Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Four Year Multidisciplinary Degree (Honors/Research) Programme with Multiple Entry and Exit option

Under Graduate Programme (III Year) of Computer Science

B. Sc. in Computer Science

Board of Studies

in

Computer Science

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

[UG III Year]

w.e.f. June, 2025

(In Accordance with NEP-2020)

Review Statement

The NEP Cell reviewed the Curriculum of **B. Sc. (Honors/ Research) in Computer Science** Programme to be effective from the **Academic Year 2023-24.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 09/08/2023

Place: Latur

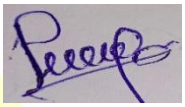
NEP CELL
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the curriculum of **B. Sc. (Honors/Research) in Computer Science** Programme to be effective from the **Academic Year 2023-24.**

Date: 14.07.2023

Place: Latur



(Dr. Renuka R Londhe)
Board of Studies in Computer Science
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Members of Board of Studies in the Subject Computer Science

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Dr Renuka R. Londhe** Head, Department of Computer Science, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur	Chairperson	HoD
2	**Dr. Girish Choudhari** Professor and Head of Department School of Computational Sciences, SRTMU, Nanded	Member	V.C. Nominee
3	**Dr. Ramesh R. Manza** Professor, Department of Computer Science and IT, BAMU, Aurangabad	Member	Academic Council Nominee
4	**Dr. Shriram Raut** Associate Professor Department of Computer Science, PAHU, Solapur	Member	Academic Council Nominee
5	**Dr. Poorna Shankar** Professor, Indira College of Engineering, Pune	Member	Expert from outside for Special Course
6	**Mr N. D. Jagtap** Technical Trainer OHI-IITC,Muscat Oman	Member	Expert from Industry
7	**Dr. Santosh Shrikhande** Assistant Professor, School of Technology, SRTMU Subcenter Latur	Member	P.G. Alumni
8	**Mrs. Suchitra K. Kasbe**	Member	Faculty Member
9	**Mrs. Pooja S. Laturiya**	Member	Faculty Member
10	**Mr. Arun S. Shinde**	Member	Faculty Member
11	**Mrs. Sunita M Jadhav**	Member	Faculty Member
12	**Dr. Mahesh Wavare**	Member	Member from same Faculty

From the Desk of the Chairperson…

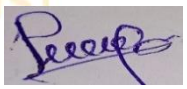
With the tremendous growth of IoT, Data Science, Artificial Intelligence, and Machine Learning technologies over the past ten years, computers have been influencing the future of humanity. Any student taking B.Sc. (Computer Science) program should be able to understand the philosophy, architecture, and mathematics behind the technologies that advance our modern society. The ever-growing discipline of computer science has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular domain. Computer science has a wide range of specialties. These include Computer Programming, Software Systems, Graphics, Artificial Intelligence, Mathematical and Statistical Analysis, Data Science, Computational Science, and Software Engineering.

A real genuine attempt has been made while designing the new curriculum of four-year B.Sc. (Computer Science) program under NEP-2020 by Board of Studies in Computer Science of Rajarshi Shahu Mahavidyalaya, Latur (Autonomous) with an aim to develop the core competence in computing and problem solving amongst its graduates. After successful completion of B.Sc. (Computer Science), students can fetch employment directly in companies as programmer, Web Developer, Software Engineer, Network Administrator, Data Scientist, or AI/ML personnel.

The curriculum focuses on building theoretical foundations in Computer Science to enable its students to think critically when challenged with different and new problems. It includes the learner-centric features of NEP-2020 including Multiple Entry and Multiple Exit, Employability, Flexibility to Choose, Multidisciplinary, Research, Advance Courses, etc.

The BoS in Computer Science believe that any student taking B.Sc. (Computer Science) program will get very strong foundation and exposure to basics, advanced and emerging trends of the subject. The curriculum makes it easier to understand the principles of computer science and offers a platform for the development of abilities like programming, networking, and database management. It also emphasizes the ethics of creating and using new technologies by making compelling arguments in favor of secure computing, user privacy protection, and green computing. The curriculum prepares the students for a career in Software industry and also inspires them towards further studies and research opportunities.

We sincerely thank all of the experts who provided their insightful comments and recommendations in order to improve the contents; we have made every effort to take each of them into consideration.



(Dr. Renuka R Londhe)
Board of Studies in Computer Science

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Computer Science Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/ OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT, FP, CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**10**
III 5.0	V	DSC IX: 04 Cr. DSC X: 04 Cr.	DSE I: 4Cr	Minor III: 04 Cr. Minor IV: 02 Cr.	NA.	VSC III: 2 Cr	NA	NA.	20	88 Cr. UG Diploma
	VI	DSC XI: 04 Cr. DSC XII: 04 Cr.	DSE II: 4Cr	Minor V: 04 Cr.	NA.	VSC :IV 2 Cr.	NA	Academic Project or OJT 04 Cr.	22	
	Cum. Cr.	16	08	08		04		04	42	
Award of Degree 88+42=130 Cr.										

Abbreviations:

1. DSC : Discipline Specific Core (Major)
2. DSE : Discipline Specific Elective (Major)
3. DSM : Discipline Specific Minor
4. GE/OE : Generic/Open Elective
5. VSEC : Vocational Skill and Skill Enhancement Course
6. VSC : Vocational Skill Courses
7. SEC : Skill Enhancement Course
8. AEC : Ability Enhancement Course
9. MIL : Modern Indian Languages
10. IKS : Indian Knowledge System
11. FSRCE : Fostering Social Responsibility & Community Engagement
12. VEC : Value Education Courses
13. OJT : On Job Training
14. FP : Field Projects
15. CEP : Community Engagement and Service
16. SSC (CC) : Students Services Centre (Co-Curricular Courses)
17. RP : Research Project/Dissertation
18. SES : Shahu Extension Services

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Computer Science

B.Sc. (Honors/Research) in Computer Science

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
III	V	(DSC-IX)	Data Science using Python	03	45
		Practical	Laboratory Course- IX	01	30
		(DSC-X)	Software Engineering	03	45
		Practical	Lab Course-X	01	30
		VSC-III	Mobile Application Development	02	30
		DSE-I	Digital Image Processing or Internet of Things	03	45
		Practical	Laboratory Course	01	30
	Total Credits			**20**	
	VI	(DSC-XI)	Data Base Administration	03	45
		Practical	Laboratory Course- XI	01	30
		(DSC-XII)	Indian Mathematics and Machine Learning	03	45
		Practical	Lab Course XII	01	30
		DSE II	Pattern Recognition or Cloud Computing	03	45
		Practical	Laboratory Course	01	30
			Academic Project	04	
	Total Credits			**22**	
Total Credits (Semester V & VI)				**42**	

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science & Technology

Programme Outcomes (POs) for B.Sc. Programme	
PO 1	**Disciplinary Knowledge:** Comprehensive knowledge of science subjects which constitute the graduate programme and execution of scientific knowledge in the specific area.
PO 2	**Scientific Outlook:** The qualities of a science graduate such as observation, precision, analytical mind, logical thinking, clarity of thought and expression and systematic approach.
PO 3	**Self-Directed Life-long Learning:** Ability to appear for various competitive examinations or choose the postgraduate programme or other related programme of their choice.
PO 4	**Research Skills:** Functional knowledge and applications of instrumentation and laboratory techniques to do independent experiments interpret the results and develop research ethos.
PO 5	**Problem Solving Skills:** Analytical and logical skills and critical thinking to extract information from qualitative and quantitative data, formulate and solve problems in a systematic and rational manner.
PO 6	**Professional Competence and Ethics:** Aptitude and skills to perform the jobs in diverse fields such as science, engineering, industries, survey , education, banking, development and planning, business, public service, self-business etc. with human rationale and moral values.

