design and deploy mobile applications.
CO3: Develop mobile apps using UI/ UX principles.
CO4: Use SQLite database for data storage in mobile applications.
CO5: Make use of Phone services and location-based services while developing applications.

Operating Environment / software –

- **Operating Environment:** Windows/Linux/Mac
- **Software:** Android Studio

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Introduction to Android (Environment Setup and Simple programs)**	**02**

Assignment No 2	**Activities and Intents**	**02**
Assignment No 3	**Android User Interface designs with Layouts and Components**	**02**
Assignment No 4	**Event Handling and List Views**	**02**
Assignment No 5	**Apps using SQLite**	**02**
Assignment No 6	**Apps using Phone and Location-Based Services**	**02**

Reference Books:

1. Mike McGrath, "Building Android Apps in Easy Steps", In Easy Steps Limited, 2nd Edition, 2016.
2. https://developer.android.com/guide
3. https://www.tutorialspoint.com/phonegap/phonegap_app_contents.htm

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-371-VSEC: Advanced JAVA Programming

Teaching Scheme **LAB: 04 Hours/Week**	**Credits: 02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End Semester: 35 Marks**

Prerequisites

- Core JAVA Programming concepts clarity

Course Objectives:

- To understand GUI development using Swing.
- To learn database programming using JDBC.
- To know server-side programming using Servlet.
- To study dynamic web development using JSP.

Course Outcomes:

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

CO1: Design and develop GUI based applications using Swing components and event handling.

CO2: Develop database applications using JDBC to perform CRUD operations (Create, Read, Update, Delete).

CO3: Apply server-side programming using Servlets to handle client requests and responses.

CO4: Use JSP for developing dynamic web applications with scripting elements and implicit objects.

CO5: Describe deploying and managing web applications on web servers like Apache Tomcat.

Operating Environment / software –

- **Operating Environment:** Windows/Linux/Mac
- **Software:** JDK (OpenJDK or Oracle JDK)/Visual Studio Code/ Eclipse IDE / JDK Tool Kit with latest version, PostgreSQL, Apache Tomcat

List of Assignments

Assignment No	**Title**	**No. of Session (12)**
Assignment No 1	**Swing and Event handling**	**04**
Assignment No 2	**Database Programming**	**03**
Assignment No 3	**Servlets**	**03**

Assignment No 4	JSP (Java Server Pages)	02

Reference Books:

1. Bates, Bert and Kathy Sierra. *Head First Servlets and JSP*. 2nd Edition, O'Reilly Media, 2008. ISBN: 978-0-596-00920-5.
2. Schildt, Herbert. *Java: The Complete Reference*. 11th Edition, McGraw Hill Education, 2018. ISBN: 978-1-260-44023-2.
3. Cornell, Kogent Learning Solutions Inc. *JDBC, Servlets, and JSP Black Book*. New Edition, Dreamtech Press, 2008. ISBN: 978-8-177-22837-3.
4. Holzner, Steven. *Core Java Programming Black Book*. Dreamtech Press, 2011. ISBN: 978-93-5119-953-0.

Savitribai Phule Pune University

Third Year Bachelor of Science (Computer Applications)

CA-381-OJT: On-Job Training/ Internship

Teaching Scheme **LAB: 08 Hours/Week**	**Credits: 04**	**Examination Scheme** **Continuous Evaluation: 30 Marks** **End Semester: 70 Marks**

Course Objectives:

- To expose students to real-world industry practices.
- To bridge the gap between academic learning and practical implementation.
- To develop professional competency, ethics, communication, and teamwork skills.
- To encourage self-learning and problem-solving abilities.

Course Outcomes:

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

- **CO1:** Apply theoretical knowledge to solve real-world engineering problems.
- **CO2:** Demonstrate technical competency in tools/technologies used in industry.
- **CO3:** Exhibit professional ethics and team spirit.
- **CO4:** Prepare technical reports and deliver effective presentations based on industry experience gained during OJT/Internship

Guidelines

1. Students should opt for an internship/OJT that would provide them to gain ample knowledge in the relevant field of computing such that theoretical knowledge gained can be applied to solve the practical/ field problem.
2. Students should start their internship work/OJT immediately after Vth semester examinations, preferably during summer break.
3. Students should take a challenging task, may be a small portion, and apply the knowledge gained to solve it.
4. Internship problem undertaken may involve data collection from different sources, including generating experimental data, collection of data from field etc.
5. Students are expected to carry out internships/OJT at central / state government organizations such as DRDO, CDAC etc., R&D labs, premier institutions like IITs and IIMs, public sector undertakings, renowned IT/ITES or any other industries, BPOs/call centers etc.

