Nirmala Memorial Foundation College of Commerce and Science

(Autonomous)

Re-accredited by NAAC with B++, ISO 9001-2015 Certified, Recognised under section 2(f) & 12(B) of the UGC Act 1956

Permanently Affiliated to the University of Mumbai,

Syllabus

Bachelor of Science in Data Science

(B.Sc. Data Science)

(Programme Code: UGDS03)

As Per New Education Policy (NEP) 2020

(To be implemented from the Academic Year 2025-2026)

*Approved in the Academic Council Meeting held on 7th **October 2025***

SEMESTER III

COURSE STRUCTURE

VERTICAL		COURSE CODE	SUBJECT	CREDIT
Vertical 1	Major	NUDS301	Data Preparation & Exploratory Analysis	2
	Major	NUDS302	Supervised Machine Learning	2
	Major	NUDS303	Data Preparation & Exploratory Analysis - **Lab**	2
	Major	NUDS304	Supervised Machine Learning - **Lab**	2
Vertical 2	Minor	NUDS305	Object Oriented Programming using Java	2
	Minor	NUDS306	OOP using Java **- Lab**	2
Vertical 3	OE1	NUDS307	Financial Literacy	2
Vertical 4	VSC	NUDS308	Linear Algebra	2
Vertical 5	AEC	NUHN301	Hindi Bhasha: Ek Vyavaharik Prayog	2
Vertical 6	CC	NUCC303	Co-curricular(Yoga and Wellness I)	2
	FP	NUFP301	Field Project	2
			Total Credits	**22**

SEMESTER IV

COURSE STRUCTURE

VERTICAL		COURSE CODE	SUBJECT	CREDIT
Vertical 1	Major	NUDS401	Optimization Techniques	**2**
	Major	NUDS402	Machine Learning (Unsupervised and Reinforcement) II	**2**
	Major	NUDS403	Optimization Techniques - **Lab**	**2**
	Major	NUDS404	Machine Learning (Unsupervised and Reinforcement) II - **Lab**	**2**
Vertical 2	Minor	NUDS405	UI/UX Design	2
	Minor	NUDS406	UI/UX Design - **Lab**	2
Vertical 3	OE	NUDS407	Digital Payment Systems and Security	2
Vertical 4	SEC	NUDS408	Data Visualization using Tableau - **Lab**	2
Vertical 5	AEC	NUHN401	Hindi Bhasha – Kaushal ke Aadhar	**2**
Vertical 6	CC	NUCC403	Yoga and Wellness – II	2
	CEP	NUCP401	Community Engagement Projects	**2**
			Total Credits	**22**

Semester – III

Vertical – I

Mandatory Courses

Name of the Course:– Data Preparation & Exploratory Analysis

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces students to the critical processes of data preparation and exploratory data analysis (EDA), which form the foundation of any data science or machine learning project. It focuses on handling real-world data issues such as missing values, outliers, and inconsistencies, along with data transformation and feature engineering. Students will also learn to explore datasets using statistical methods and visualization tools to identify patterns, anomalies, and insights.
2	**Vertical:**	**Major**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To provide knowledge of data types, data quality challenges, and preprocessing techniques. 2. To train students in data cleaning, transformation, and feature engineering for better model performance. 3. To develop the ability to perform univariate, bivariate, and multivariate analysis using descriptive statistics and visualizations. 4. To enable students to use modern tools such as Python, Excel, and Tableau for effective EDA.	
8	**Course Outcomes:** By the end of this course, students will be able to: 1. Understand the role of data preparation in analytics and machine learning. 2. Apply data cleaning, transformation, and feature engineering techniques. 3. Perform exploratory analysis using statistical methods and visualization. 4. Use tools like Python/Excel/Tableau for data preprocessing and EDA.	
9	**Modules:-** **Module 1 : Introduction to data preparation & data quality issues (15 hours):**	
	• Types of data: structured, unstructured, semi-structured • Data cleaning: handling missing values, duplicates, noisy data • Outlier detection and treatment • Data preprocessing: scaling, normalization, categorical encoding • Data transformation: aggregation, binning, discretization	