Shiv Chhatrapati Shikshan Sanstha's

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Programme Specific Outcomes (PSOs) for B.Sc. Computer Science (Honors/Research)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Acquire fundamental knowledge of Computer Science and the ability to apply design principles in developing solutions for problems of varying complexity.
PSO 2	Develop programming skills to address diverse issues and real-world applications, with a strong understanding of multiple programming languages at different levels.
PSO 3	Apply sound knowledge of computer application software to design and develop applications for practical problem-solving.
PSO 4	Demonstrate professional ethics, integrity in the workplace, and awareness of societal impacts arising from computer-based solutions.
PSO 5	Cultivate independent learning abilities and a lifelong learning mindset.
PSO 6	Gain inspiration to pursue advanced studies and research in Computer Science.
PSO 7	Utilize standard Software Engineering practices and strategies in real-time software project development.
PSO 8	Analyze and solve information-handling problems using acquired knowledge and critical thinking.
PSO 9	Work effectively both independently on substantial software projects and collaboratively as a productive team member.

Semester - V

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Department of Computer Science

Course Type: DSC-IX

Course Title: Data Science Using Python

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To understand the fundamental concepts of data science and the role of Python libraries in handling and visualizing data effectively.

LO 2. To perform Data Manipulation & Cleaning.

LO 3. To conduct Exploratory Data Analysis (EDA).

LO 4. To work with real word data.

Course Outcomes:

After completion of the course, the student will be able to

CO1. Describe the data science workflow including data acquisition, cleaning, analysis, modeling & visualization

CO2. Explain role of Python Libraries.

CO3. Perform Exploratory Data Analysis.

CO4. Solve real world problems (sales, forecasting, customer segmentations) by applying data science pipelines

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Data Science and Python**	**10**
	Overview of Data Science: Concepts, Applications, and Lifecycle, Python for Data Science: Libraries (NumPy, Pandas, Matplotlib, Seaborn, Data Types, Variables, and Data Structures in Python, Introduction to Jupyter Notebook and IDEs for Data Science.	
	Unit Outcomes: UO1. Describe the data science workflow including data acquisition, cleaning, analysis, modeling & visualization UO2. Explain role of Python Libraries.	
II	**Data Manipulation and Cleaning**	**10**
	Data Wrangling: Handling Missing Data, Duplicates, and Outliers Data Manipulation with Pandas: Filtering, Sorting, and Aggregation Data Cleaning Techniques: Normalization and Transformation. Working with Different Data Formats: CSV, JSON, Excel.	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Import, clean & preprocess structured data using Pandas, NumPy UO2. Extract & analyze data from diverse sources	
III	**Exploratory Data Analysis (EDA) and Visualization**	**12**
	Descriptive Statistics: Measures of Central Tendency and Dispersion. Data Visualization: Line Plots, Bar Charts, Histograms, Scatter Plots. Advanced Visualization: Heatmaps, Boxplots, and Pairplots. Case Studies: EDA on Real-World Datasets.	
	Unit Outcomes: UO1. Perform Exploratory Data Analysis using Statistical methods UO2. Perform Exploratory Data Analysis using visualization	
IV	**Introduction to Machine Learning and Applications**	**13**
	Basics of Machine Learning: Supervised vs. Unsupervised Learning. Introduction to Scikit-learn: Building and Evaluating Models. Linear Regression, Logistic Regression, and Clustering. Case Study: Predictive Modeling with Python.	
	Unit Outcomes: UO1. Build Train & Evaluate Machine Learning Models UO2. Optimize Models by tuning hyper parameters	

Learning Resources:

1. Data Science from Scratch – Joel Grus
2. Python for Data Analysis – Wes McKinney (Pandas-focused).
3. Data Wrangling with Python – Jacqueline Kazil & Katharine Jarmul
4. Pandas Cookbook– Theodore Petrou
5. Python Data Science Handbook – Jake VanderPlas (Matplotlib/Seaborn focus).
6. Practical Statistics for Data Scientists – Peter Bruce & Andrew Bruce
7. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron
8. Python Machine Learning – Sebastian Raschka & Vahid Mirjalili
9. Introduction to Statistical Learning – Gareth James et al. (free PDF available)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Laboratory Course- IX

Course Title: Lab Course –IX

Course Code: _____

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. To understand the fundamental concepts of data science and the role of Python libraries in handling and visualizing data effectively.

LO 2. To perform Data Manipulation & Cleaning

LO 3. To conduct Exploratory Data Analysis (EDA)

LO 4. To work with real word data

Course Outcomes:

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

CO1. Describe the data science workflow including data acquisition, cleaning, analysis, modeling & visualization

CO2. Explain role of Python Libraries.

CO3. Perform Exploratory Data Analysis.

CO4. Solve real world problems (sales, forecasting, customer segmentations) by applying data science pipelines

Practical No.	Contents
1	Exploring Python Libraries for Data Science Task: Use NumPy, Pandas, Matplotlib, and Seaborn to perform basic operations, plot graphs, and summarize data.
2	Working with Jupyter Notebooks Task: Set up and experiment with Jupyter Notebook. Explore Markdown, cell execution, and error handling.
3	Handling Missing Data Task: Use Pandas to identify and handle missing values in a dataset (e.g., imputation, dropping).
4	Removing Duplicates and Outliers Task: Identify and remove duplicates and outliers in a dataset using statistical methods or visualization.
5	Data Normalization and Transformation Task: Normalize or transform variables (e.g., log, scaling) in a dataset.
6	Working with Data Formats Task: Load and manipulate data from CSV, JSON, and Excel formats using Pandas.