Expected Internship Activities

- Students are expected to perform the following activities during internship:
- Phase I – Orientation and Requirement Study

- Understanding organization structure
- Study of workflow and operational processes
- Requirement analysis and project allocation
- Understanding tools and technologies used

- Phase II – Technical Learning and Development
  - Coding and implementation
  - Database design and integration
  - Software testing and debugging
  - API integration and deployment
  - Use of version control systems
  - Documentation practices
- Phase III – Execution
  - Module development
  - Testing and validation
  - Performance optimization
  - Client interaction (if applicable)
  - Team collaboration
- Phase IV – Documentation and Presentation
  - Preparation of internship report
  - Preparation of presentation and demonstration
  - Final presentation and viva voce

Documents to maintained and submitted by students

- Internship Joining Report
- Weekly Logbook
- Mid-term Progress Report
- Supervisor Feedback (Initial)

Internship opportunities

The internship may be carried out in any one of the following domains:

- Software Development

- Artificial Intelligence and Machine Learning
- Data Science and Analytics
- Cloud Computing and DevOps
- Cyber Security
- Web and Mobile Application Development
- IoT and Embedded Systems
- Networking and System Administration
- Automation and Robotics Software
- Research and Development
- Entrepreneurship and Startup Projects
- Government/NGO Technical Projects

Guidelines for Internship Report Writing

1. Initial Section
    - Face Page
    - Certificate from Organization
    - Certificate from Department
    - Acknowledgement
    - Abstract
    - Table of Contents
2. Chapter 1 – Organization Profile
    - Company overview
    - Vision and mission
    - Products/services
    - Organizational structure
3. Chapter 2 – Problem Statement and Objectives
    - Project title
    - Need of project
    - Objectives
    - Scope

4. Chapter 3 – Technologies and Methodology
    - Software/hardware tools used
    - Development methodology
    - System architecture
    - Database design
5. Chapter 4 – Work Carried Out
    - Tasks completed
    - Screenshots/results
    - Challenges faced
    - Solutions implemented
6. Chapter 5 – Learning Outcomes
    - Technical learning
    - Professional skills acquired
    - Industry exposure
    - Future scope
7. Chapter 6 – Conclusion
    - Summary of work
    - Achievements
    - Suggestions

Savitribai Phule Pune University, Pune

Maharashtra, India

Task Force for Curriculum Design and Development Of T. Y. B. Sc. (Computer Applications)

Programme Coordinator

Dr. A B Nimbalkar - Member, Ad-hoc Board of Studies (Computer Applications)

Team Members for Course Design

Software Engineering and Testing	
Name of the Faculty	**Name of the College**
Dr. Patil Rahul	KRT Arts, BH Commerce and AM Science College (KTHM), Nashik
Dr. Vikas Mahandule	MAEERs MIT Arts Commerce & Science College Alandi (D) Pune
Dr. Alok Arjun Pawar	Sinhgad College of Science
Suvarna Sachin Pardeshi	Ahmednagar College, Ahilyanagar

Fundamentals of Artificial Intelligence	
Name of the Faculty	**Name of the College**
Shital Shahaji Jadhav	Sinhgad College of science Ambegaon,Pune
Madhuri Piyush Gandhi	S. M. B. S. T College, Sangamner
Rutuja Ganesh More	JSPM'S JSCOE Hadapsar Pune 28
Kamble Jayshree Sharadchandra	Pratibha College of Commerce and Computer Studies
Alka Baban Mhetre	Rajmata Jijau Shikshan Prasarak Mandals College ACS Bhosari

Fundamentals of Data Science	
Name of the Faculty	**Name of the College**
Dr. Reena shinde	Sinhgad College of Science, Ambegaon (Bk.), Pune
Mrs. Savita Bhjbal	Annasaheb Magar Mahavidyalaya Hadapsar Pune
Mrs. Smita Jaywantrao Gorpade	KRT Arts, BH Commerce and AM Science College (KTHM), Nashik
Mrs. Vidya Shelar	S.M. Joshi College, Hadapsar, Pune
Mrs. Mamta Sandeep Bendale	K.V.N. Naik Arts, Commerce and Science College, Nashik

User Interface and User Experience (UI-UX) Design	
Name of the Faculty	**Name of the College**
Pritibala Sudhakar Ingle	Sinhgad College of Science, Pune-411046
Zurange Priyanka Kailas	Waghire College of Arts, Commerce & Science, Saswad
Sherkhane Pranita	Waghire College of Arts,Commerce & Science, Saswad
Thorat Radha Dilip	JSPM'S JSCOE Hadapsar, Pune 28
Pranjali Rohidas Pandhare	Sinhgad College of Science, Pune-411046

Cloud Computing	
Name of the Faculty	**Name of the College**
Pavan Sunil Malani	K K Wagh ACS and CS College Nashik
Mr. Joshi Pushkar Dilip	IBMRD college Ahilynagar
Smt.Gosavi Shweta Vishnu	Maratha Vidya Prasarak Samaj's S.V.K.T.College, Deolali Camp, Nashik
Mrs. Priyanka Sunil Aher	KRT Arts, BH Commerce and AM Science College (KTHM), Nashik

Cyber Security	
Name of the Faculty	**Name of the College**
Gunjal Rohini Sandip	S. M. B. S. T College, Sangamner
Asha Chandrakant Mane	Annasaheb Magar Mahavidyalaya Hadapsar, Pune
Vidya Domatwar	P Jog College of Science and Commerce, Pune
Mithila Patwardhan	Modern College of Arts Science and Commerce Warje, Pune-58
Archana Nitin Shitole	Annasaheb Magar Mahavidyalaya Hadapsar, Pune