<table>
<tr><td></td><td colspan="2">

Feature engineering & selection (basics)
Dimensionality reduction (PCA overview)

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<tr><td></td><td colspan="2">Module 2 Exploratory Data Analysis (15 Hours)</td></tr>
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Introduction to EDA and its role in data science workflow
Descriptive statistics: central tendency, dispersion, skewness, kurtosis
Correlation and covariance
Univariate analysis (frequency tables, histograms, boxplots)
Bivariate & multivariate analysis (scatterplots, heatmaps, pairplots)
Identifying patterns, anomalies, and insights
Visualization tools: Python (Pandas, Matplotlib, Seaborn), Excel, Tableau/PowerBI
Case study: EDA on a real-world dataset

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<tr><td>10</td><td colspan="2">Text Books</td></tr>
<tr><td>11</td><td colspan="2">Reference Books

Data Science: A Beginner’s Guide – C. Raju, Penguin Business (India)
Statistics for Data Scientists and Analysts – Dipendra Pant, Suresh Kumar Mukhiya, BPB Publications
Data Analytics Essentials You Always Wanted To Know – Vishal Iyer, Vibrant Publishers
Hands-On Exploratory Data Analysis with Python – Suresh Kumar Mukhiya, Usman Ahmed, Packt Publishing
Big Data Analytics – D. Satheesh Kumar, N. Subasri, S. Tamizharasu, S. Gokila, Nitya Publications
Data Mining and Predictive Analytics (Indian Adaptation) – Daniel T. Larose, Chantal D. Larose, O. P. Wali, Wiley India

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<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>Continuous Evaluation through:
Class test of 15 marks
Quizzes/ Presentations/ Assignments: 5 marks
Total: 20 marks</td><td>Format of Question Paper: External Examination (30 Marks)– 1 hr duration</td></tr>
<tr><td>14</td><td colspan="2">Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)
<table>
<tr><th>Questions</th><th>Based On</th><th>Options</th><th>Marks</th></tr>
<tr><td>Q.1</td><td>Module 1</td><td>Any 2 out of 4</td><td>10</td></tr>
<tr><td>Q.2</td><td>Module 2</td><td>Any 2 out of 4</td><td>10</td></tr>
<tr><td>Q.3</td><td>Module 1 & 2</td><td>Any 2 out of 4</td><td>10</td></tr>
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Name of the Course: Supervised Machine Learning

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides an introduction to classical machine learning methods, covering supervised machine methods of regression and classification algorithms. It emphasizes building predictive models using algorithms such as linear regression, logistic regression, decision trees, k-NN, and advanced techniques including ensemble methods. Students will also learn model evaluation metrics, cross-validation, and hyper parameter tuning, with practical applications on real-world datasets.
2	**Vertical:**	**Major**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To introduce the principles of supervised learning and its role in predictive modeling. 2. To provide practical exposure to regression and classification algorithms for real-world applications. 3. To equip students with knowledge of evaluation metrics and validation techniques for assessing model performance. 4. To develop skills in ensemble methods and model optimization techniques for improved accuracy.	
8	**Course Outcomes :** By the end of this course, students will be able to: 1. Understand supervised learning concepts. 2. Apply regression and classification algorithms. 3. Evaluate supervised models using proper metrics. 4. Use ensemble methods and tuning techniques.	
9	**Modules:-** **Module 1 (15 hours):**	
	Module I: Regression & Basic Classification (15 Hrs) ● Introduction to Supervised Learning ● Linear Regression (Simple, Multiple, Polynomial) ● Regularization (Ridge, Lasso) ● Logistic Regression ● k-Nearest Neighbors (k-NN) ● Decision Trees	