7	Descriptive Statistics Task: Calculate measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation) for a dataset.
8	Visualizing Data Trends Task: Use line plots, bar charts, and scatter plots to visualize trends and relationships in data.
9	Creating Advanced Visualizations Task: Generate heatmaps, boxplots, and pairplots to explore data distribution and relationships.
10	Case Study on Real-World Dataset Task: Perform EDA on a real-world dataset (e.g., a Kaggle dataset) and present findings.
11	Linear Regression Modeling Task: Build and evaluate a simple linear regression model using Scikit-learn.
12	Logistic Regression for Classification Task: Implement logistic regression on a dataset (e.g., Titanic dataset) to classify data points.
13	Clustering with k-Means Task: Perform k-means clustering on a dataset to group similar data points.
14	Model Evaluation Metrics Task: Use evaluation metrics (e.g., accuracy, precision, recall, F1 score) to assess model performance.
15	Predictive Modeling Case Study Task: Create and evaluate a predictive model (e.g., predicting house prices or customer churn).
16	Feature Engineering and Selection Task: Experiment with feature engineering techniques like one-hot encoding and feature scaling.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

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Faculty of Science and Technology

Department of Computer Science

Course Title: Software Engineering

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To impart the knowledge on the Software Engineering Principles, Applications and Process models.

LO 2. To help the students to learn the Requirement Engineering Process.

LO 3. To create awareness on the basic activities of software project management.

LO 4. To provide the idea of decomposing the given problem into Analysis, Design, implementation, Testing and Maintenance phases.

Course Outcomes:

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

CO 1. Demonstrate an understanding of the key facts, concepts, principles, and theories of software engineering.

CO 2. Analyze the effective software engineering process, based on knowledge of widely used development lifecycle models.

CO 3. Choose appropriate process model depending on the user requirements.

CO 4. Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction and Software Metrics**	**10**
	Software, Software Characteristics, Software Components, Software Applications, Software: A Crisis on The Horizon, The Software Process, Software Process Models: The Linear Sequential Model, The Prototyping Model, Evolutionary Software Process Models: The Incremental Model, The Spiral Model, Agile Software Development: Agile Process and its Importance, Extreme Programming, Adaptive Software Development, Scrum, Dynamic Systems Development Method (DSDM),Software Project Management: People, The Problem, The Process Measures, Metrics, Indicators, Software Measurement: Size -Oriented Metrics, Function-Oriented Metrics.	
	Unit Outcomes: UO1. Select the relevant software solution for the given problem with justification UO2. Suggest the relevant activities in Agile Development Process in the given situation with justification	

II	**Software Project Planning and Risk Management**	**12**
	Requirement Engineering: Requirement Gathering and Analysis, Types of Requirements, Software Requirement Specification: Need of SRS, Format and its Characteristics, Project Planning Objectives, Software Scope, Resources, Software Project Estimation, Empirical Estimation Models: The Structure of Estimation Models, COCOMO Model, The Software Equation, Software Risks, Risk Identification: Product Size, Business Impact, Customer Characteristics, Process Definition, Development Environment, Technology to Be Built, Staff Size and Experience, RMMM Plan, Software Scheduling: Timeline Chart, Tracking the Schedule, The Project Plan.	
	Unit Outcomes: UO1. Prepare SRS for the given problem UO2. Evaluate the size of the given software using COCOMO Model UO3. Apply the RMMM strategy in identified risks for the given software development problem UO4 Prepare the timeline chart/Gantt chart to track progress of the given project	
III	**Software Quality Assurance and Configuration Management**	**12**
	Quality Concepts: Quality, Quality Control, Quality Assurance, Cost of Quality, Formal Technical Reviews: The Review Meeting, Review Reporting and Record Keeping, Review Guidelines, SQA Plan, The ISO 9000 Quality Standards, Software Configuration Management: Baseline, Software Configuration Items, The Design Process.	
	Unit Outcomes: UO1. Describe the given Software Quality Assurance (SQA) activity UO2. Describe features of the given software quality evaluation Standard	
IV	**Types and Levels of Testing**	**11**
	White Box Testing, Black Box Testing, Levels of Testing, Unit Testing, Integration Testing, Testing web application: Performance Testing, Load Testing, Stress Testing, Security Testing, Client-Server Testing, Acceptance Testing: Alpha Testing, Beta Testing, GUI testing, Regression testing, Manual testing, Automated testing.	
	Unit Outcomes: UO1. Explain the given characteristics of software testing UO2. Explain types of testing	

Learning Resources:

1. Software Engineering A Practitioner's Approach Fourth Edition, Roger S.Pressman, Ph.D.
2. Software Engineering A Practitioner's Approach Seventh Edition, Roger S.Pressman, Ph.D.
3. Software Engineering Concepts by Fairly, Richard McGraw Hill Education New Delhi
4. Software Engineering Principles and Practices by Jain, Deepak Oxford University Press, New Delhi
5. Yogesh Singh, "Software Testing", Cambridge University Press, 2012.
6. Software Testing: Principles and Practices, Srinivasan Desikan, Gopalswamy Ramesh, Pearson Publisher
7. Software Testing: Principles, Techniques and Tools, Limaye M. G. Tata McCraw Hill Education, New Delhi
8. Software Testing: Principles and Practices, Naresh Chauhan, Oxford University
9. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Laboratory Course- X

Course Title: Lab Course–X

Course Code: _____

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. To impart the knowledge on the Software Engineering Principles, Applications and Process models.

LO 2. To help the students to learn the Requirement Engineering Process.

LO 3. To create awareness on the basic activities of software project management.

LO 4. To provide the idea of decomposing the given problem into Analysis, Design, implementation, Testing and Maintenance phases.

LO 5. To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Outcomes:

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

CO 1. Demonstrate an understanding of the key facts, concepts, principles, and theories of software engineering.

CO 2. Analyze the effective software engineering process, based on knowledge of widely used development lifecycle models.

CO 3. Choose appropriate process model depending on the user requirements.

CO 4. Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.

CO 5. Apply the knowledge, techniques, and skills in the development of a software product.

Practical No.	Contents
1	Investigation of Software Characteristics and Components in an Open-Source Text Editor
2	Comparative Analysis of Linear Sequential, Prototyping, Incremental, and Spiral Models in Software Development Procedure:
3	Simulating Software Project Management: Roles, Risks, Processes, and Metrics
4	Evaluation and Comparison of Size-Oriented and Function-Oriented Metrics in an Open-Source Software Project
5	Comparative Analysis of Empirical Estimation Models in Software Project Planning.
6	Risk Identification and Management in Software Projects: A Case Study Approach.

7	Effective Software Scheduling and Timeline Management Using Gantt Charts
8	Defining Software Project Scope and Efficient Resource Allocation.
9	Analyzing Software Quality Assurance and Cost of Quality in Open-Source Projects
10	Implementation and Analysis of Formal Technical Reviews in Software Projects
11	Implementing Software Configuration Management Practices in Open-Source Projects
12	Developing and Implementing an SQA Plan Based on ISO 9000 Quality Standards
13	Study of testing tool WinRunner
14	Study of web testing tool Selenium
15	Study of bug tracking tool Bugzilla

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: VSC III

Course Title: Mobile Application Development

Course Code: _____

Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To explain Android architecture, versions, and development environment.

LO2. To set up and configure Android Studio for app development.

LO3. To manage Activity lifecycle and navigation between screens.