Core JAVA Programming	
Name of the Faculty	**Name of the College**
Dr. Suvarna Gogate	KES' Pratibha College of Commerce and Computer Studies Chinchwad Pune
Shivarkar Sonali Yashwantrao	S. M. Joshi College, Hadapsar, Pune 28
Bagul Harshali Sachin	S. M. Joshi College, Hadapsar, Pune 28
Suvarna Sachin Pardeshi	Ahmednagar College, Ahilyanagar

Introduction to AR-VR	
Name of the Faculty	**Name of the College**
Dr. Dipali Meher	PES Modern College of Arts science and Commerce, Ganeshkhind Pune
Dr. Alok Arjun Pawar	Sinhgad College of Science
Vaishali P. Salve	Sinhgad College of science, Ambegaon (BK), Pune

Software Project Management	
Name of the Faculty	**Name of the College**
Ms. Vinita Kadlag	Annasaheb Magar Mahavidyalaya Hadapsar Pune
Ashwini Yogesh Dhanave	ASM College Of Commerce Science and Information Technology, Pimpri Pune
Mrs. Priti Sagar Shingare	PMT's Arts commerce and Science College, Shevgaon

Web Programming	
Name of the Faculty	**Name of the College**
Dr Surekha Manohar Jadhav	PRES's -Women College of Home Science and B. SC. (COMPUTER APPLICATIONS) Loni
Rohini Vijay Daund	KTHM College Nashik
Vrushali Chetan Patil	JSPM's-Bhivarabai Sawant Institute of Technology & Research, Wagholi Pune
Sonam Mahaling Ghewari	PMT's Art's, Commerce and Science college, Shevgaon
Rutika Sanjay Deshmukh	B.P.H E Society's Ahemdnagar College, Ahilyanagar

Operating system Design	
Name of the Faculty	**Name of the College**
Rohini Subhash Kapse	MVP Samaj's KRT Arts, BH Commerce and AM Science College (KTHM) College, Nasik
Vrunda Chouthkanthiwar	JSPM Jaywantrao Sawant Institute of Management and Research, Pune
Patil Suvarna Santosh	BJS ASC College Wagholi, Pune
Borse Sucheta	KTHM College Nashik
Dr. Manjusha Patil	ATSS College of Business Studies and Computer Application

Prompt and Generative AI	
Name of the Faculty	**Name of the College**
Ms. Gadekar Manisha Jankiram	Annasaheb Magar Mahavidyalaya Hadapsar Pune
Dr. Sonali Sagar Gholve	Sarhad College Of Arts Commerce and Science Katraj Pune
Ms. Prerana Sherla	Modern College Ganeshkhind Pune
Mr. Swapnil Sugaraj Jadhavrao	PVG's College of science and commerce Pune-09

Big Data and Analytics	
Name of the Faculty	**Name of the College**
Dr. Harshita Vachhani	Pratibha College of Commerce and Computer Studies, Pune
Varsha Subhash Thakare	Pratibha College of Commerce and Computer Studies, Pune
Mrs.Suvidha Tushar Deshmukh	KTHM College Nashik
Rutika Sanjay Deshmikh	Ahmednagar college, Ahilyanagar

Mobile Application Development	
Name of the Faculty	**Name of the College**
Dipali Deepak Mali	Annasaheb Magar Mahavidyalaya Hadapsar Pune
Jagdhane Vishal Hiraman	K.J.Somaiya College of Arts, Commerce and Science, Kopargaon
Kirti Dinkar More	MVP Samaj's K.T.H.M. College, Nashik
Priya Dhadawe	Sarhad College of Art, Commerce and Science

Advanced JAVA Programming	
Name of the Faculty	**Name of the College**
Dr. Rahul Patil	KRT Arts, BH Commerce and AM Science College (KTHM), Nashik
Ms. Sonal Anant Kadam	Baburaoji Gholap College
Derle Deepak Radhakrishna	KRT Arts, BH Commerce and AM Science College (KTHM), Nashik
Mahatme Jyoti Anil	KRT Arts, BH Commerce and AM Science College (KTHM), Nashik

On-Job Training/Internship	
Name of the Faculty	**Name of the College**
Shahuraj Yevate	Institute of Computer and Management Research, Pune

Chairman

Dr. S S Sane – Chairman, Ad-hoc Board of Studies - Computer Applications

Abbreviations

AEC	Ability Enhancement Course
CEP	Community Engagement Project
FoS&T	Faculty of Science and Technology
FP	Field Project
GE / OE	General / Open Elective Course
IKS	Indian Knowledge System
MJ	Major Core Theory Course
MJP	Major Core Laboratory Course
MN	Multidisciplinary Minor Theory Course
MNP	Multidisciplinary Minor Laboratory Course
MOOC	Massive Open Online Course
NEP	National Educational Policy - 2020
NPTEL	National Programme on Technology Enhanced Learning
SEC	Skill enhancement Course

SPPU	Savitribai Phule Pune University
SWAYAM	Study Webs of Active-Learning for Young Aspiring Minds
VEC	Value Education Course
VSC	Vocational Skill Enhancement Course