	• Evaluation Metrics: MSE, RMSE, R^2, Confusion Matrix, Precision, Recall, F1
	Module 2 (15 hours):
	Module II: Advanced Models & Ensemble Methods (15 Hrs) • Random Forest • Support Vector Machines (linear & kernel) • Naïve Bayes • Ensemble Learning (Bagging, Boosting: AdaBoost, Gradient Boosting, XGBoost overview) • Cross-validation & Hyperparameter Tuning • Handling Imbalanced Data (SMOTE, undersampling/oversampling) • Case Study: End-to-end Supervised ML
10	**Reference Books** • **Machine Learning with Python** – Prateek Joshi, BPB Publications • **Python Machine Learning** – Suresh Kumar Mukhiya, Packt Publishing (Indian edition available) • **Hands-On Machine Learning with Scikit-Learn and TensorFlow (Indian Adaptation)** – A. Ravindran, Wiley India • **Data Mining and Machine Learning** – S. Sumathi, Springer India • **Applied Machine Learning** – R. Rajesh, Khanna Publishing • **Pattern Recognition and Machine Learning** – Christopher M. Bishop, Springer • **Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow** – Aurélien Géron, O'Reilly • **Introduction to Machine Learning with Python** – Andreas C. Müller & Sarah Guido, O'Reilly • **Machine Learning: A Probabilistic Perspective** – Kevin P. Murphy, MIT Press • **Machine Learning Yearning** – Andrew Ng, Self-published (PDF available online)
11	**Internal Continuous Assessment: 40%** / **Semester End Examination: 60%**
12	**Continuous Evaluation through:** Class test of 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks / **Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
13	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)**

Questions	Based On	Options	Marks
Q.1	Module 1	Any 2 out of 4	10
Q.2	Module 2	Any 2 out of 4	10
Q.3	Module 1 & 2	Any 2 out of 4	10

Name of the Course: Data Preparation & Exploratory Analysis - Lab

Sr. No.	Heading	Particulars
1	**Description the course:**	This practical course complements the theory of data preparation and EDA by offering hands-on experience with real-world datasets. Students will practice importing, cleaning, transforming, and encoding data, followed by applying exploratory data analysis techniques through descriptive statistics and visualization. The lab emphasizes project-based learning where students complete a mini EDA project and present insights effectively.
2	**Vertical:**	**Major**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To provide practical experience in importing and exploring datasets while identifying data quality issues. 2. To train students in handling missing values, outliers, and applying data transformations. 3. To develop the ability to perform statistical analysis and visualization for EDA. 4. To encourage problem-solving through an end-to-end EDA project on real-world datasets.	
8	**Course Outcomes :** By the end of this course, students will be able to: ● Import, explore, and summarize datasets while identifying data quality issues. ● Handle missing values and treat outliers using appropriate techniques. ● Transform and encode data for analysis, including normalization, standardization, and categorical encoding. ● Perform univariate, bivariate, and multivariate exploratory data analysis using statistical and visualization methods. ● Conduct an end-to-end EDA mini project on a real-world dataset and present insights effectively.	
9	**Modules:-** **Module 1 (15 hours):**	
	Module I: Data Preparation 1. Importing and Exploring a Dataset – Load a dataset (CSV/Excel), check dimensions, data types, summary statistics, and detect data quality issues.	

	2. Handling Missing Data – Apply deletion, mean/median imputation, and forward/backward fill methods. 3. Outlier Detection & Treatment – Identify outliers using visualization (boxplot) and statistical methods (Z-score, IQR). 4. Data Transformation – Apply normalization, standardization, and log transformation; compare effects. **5.** Categorical Data Handling – Perform label encoding and one-hot encoding; demonstrate impact on analysis.	
	Module 2 (15 hours):	
	Module II: Exploratory Data Analysis (Any 5 Practicals) 1. **Descriptive Statistics** – Generate measures of central tendency, dispersion, skewness, and kurtosis for a dataset. 2. **Univariate Analysis** – Create histograms, bar charts, and boxplots for single variable exploration. 3. **Bivariate Analysis** – Use scatterplots and correlation heatmaps to study relationships between two variables. 4. **Multivariate Analysis** – Perform pairplots, grouped bar charts, and crosstabs for multiple variables. **Mini Project: Complete EDA** – Perform cleaning + exploratory analysis on a real-world dataset (e.g., Titanic, Iris, Sales, Healthcare) and present insights with visualizations.	
10	**Reference Books** • **Data Science: A Beginner's Guide** – C. Raju, Penguin Business (India) • **Statistics for Data Scientists and Analysts** – Dipendra Pant, Suresh Kumar Mukhiya, BPB Publications • **Data Analytics Essentials You Always Wanted To Know** – Vishal Iyer, Vibrant Publishers • **Hands-On Exploratory Data Analysis with Python** – Suresh Kumar Mukhiya, Usman Ahmed, Packt Publishing • **Big Data Analytics** – D. Satheesh Kumar, N. Subasri, S. Tamizharasu, S. Gokila, Nitya Publications **Data Mining and Predictive Analytics (Indian Adaptation)** – Daniel T. Larose, Chantal D. Larose, O. P. Wali, Wiley India	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**