LO4. To design simple UIs using XML layouts.

Course Outcomes:

After completion of the course, students will be able to-

CO1. Demonstrate understanding of Android architecture and development environment

CO2 Design and implement user interfaces using appropriate layouts and components

CO3 Develop applications with proper activity lifecycle management and navigation

CO4 Integrate external data sources through REST APIs

CO5 Build complete, functional Android applications with multiple feature debug, test, and optimize Android applications

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Android and Development Setup**	**15**
	Introduction to Android Android History Android Features and Versions Architecture of Android Various IDE for Android Installing Android Studio Creating First Hello App Basic UI: Views (TextView, Button, EditText) & Layouts (Linear, Relative, Constraint)	
	Unit Outcomes: UO 1. Understand how Android Application interact with the system UO 2. Create and Run a Simple "Hello World" Android App	
II	**Activities, Intents and Knowing user Interface**	**10**

	Activity Concept Activity life cycle Concept of Intent Linking two Activities View and View Groups Layouts (Constraint Layout, Linear, Grid, Frame, Relative, Table)	
	Unit Outcomes: UO 1. Describe the Activity Lifecycle and how to manage state changes UO 2. Design User interface using various Layouts	
II	**Android Desing User Interface**	**10**
	Text View Edit Text Button Radio Group Checkbox List View Image View Progress Bar.	
	Unit Outcome: UO 1. Memorize the basics of CSS & its syntax UO 2. Apply the styles of CSS to create web pages	
IV	**Practical**	**10**
	Development of App Using Android Examples: Stopwatch/ Timer App Simple Notes App Weather App Login And Registration QR code Scanner App Music Player App	
	Unit Outcomes: UO 1. Develop and deploy App	

Learning Resources:

1. Professional Android 4 Application Development, Edition 3 by Reto Meier, Wrox Publication
2. Beginning Android 4 Application Development, Edition illustrated by Wei-Meng Lee, John Wiley & Sons, Wrox Publication
3. Learning Android by Marko Gargenta, OREILLY
4. Android Black Book
5. https://developer.android.com/courses
6. https://www.udemy.com/topic/android-development
7. https://online.codingblocks.com/courses/android-app-training-online
8. https://trainings.internshala.com/android-course/

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Computer Science

Course Type: DSE I

Course Title: Digital Image Processing

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To define digital images and explain how they differ from analog images.

LO 2. To understand the fundamentals of digital image processing (DIP) and its significance.

LO 3. To identify real-world applications of image processing in fields like medicine, robotics, and AI.

LO 4. To use MATLAB for basic image operations.

LO 5. To perform Image processing.

Course Outcomes:

After completion of this course, students will be able to

CO 1. Understand core concepts of digital image processing.

CO 2. Implement image processing techniques using MATLAB

CO 3. Analyze the impact of different algorithms on image quality

CO 4. Develop practical solutions for real-world image processing tasks.

CO 5. Evaluate the performance of segmentation and enhancement methods

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Digital Image Processing**	**15**
	What is Digital Image? What is Digital Image Processing? Applications of Image Processing Fundamental steps in DIP Image Representation: Pixels, Channels, and Color Models (RGB, Grayscale, HSV) Introduction to MATLAB: Data Classes, Image Types, Data Class conversion, Operators in MATLAB, Image Arithmetic, Control statements, Function creation,. Reading, writing and displaying images in MATLAB.	
	Unit Outcomes: UO 1. Demonstrate the ability to load and manipulate images in Matlab UO 2. Implement basic image I/O operations programmatically	
II	**Image Fundamentals and Basic Operations**	**10**
	Image Properties: Resolution, Bit Depth, and File Formats Basic Image Manipulations: Cropping, Resizing, Rotation, and Flipping Arithmetic and Logical Operations on Images	

Unit No.	Title of Unit & Contents	Hrs.
	Blending and Overlaying Images Handling Different Color Spaces and Conversions	
	Unit Outcomes: UO 1. Modify images using geometric transformations UO 2. Apply arithmetic operations to enhance or combine images	
III	**Image Enhancement Techniques**	**10**
	Point Processing: Brightness, Contrast, and Negative Transformations Histogram Processing: Histogram Equalization Adaptive Histogram Equalization (CLAHE) Spatial Filtering: Smoothing Filters (Averaging, Gaussian, Median) Sharpening Filters (Laplacian, Sobel, Prewitt) Frequency Domain Filtering (Introduction to Fourier Transform)	
	Unit Outcomes: UO 1. Apply point processing techniques (brightness, contrast, negative transformations). UO 2. Implement spatial filtering for noise reduction (Gaussian, Median) and edge sharpening (Sobel, Laplacian).	
IV	**Image Segmentation**	**10**
	Thresholding Techniques: Global vs. Adaptive Thresholding Otsu's Method Edge Detection: Canny Edge Detector Sobel and Prewitt Operators Region-Based Segmentation: Watershed Algorithm Contour Detection	
	Unit Outcomes: UO 1. Detect edges using Canny, Sobel, and Prewitt operators. UO 2. Implement region-based segmentation (watershed algorithm, contour detection).	

Learning Resources:

1. Digital Image Processing – Rafael C. Gonzalez & Richard E. Wood
2. Computer Vision: Algorithms and Applications" – Richard Szeliski (Free PDF)
3. Digital Image Processing using MATLAB- Rafael C. Gonzalez & Richard E. Wood
4. https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Computer Science

Course Type: Lab Course

Course Title: Lab Course – (DSE)

Course Code: _____

Credits: 03 **Max. Marks: 50** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To define digital images and explain how they differ from analog images.

LO 2. To understand the fundamentals of digital image processing (DIP) and its significance.

LO 3. To identify real-world applications of image processing in fields like medicine, robotics, and AI.

LO 4. To use Python libraries (OpenCV, PIL, scikit-image, Matplotlib, NumPy) for basic image operations.

LO 5. To perform Image processing.

Course Outcomes:

After completion of this course, students will be able to

CO 1. Understand core concepts of digital image processing.

CO 2. Implement image processing techniques using Python

CO 3. Analyze the impact of different algorithms on image quality

CO 4. Develop practical solutions for real-world image processing tasks.

CO 5. Evaluate the performance of segmentation and enhancement methods

Practical No.	Unit
1	Read, write and display images in MATLAB.
2	Convert an RGB image to Grayscale and HSV, then display each channel separately.
3	Access and modify pixel values (e.g., invert colors, set a region to black).
4	Write a script to print an image's resolution, bit depth, and file size
5	Crop, resize (with interpolation), rotate (45°), and flip (vertically/horizontally) an image.
6	Programs on image arithmetics.
7	Programs on intensity transformation.
8	Programs on spatial filtering.
9	Programs on filtering in frequency domain.
10	Convert an image from RGB to YCrCb and extract luminance (Y) channel.
11	Apply global histogram equalization and CLAHE to a low-contrast image.
12	Programs on image segmentation.
13	Frequency Domain (Optional): Perform Fourier Transform and visualize the spectrum (using np.fft).
14	Apply global thresholding vs. Otsu's method to a grayscale image.
15	Detect edges using Canny, Sobel, and Prewitt operators; compare results.
16	Separate overlapping objects (e.g., coins) using marker-based watershed.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Computer Science

Course Type: DSE II

Course Title: Internet of Things

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To introduce the concepts of Internet of Things.

LO 2. To impart the knowledge on IoT application areas.

LO 3. To introduce the IoT business process models, design technology for Connected Devices.

LO 4. To enable the students, learn the effective usage of device connectivity and web connectivity models

Course Outcomes:

After completion of this course, students will be able to

CO 1. Demonstrate the need of IoT in the computing world.

CO 2. Identify the Business Process models of IoT.

CO 3. Analyze the data storage and acquisition mechanisms for real time applications.

CO 4. Design IoT based prototypes

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction Internet of Things**	**10**
	Definition and characteristics of IoT. Sensing, Actuation, Networking basics, Sensor Network. Physical Design of IoT, Things in IoT, IoT Protocols Logical Design of IoT- IoT functional blocks, IoT communication models, IoT enabling Technologies-Wireless sensor networks, cloud computing, big data analytics, communication protocols, embedded systems IoT Levels and deployment templates- IoT Level1 to IoT Level6.	
	Unit Outcomes: UO 1. Describe the concept of IoT its characteristics& components. UO 2. Learn about networking basics in the context of IoT, and their use in connecting IoT devices.	
II	**Domain Specific IoTs and IOT vs M2M**	**10**
	Introduction: **Home automation-** Smart lighting, smart appliances, intrusion detection, smoke or gas detectors **Cities**-Smart parking, smart lighting, smart roads, structural help monitoring, surveillance, emergency response **Environment**-Weather monitoring, Air pollution monitoring, forest fire detection, river flood detection	

Unit No.	Title of Unit & Contents	Hrs.
	Retail- Inventory management, smart payments, smart vending machines Logistics- Route generation and scheduling, fleet tracking, ship monitoring, remote vehicle diagnostic **Agriculture-** smart irrigation, greenhouse control Industry- machine diagnostic, prognosis, indoor air quality monitoring Health and Lifestyle.	
	Unit Outcomes: UO 1. Describe different applications of IoT in home automation. UO 2. Learn about the role of IoT in environmental monitoring applications	
III	**IoT Design Methodology**	**15**
	Purpose and requirement specification, Process specification, Domain model specification Information model specification, Service specification, IoT level specification, Functional View specification, Operational View specification Device and component integration, Application Development with Python, Case Study on IoT System for weather monitoring.	
	Unit Outcomes: UO 1. Define the purpose and requirements of an IoT system, and use appropriate methods and tools to elicit, analyze, validate, and document them. UO 2. To identify the domain entities and relationships of an IoT system, and use appropriate methods and tools to model, verify, and refine the domain model.	
IV	**Developing IoT Solutions.**	**10**
	What is an IoT Device? Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Other IoT Devices, IoT Physical Servers on Cloud Offering, Amazon Web Services for IoT	
	Unit Outcomes: UO 1. Use Raspberry Pi as an IoT device, and interface it with various sensors, actuators, and peripherals using GPIO pins I2C, SPI, UART, etc. UO 2. Understand and use various cloud services and platforms to host IoT physical servers.	

Learning Resources:

1. Internet of Things (A hands on approach) - Vijay Madisetti and Arshdeep Bagha
2. Designing the Internet of Things - Adrian McEwen & Hakim Cassimally.
3. Rethinking the Internet of Things - A scalable approach to connecting everything – Francis Dacosta.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Lab Course

Course Title: Lab Course –VIII (Based on Major DSE)

Course Code:

Credits: 03 **Max. Marks: 50** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To introduce the concepts of Internet of Things.

LO 2. To impart the knowledge on IoT application areas.

LO 3. To introduce the IoT business process models, design technology for Connected Devices.

LO 4. To enable the students, learn the effective usage of device connectivity and web connectivity models

Course Outcomes:

After completion of this course, students will be able to

CO 1. Demonstrate the need of IoT in the computing world.

CO 2. Identify the Business Process models of IoT.

CO 3. Analyze the data storage and acquisition mechanisms for real time applications.

CO 4. Design IoT based prototypes.

Practical No.	Unit
1	Install Virtual box and Raspberry Pi to perform actions of Raspberry Pi.
2	Starting Raspbian OS, familiarizing with raspberry pi components and Interface, connecting to ethernet, monitor, USB.
3	Using Desktop /Laptop Screen to view contents of Raspberry Pi Device
4	Displaying different LED patterns with Raspberry Pi.
5	Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi.
6	Control Raspberry Pi via Telegram Messenger.
7	Setting up Wireless Access Point using Raspberry Pi.
8	Fingerprint Sensor interfacing with Raspberry Pi.
9	GPS Module Interfacing with Raspberry Pi.
10	IoT based Web Controlled Home Automation using Raspberry Pi
11	RFID interfacing with Raspberry Pi.

Semester - VI

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: DSC-XI

Course Title: Data Base Administration

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To explain the roles and responsibilities of a Database Administrator

LO2. To perform database installations, configurations, and implement backup and recovery strategies.

LO3. To optimize database performance through indexing, query optimization, and performance monitoring.

LO4. To assess emerging trends such as cloud computing, distributed databases, and blockchain databases for real-world applications.

Course Outcomes:

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

CO1. Gain comprehensive knowledge of database administration principles, architectures, and types of databases.

CO2. Demonstrate practical skills in database installation, configuration, maintenance, security, and performance optimization.

CO3. Utilize advanced database management techniques to design, secure, and troubleshoot database systems effectively

CO4. Analyze emerging trends and technologies in database management.

Unit No.	Title of Unit & Contents	Hrs.
I	**Database Administration Basics**	**12**
	Introduction to Database Administration Roles and Responsibilities of a Database Administrator (DBA) Database Architecture and Components Types of Databases: Relational, NoSQL, and Cloud Databases Overview of Database Management Tools	
	Unit Outcomes: UO1. Explain the roles and responsibilities of a DBA in various database environments. UO2. Analyze database management tools to enhance efficiency and performance.	

II	**Installation, Configuration, and Maintenance**	**12**
	Installing and Configuring Database Management Systems (DBMS) Database Instances and Storage Structures Backup and Recovery Strategies Database Security Essentials Performance Monitoring and Optimization	
	Unit Outcomes: UO1. Implement database installation, configuration, and storage structures. UO2. Evaluate security essentials and backup strategies for effective database maintenance.	
III	**Advanced Database Management**	**10**
	Managing User Roles and Permissions Indexing and Query Optimization Techniques Implementing Replication and Clustering Monitoring Logs and Troubleshooting Database Issues Data Migration: Strategies and Best Practices	
	Unit Outcomes: UO1. Design advanced database setups using replication and clustering techniques. UO2. Diagnose and resolve database issues using monitoring and troubleshooting tools.	
IV	**Unit 4: Emerging Trends and Case Studies**	**11**
	Database Solutions in Cloud Computing Introduction to Big Data and Analytics Overview of Distributed Databases and Blockchain Databases Case Studies: Real-world Database Administration Scenarios Future Trends in Database Administration	
	Unit Outcomes: UO1. Assess distributed databases and blockchain databases for emerging use cases. UO2. Create practical solutions for database challenges using real-world case studies.	