12	**Continuous Evaluation through:** Practical journal submission, viva, assignments ● Journal Submission : 10 Marks ● Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
13	Format of Question Paper: (Semester End Practical Examination : 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Name of the Course : Supervised Machine Learning - Lab

Sr. No.	Heading	Particulars
1	**Description the course:**	This lab course offers practical exposure to machine learning techniques, enabling students to implement algorithms for regression and classification. Through hands-on exercises, students will build, evaluate, and optimize models using Python libraries. They will also work with ensemble methods and hyperparameter tuning to improve predictive performance and apply these methods in end-to-end machine learning experiments.
2	**Vertical:**	**Major**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To provide practical implementation of regression and classification algorithms for real-world tasks. 2. To train students in applying model evaluation metrics and interpreting results. 3. To develop skills in advanced supervised learning techniques including ensemble methods and hyperparameter tuning. 4. To enable students to design and execute complete machine learning workflows using real-world datasets.	
8	**Course Outcomes (COs)** 1. Implement regression techniques (simple, multiple, polynomial) and apply regularization methods to model continuous variables. 2. Apply classification algorithms including logistic regression, k-NN, decision trees, SVM, and Naïve Bayes for supervised learning tasks. 3. Evaluate model performance using appropriate metrics such as MSE, RMSE, R^2, confusion matrix, precision, recall, and accuracy. 4. Build and interpret ensemble models (Random Forest, Bagging, Boosting) and perform hyperparameter tuning for improved performance. 5. Conduct end-to-end supervised machine learning experiments on real-world datasets, integrating model building, evaluation, and visualization of results	
9	**Modules:-** **Module 1 (15 hours):**	

Module I: Regression & Basic Classification

Practical 1: Implement Simple Linear Regression

- **AIM:** To fit a linear model to predict a continuous target variable.
- **Task:** Import dataset (e.g., Salary vs Experience), train a linear regression model, predict target values, visualize regression line, and evaluate model using MSE and RMSE.

Practical 2: Multiple Linear Regression

- **AIM:** To predict a continuous variable using multiple independent features.
- **Task:** Load a dataset (e.g., House Prices), train a multiple linear regression model, interpret coefficients, and evaluate model using R^2 and Adjusted R^2.

Practical 3: Polynomial Regression and Regularization

- **AIM:** To handle non-linear relationships and reduce overfitting.
- **Task:** Fit a polynomial regression model on a non-linear dataset, apply Ridge and Lasso regularization, and compare model performance.

Practical 4: Logistic Regression (Binary Classification)

- **AIM:** To perform classification on binary outcome datasets.
- **Task:** Train logistic regression on a dataset (e.g., Titanic Survival), predict probabilities and classes, evaluate using confusion matrix, precision, and recall.

Practical 5: k-Nearest Neighbors (k-NN) Classifier

- **AIM:** To classify data points based on proximity to neighbors.

  Task: Apply k-NN on a dataset (e.g., Iris), experiment with different k values, visualize decision boundaries, and evaluate performance metrics.

Module 2 (15 hours):

Module II: Advanced Models & Ensemble Methods

Practical 6: Decision Tree Classifier

- **AIM:** To build and interpret a decision tree for classification.