Learning Resources:

1. **Database System Concepts** by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan
1. **Fundamentals of Database Systems** by Ramez Elmasri and Shamkant B. Navathe
2. **Database Administration: The Complete Guide to Practices and Procedures** by Craig S. Mullins
3. **SQL Performance Explained** by Markus Winand
4. **High Performance MySQL** by Baron Schwartz, Peter Zaitsev, and Vadim Tkachenko
5. **Seven Databases in Seven Weeks** by Eric Redmond and Jim R. Wilson
6. **Pro SQL Server Administration** by Peter Carter

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Laboratory Course- VII

Course Title: Lab Course–VII

Course Code: _____

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To explain the roles and responsibilities of a Database Administrator

LO2. To perform database installations, configurations, and implement backup and recovery strategies.

LO3. To optimize database performance through indexing, query optimization, and performance monitoring.

LO4. To assess emerging trends such as cloud computing, distributed databases, and blockchain databases for real-world applications.

Course Outcomes:

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

CO1. Gain comprehensive knowledge of database administration principles, architectures, and types of databases.

CO2. Demonstrate practical skills in database installation, configuration, maintenance, security, and performance optimization.

CO3. Utilize advanced database management techniques to design, secure, and troubleshoot database systems effectively

CO4. Analyze emerging trends and technologies in database management.

Practical No.	Contents
1	Installing a DBMS: Install PostgreSQL or MySQL. Tools Required: PostgreSQL, MySQL installer.
2	Configuring Database Instances: Set up storage structures and configure an instance. Configuring Database Instances: Set up storage structures and configure an instance.
3	Backup and Recovery: Demonstrate a backup strategy and simulate recovery. Tools: Export/ Import command / SQL Server Management Studio
4	Database Security: Configure user roles and permissions. Tools: Oracle DB, MongoDB Compass
5	Performance Monitoring: Utilize a database monitoring tool. Tools: SolarWinds Database Performance Monitor.
6	Indexing Techniques: Optimize query performance using indexing.

	Tools: SQL Server, PostgreSQL.
7	Replication Setup: Implement replication for high availability. Tools: MySQL Workbench, MongoDB.
8	Cluster Implementation: Demonstrate clustering for scalability. Tools: MariaDB Galera Cluster.
9	Troubleshooting Logs: Monitor and analyze database logs. Tools: Kibana, Elasticsearch.
10	Data Migration: Perform a migration task between databases. Tools: Data Loader, Oracle SQL Developer.
11	Cloud Database Deployment: Deploy a database on AWS or Azure. Tools: AWS RDS, Azure SQL Database.
12	Introduction to Big Data: Create a basic setup for handling big data. Tools: Hadoop, Spark.
13	Distributed Database Demo: Design a distributed database for scalability. Tools: Apache Cassandra, CockroachDB.
14	Blockchain Database: Explore blockchain architecture in databases. Tools: Hyperledger Fabric.
15	Case Study Analysis: Solve a real-world database administration scenario. Tools: Case study materials, DBMS tools.
16	Future Trends Project: Design a theoretical database model for upcoming trends. Tools: Visualization software (Lucidchart, Visio).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: DSC-XII

Course Title: Indian Mathematics and Machine Learning

Course Code:

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To understand: Analyze foundational concepts and contributions of Indian Mathematics and Machine Learning.

LO2. To implement mathematical principles in solving machine learning problems.

LO3. To assess the integration of Indian mathematical techniques into modern machine learning models.

LO4. To develop innovative machine learning algorithms inspired by Indian Mathematics.

Course Outcomes:

After completion of course the student will be able to-

CO1. Gain in-depth knowledge of Indian Mathematics and its relevance in modern computational techniques.

CO2. Develop the ability to apply mathematical foundations to design and optimize machine learning models.

CO3. Explore innovative methodologies by combining traditional Indian Mathematics with cutting-edge machine learning tools.

CO4. Evaluate and analyze real-world applications and future trends of AI in the Indian context.

Unit No.	Title of Unit & Contents	Hrs.
I	**Indian Mathematics - Foundations and Contributions**	**10**
	Vedic Mathematics: Speed Mathematics Techniques, Contributions of Aryabhata, Brahmagupta, and Bhaskara II, Concepts of Zero and Infinity in Indian Mathematics, Ancient Algebra and Geometry: Sulba Sutras and their Applications, Algorithmic Thinking in Indian Mathematics: Historical Perspectives	
	Unit Outcomes: UO1. Explain the historical significance and mathematical concepts contributed by Indian scholars. UO2. Demonstrate algorithmic thinking inspired by ancient Indian Mathematics.	

II	**Introduction to Machine Learning**	**14**
	Basics of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning, Mathematical Foundations: Linear Algebra, Probability, and Calculus, Dataset Preparation: Preprocessing and Feature Engineering, Regression Analysis: Linear and Polynomial Regression, Classification Techniques: Decision Trees, k-Nearest Neighbors (k-NN)	
	Unit Outcomes: UO1. Understand the core concepts and mathematical foundations of machine learning. UO2. Apply regression and classification techniques on sample datasets	
III	**Advanced Machine Learning Techniques**	**8**
	Artificial Neural Networks: Concepts and Applications, Support Vector Machines (SVMs) and Kernel Methods, Ensemble Methods: Random Forests, Bagging, and Boosting, Optimization Techniques in Machine Learning: Gradient Descent, Handling Large Datasets: Scalability and Big Data Integration	
	Unit Outcomes: UO1. Implement advanced machine learning techniques like neural networks and ensemble methods. UO2. Analyze optimization methods for improving machine learning performance.	
IV	**Integration of Indian Mathematics in Machine Learning**	**13**
	Indian Mathematical Concepts in Machine Learning Algorithms, Efficient Computation Using Vedic Mathematics, Case Studies: Real-world Applications of Indian Mathematics, Emerging Trends: AI and Machine Learning in the Indian Context, Future Directions: Ethical and Cultural Implications of AI	
	Unit Outcomes: UO1. Explore the integration of Indian mathematical techniques in modern AI algorithms. UO2. Analyze case studies and emerging trends influenced by Indian Mathematics in machine learning.	