	• **Task:** Train a decision tree on a dataset (e.g., Iris), visualize the tree structure, and evaluate model using accuracy, precision, and recall. **Practical 7: Random Forest Classifier** • **AIM:** To improve classification performance using an ensemble of trees. • **Task:** Build a random forest on a dataset (e.g., Customer Churn), analyze feature importance, and compare results with a single decision tree. **Practical 8: Support Vector Machine (SVM)** • **AIM:** To classify data using maximum margin hyperplanes. • **Task:** Apply linear and RBF kernel SVM on a dataset (e.g., Wine), visualize decision boundaries, and evaluate model metrics. **Practical 9: Naïve Bayes Classifier** • **AIM:** To classify data based on probabilistic reasoning. • **Task:** Train Gaussian/Multinomial Naïve Bayes on a dataset (e.g., SMS Spam Detection), predict labels, and evaluate accuracy, precision, and recall. **Practical 10: Ensemble Methods & Model Tuning (Bagging and Boosting)** • **AIM:** To enhance model performance using ensemble techniques. • **Task:** Apply Bagging and AdaBoost/Gradient Boosting on a dataset, tune hyperparameters, and compare performance with base classifiers.	
10	**Reference Books** • **Machine Learning with Python** – Prateek Joshi, BPB Publications • **Python Machine Learning** – Suresh Kumar Mukhiya, Packt Publishing (Indian edition available) • **Hands-On Machine Learning with Scikit-Learn and TensorFlow (Indian Adaptation)** – A. Ravindran, Wiley India • **Data Mining and Machine Learning** – S. Sumathi, Springer India • **Applied Machine Learning** – R. Rajesh, Khanna Publishing • **Pattern Recognition and Machine Learning** – Christopher M. Bishop, Springer • **Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow** – Aurélien Géron, O'Reilly • **Introduction to Machine Learning with Python** – Andreas C. Müller & Sarah Guido, O'Reilly • **Machine Learning: A Probabilistic Perspective** – Kevin P. Murphy, MIT Press • **Machine Learning Yearning** – Andrew Ng, Self-published (PDF available online)	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Practical journal submission, viva,	**A semester end practical examination of 2 hours duration for 30 marks as the paper**

	assignments ● Journal Submission : 10 Marks ● Assignments: 10 Marks Total: 20 marks	**pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
13	Format of Question Paper: (Semester End Practical Examination : 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Vertical – II

Minor Courses

Name of the Course: Object Oriented Programming using Java

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces students to the principles of Object-Oriented Programming (OOP) using Java. It covers the core concepts such as classes, objects, inheritance, polymorphism, abstraction, and encapsulation, along with advanced features like collections, exception handling, and file I/O. The course emphasizes modular programming and reusability while linking OOP applications to data science workflows.
2	**Vertical:**	**Minor**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits (1 credit = 15 Hours for Theory)**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To introduce the fundamental principles of OOP and their implementation in Java. 2. To develop the ability to design modular and reusable programs using Java classes and objects. 3. To enable students to implement inheritance, polymorphism, abstraction, and encapsulation effectively. 4. To provide knowledge of Java's collections, exception handling, and file-handling mechanisms for data-centric applications. 5. To prepare students to build small-scale Java programs relevant to data processing and data science contexts.	
8	**Course Outcomes:**By the end of the course, students will be able to: 1. Understand the fundamental concepts of Object-Oriented Programming (OOP) in Java. 2. Apply OOP concepts to design classes, objects, and modular programs. 3. Implement inheritance, polymorphism, encapsulation, and abstraction in Java programs. 4. Use Java collections, exception handling, and file I/O for basic data handling. 5. Develop small Java programs useful in Data Science workflows.	
9	**Modules:-** **Module 1 (15 hours):**	
	Module I: Fundamentals of OOP in Java (15 Hrs) ● Introduction to Java and OOP Concepts ○ Classes and Objects ○ Data members and member functions ○ Constructors (default, parameterized) ○ this keyword and static members	