Learning Resources:

1. The Great Indian Mathematicians: 15 Pioneers Who Put Indian Mathematics on the World Map by Gaurav Tekriwal.
2. Mathematics in India by Kim Plofker
3. Vedic Mathematics Made Easy by Dhaval Bathia.
4. Indian Mathematics: Engaging with the World from Ancient to Modern Times by George Gheverghese Joseph.
5. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron
6. Introduction to Machine Learning with Python by Andreas C. Müller and Sarah Guido
7. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy
8. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Laboratory Course- VIII

Course Title: Lab Course–VIII

Course Code: _____

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To understand: Analyze foundational concepts and contributions of Indian Mathematics and Machine Learning.

LO2. To implement mathematical principles in solving machine learning problems.

LO3. To assess the integration of Indian mathematical techniques into modern machine learning models.

LO4. To develop innovative machine learning algorithms inspired by Indian Mathematics.

Course Outcomes:

After completion of course the student will be able to-

CO1. Gain in-depth knowledge of Indian Mathematics and its relevance in modern computational techniques.

CO2. Develop the ability to apply mathematical foundations to design and optimize machine learning models.

CO3. Explore innovative methodologies by combining traditional Indian Mathematics with cutting-edge machine learning tools.

CO4. Evaluate and analyze real-world applications and future trends of AI in the Indian context.

Practical No.	Contents
1	Vedic Mathematics: Demonstrate mental calculations using Vedic methods. Tools Required: None (manual practice or basic calculators)
2	Exploring Sulba Sutras: Construct geometric shapes described in Sulba Sutras. Tools: Ruler, compass, and graph paper.
3	Zero and Infinity in Coding: Implement algorithms involving large numbers or zero-based logic. Tools: Python.
4	Dataset Preprocessing: Normalize and clean data for a regression model. Tools: Python, Pandas.
5	Linear Regression: Build a predictive model using linear regression. Tools: Jupyter Notebook, Scikit-learn.
6	Classification with k-NN: Apply k-NN classification on a sample dataset. Tools: Python, Scikit-learn.

7	Artificial Neural Network: Design and train a simple neural network. Tools: TensorFlow, Keras.
8	Gradient Descent Optimization: Demonstrate gradient descent algorithm visually. Tools: Matplotlib, Numpy.
9	Random Forest Implementation: Build an ensemble model for classification. Tools: Matplotlib, Numpy.
10	Support Vector Machine: Apply SVM on a multi-class dataset. Tools: Python, Scikit-learn.
11	Big Data Handling: Process a large dataset for a machine learning algorithm. Tools: Apache Spark.
12	Integration of Vedic Mathematics: Develop efficient algorithms inspired by Vedic methods. Tools: Python
13	Case Study Analysis: Analyze AI applications influenced by Indian mathematics Tools: Research articles and datasets.
14	Algorithm Optimization: Optimize existing machine learning algorithms using Sulba Sutra concepts. Tools: Python.
15	Cultural AI Models: Build an AI model with cultural datasets for predictions. Tools: Scikit-learn, Numpy.
16	Ethics in AI: Perform a qualitative analysis of ethical implications in AI. Tools: Research papers and documentation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: DSE-XII

Course Title: Pattern Recognition

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To grasp the foundational concepts of pattern recognition systems and methods.
LO2. To implement various statistical and machine learning techniques for pattern analysis.
LO3. To evaluate pattern recognition models and metrics across diverse applications.
LO4. To develop pattern recognition solutions for real-world problems using appropriate tools.

Course Outcomes:

After completion of course the student will be able to-

CO1. Gain a comprehensive understanding of pattern recognition methodologies and their practical applications.
CO2. Develop skills to apply statistical and structural approaches to solve real-world recognition tasks.
CO3. Evaluate and compare the performance of various classification and clustering algorithms.
CO4. Design and implement customized pattern recognition systems for specific use cases.

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Pattern Recognition**	**12**
	Definition and Applications of Pattern Recognition, Pattern Recognition Systems and Processes, Supervised and Unsupervised Learning, Basic Concepts: Features, Patterns, and Classifiers, Metrics for Pattern Similarity and Dissimilarity	
	Unit Outcomes: UO1. Explain the fundamental principles and applications of pattern recognition. UO2. Identify the basic components and design processes of a pattern recognition system.	
II	**Statistical Pattern Recognition**	**09**
	Bayes Decision Theory, Parametric and Non-Parametric Methods, Maximum Likelihood Estimation (MLE) and Bayesian Estimation,	

	Dimensionality Reduction Techniques: PCA and LDA, Evaluation Metrics: Precision, Recall, F1-Score	
	Unit Outcomes: UO1. Apply Bayesian decision theory and estimation techniques to classify patterns. UO2. Utilize dimensionality reduction methods to optimize pattern recognition performance.	
III	**Structural and Syntactic Pattern Recognition**	**12**
	Structural Representations: Strings, Trees, and Graphs, Grammar-based Methods: Formal Grammar and Parse Trees, Pattern Recognition Using Neural Networks, Hidden Markov Models (HMMs), Applications in Handwriting and Speech Recognition,	
	Unit Outcomes: UO1. Represent patterns structurally using strings, trees, and graphs.. UO2. Demonstrate the use of grammar-based methods and Hidden Markov Models in pattern recognition.	
IV	**Machine Learning for Pattern Recognition**	**12**
	Feature Extraction and Selection Methods, Classification Algorithms: k-NN, SVM, and Decision Trees, Clustering Algorithms: k-Means, Hierarchical Clustering, Ensemble Learning: Bagging, Boosting, and Random Forests, Case Studies: Applications in Image Recognition and Medical Diagnosis	
	Unit Outcomes: UO1. Implement machine learning algorithms for feature extraction and classification. UO2. Design clustering models and analyze real-world case studies in pattern recognition.	

Learning Resources:

1. Pattern Recognition and Machine Learning by Christopher Bishop.
2. Pattern Classification by Richard O. Duda, Peter E. Hart, and David G. Stork
3. Introduction to Statistical Pattern Recognition by Keinosuke Fukunaga
4. Neural Networks for Pattern Recognition by Christopher M. Bishop.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Laboratory Course- VIII

Course Title: Lab Course–VIII

Course Code: _____

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To grasp the foundational concepts of pattern recognition systems and methods.

LO2. To implement various statistical and machine learning techniques for pattern analysis.

LO3. To evaluate pattern recognition models and metrics across diverse applications.

LO4. To develop pattern recognition solutions for real-world problems using appropriate tools.

Course Outcomes:

After completion of course the student will be able to-

CO1. Gain a comprehensive understanding of pattern recognition methodologies and their practical applications.

CO2. Develop skills to apply statistical and structural approaches to solve real-world recognition tasks.

CO3. Evaluate and compare the performance of various classification and clustering algorithms.

CO4. Design and implement customized pattern recognition systems for specific use cases.

Practical No.	Contents
1	Pattern Similarity Metrics: Calculate Euclidean and Manhattan distances. Tools: Python (NumPy).
2	Feature Extraction: Extract features from an image dataset. Tools: OpenCV, Python.
3	Classifier Implementation: Implement k-NN for a given dataset. Tools: Python (Scikit-learn)
4	Bayesian Classification: Design a Bayes classifier for binary classification. Tools: Python.
5	Dimensionality Reduction: Apply PCA and visualize components Tools: Python (Scikit-learn, Matplotlib).
6	Evaluation Metrics: Compute accuracy, precision, recall, and F1-Score for a classifier. Tools: Python.
7	Structural Representation: Represent patterns using graphs and parse trees Tools: NetworkX (Python)

8	Parse Tree Construction: Develop a grammar for pattern parsing. Tools: Python (NLTK).
9	Hidden Markov Models: Train an HMM for simple sequence recognition Tools: Python (hmmlearn library).
10	Handwriting Recognition: Use OCR techniques on a handwriting dataset. Tools: OpenCV, Python.
11	k-Means Clustering: Cluster images using k-means. Tools: Scikit-learn
12	Decision Tree Classification: Implement a decision tree on a dataset. Tools: Python (Scikit-learn).
13	Support Vector Machine (SVM): Train an SVM for binary classification. Tools: Python (Scikit-learn).
14	Ensemble Methods: Apply Random Forest for multiclass classification. Tools: Python (Scikit-learn).
15	Speech Recognition: Build a basic speech recognition model. Tools: Python (SpeechRecognition library).
16	Real-World Application: Develop a pattern recognition system for medical images. Tools: TensorFlow, Python.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: DSE-XII

Course Title: Cloud Computing

Course Code: _____

Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO1. To describe deployment models
LO2. To explain virtualization in cloud computing.
LO3. To understand security in cloud computing.
LO4. To understand storage in cloud.

Course Outcomes:

After completion of course the student will be able to-
CO1. Maintain cloud-based application.
CO2. Implement virtualization in cloud computing
CO3. Maintain storage system in cloud
CO4. Maintain cloud services
CO5. Implement security in cloud computing

Unit No.	Title of Unit & Contents	Hrs.
I	**Fundamentals of Cloud Computing and Virtualization**	**10**
	Cloud Computing, Essential characteristics of cloud computing Cloud deployment model: Public cloud, Private cloud, Community cloud, Hybrid cloud Cloud service models: Iaas, Saas, Paas Cloud economics and benefits, Architecture of cloud computing, Cloud computing infrastructure, Cloud based integrated development environment (IDE) to write, run and debug code with a browser Introduction to Virtualization and Reference Model, Characteristics of Virtualized Environment, Virtualization Types Technology Example: VMWare, Microsoft Hyper- V, KVM, Xen Advantages: Virtual Machine (VM), VM Migration, VM Consolidation, VM Management Disadvantages of Virtualization	
	Unit Outcomes: UO1. Describe features of virtualization. UO2. Explain characteristics of cloud computing . UO3. Compare cloud deployment models	

Unit No.	Title of Unit & Contents	Hrs.
II	**Storage in Clouds and Cloud Monitoring**	**12**
	Storage System Architecture, Virtualize Data Centre (VDC) Architecture, VDC Environment, Server, Storage, Networking, Desktop and Application Virtualization Techniques and Benefits, Block and File Level Storage Virtualization, Virtual Provisioning and automated storage Tiering, Virtual Storage Area Network (VSAN) and Benefits Cloud File Systems: Google File System (GFS) and Hadoop Distributed File Systems (HDFS), Service Provider and Users, An Architecture of Federated Cloud Computing	
	Unit Outcomes: UO1. Write steps to design storage system for the given cloud setup . UO2. Compare GFS and HDFS based on the given criteria UO3. Describe the given component of federated cloud computing	
III	**Cloud Management and Security in Cloud Computing**	**8**
	Service Level Agreement (SLA) Management: Types of SLA, Life Cycle of SLA, Service catalog, Management, and Functional Interfaces of Services, Cloud Portal and its Functions, **Cloud Service Life Cycle Phases:** Planning, Creation, Operation, Termination, Cloud Resource Management: Ab-initio Resource Assignment, Periodic Resource Optimization Cloud Security Fundamentals, Cloud Risk, Risk Division: Polity and Organizational Risk, Technical and Legal Risk, Technologies for Data Security, Data Security Risk, Digital Identity and Access Management, Content Level Security, Content As-A-Cloud-Service	
	Unit Outcomes: UO1. Compare different types of SLA based on the given criteria UO2. Describe the steps to use relevant technique for managing the given cloud resource UO3. Explain the security related risk in cloud computing UO4. Describe the features of Security-As-A-Cloud Service	
IV	**Trends and Future in Cloud Computing**	**15**
	Cloud Trends in Supporting Ubiquitous Computing, Enabling Technologies with the Internet of Things (RFID, Sensor Networks and ZigBee Technologies, GPS), Innovative Applications with the Internet of Things (Ex: Smart Buildings and Smart Power Grid), Future of Cloud-Based Smart Devices, Home-Based Cloud Computing, Energy Aware Cloud Computing. Cloud Platforms: AmazonEC2 and S3, Microsoft Azure, Cloudstack, Intercloud, Google App Engine, Open -Source Cloud Eucalyptus, Open Stack, Open Nebulla etc.	
	Unit Outcomes: UO1. Select relevant cloud platform for the identified application with justification UO2. Describe the features of the given type of cloud-based smart devices	

Learning Resources:

1. Cloud computing, Principals and Paradigms by Buyya Rajkumar, J. Broberg, A. Goscinski, A John Wilwy & Sons, Inc. Publication
2. Cloud Computing by Sharma Rishabh, Wiley publication
3. Mastering cloud by Buyya Rajkumar, McGraw Hill Publication
4. Computing by Vecchiola Christian, Selvi S Thamarai
5. Cloud Computing by Singh Shailendra, Oxford university Press

Websites:

6. https://www.pragimtech.com/blog/cloud/cloud-tutorial-for-beginners/#google_vignette
7. https://azure.microsoft.com/en-us/pricing/purchase-options/azure-account?icid=get-started
8. https://www.pragimtech.com/blog/azure/azure-tutorials-for-beginners/

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Computer Science

Course Type: Laboratory Course- VIII

Course Title: Lab Course–VIII

Course Code: _____

Credits: 01 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO1. To understand configuration of cloud tool

LO2. To use different services of cloud.

Outcomes:

After completion of course the student will be able to-

CO1. Use different cloud tools

CO2. Use different services of cloud.

Practical No.	Contents
1	Use google doc to make spreadsheet and notes
2	Install/configure cloud using JustCloud
3	Use Cloud9 to demonstrate use of different language
4	Create/Delete virtual machine using VMware (private cloud)
5	Study of GoogleApp Engine
6	Implement storage service on cloud using OpenStack
7	Use OpenStack for file management
8	Monitor cloud using Nagios tool
9	Host simple application on Microsoft Azure/Google Cloud/Any platform
10	Use google doc to make spreadsheet and notes
11	Install/configure cloud using JustCloud