	● Encapsulation and Access Modifiers (private, public, protected) ● Inheritance ○ Single, Multilevel, and Hierarchical inheritance ○ super keyword ● Polymorphism ○ Compile-time / Method overloading ○ Runtime / Method overriding ● Abstraction ○ Abstract classes and interfaces
	Module 2 (15 hours):
	Module II: Advanced OOP Concepts and Data Handling in Java ● Java Collections Framework (overview) ○ ArrayList, HashMap, HashSet ○ Iterating collections ● Exception Handling ○ try-catch-finally, multiple catch blocks ● Throwing exceptions File Handling ○ Reading and writing text files ○ BufferedReader, BufferedWriter, FileReader, FileWriter ● Nested and Inner Classes (brief overview) ● Application of OOP concepts in Data Science ● Modeling data objects (e.g., Student, Customer, SensorData) ● Creating reusable modules for data processing
10	**Reference Books** 1. E. Balagurusamy, Programming with Java- A Primer, Tata McGraw-Hill Education India, 2023 2. Programming in JAVA, 2nd Ed, Sachin Malhotra & Saurabh Choudhary, Oxford Press, 2018 3. Joe Wigglesworth and Paula McMillan, Java Programming: Advanced Topics, Thomson Course Technology (SPD) 4. Herbert Schildt, Java The Complete Reference, Eleventh Edition, McGraw-Hill Education, 2020
11	**Internal Continuous Assessment: 40%** / **Internal Continuous Assessment: 40%**
12	**Continuous Evaluation through:** Class test of 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks / **Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
13	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)**

Questions	Based On	Options	Marks
Q.1	Module 1	Any 2 out of 4	10
Q.2	Module 2	Any 2 out of 4	10
Q.3	Module 1 & 2	Any 2 out of 4	10

Name of the Course: Object Oriented Programming using Java - Lab

Sr. No.	Heading	Particulars
1	**Description the course:**	This lab course provides hands-on practice in Object-Oriented Programming using Java. Students will implement OOP concepts such as classes, objects, inheritance, polymorphism, abstraction, and encapsulation through structured programming exercises. The course also includes practical exposure to Java collections, exception handling, file I/O operations, and the development of small reusable modules. A mini-project will allow students to apply OOP concepts to solve real-world data handling problems.
2	**Vertical:**	**Minor**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To provide practical exposure to implementing OOP concepts in Java. 2. To train students in designing classes, creating objects, and applying constructors and methods. 3. To enable students to handle inheritance, polymorphism, abstraction, and encapsulation in real-world programming. 4. To develop practical skills in collections, exception handling, and file-handling in Java. 5. To encourage project-based learning through the creation of small reusable Java modules.	
8	**Course Outcomes:** By the end of this course, students will be able to: 1. Design and implement Java classes and objects for real-world applications. 2. Demonstrate encapsulation, inheritance, and polymorphism through practical examples. 3. Apply abstraction using abstract classes and interfaces in modular programs. 4. Utilize Java collections, exception handling, and file I/O operations effectively. 5. Develop and present a mini-project applying OOP principles to data-centric problems.	
9	**Module I Practicals**	
	1. Create a Java class with attributes and methods; instantiate objects and display data. 2. Implement constructors and use this keyword in a Java class. 3. Demonstrate encapsulation using private variables and getter/setter methods. 4. Implement single and multilevel inheritance with method overriding.	

	5. Create an abstract class and interface; implement them in concrete classes.	
	Module II Practicals	
	6. Use ArrayList, HashMap, and HashSet to store and manipulate dataset-like information. 7. Implement exception handling in a Java program (divide-by-zero, file not found). 8. Read and write data from/to text files using BufferedReader/BufferedWriter. 9. Create nested/inner classes to model hierarchical data. 10. Mini project: Create a reusable Java module for a small dataset (e.g., Student Marks or Customer Orders) using OOP principles.	
10	**Reference Books** 1. E. Balagurusamy, Programming with Java- A Primer, Tata McGraw-Hill Education India, 2023 2. Programming in JAVA, 2nd Ed, Sachin Malhotra & Saurabh Choudhary, Oxford Press, 2018 3. Joe Wigglesworth and Paula McMillan, Java Programming: Advanced Topics, Thomson Course Technology (SPD) 4. Herbert Schildt, Java The Complete Reference, Eleventh Edition, McGraw-Hill Education, 2020	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Practical journal submission, viva, assignments • Journal Submission : 10 Marks • Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
13	Format of Question Paper: (Semester End Practical Examination: 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Vertical – III

Open Elective

Name of the Course: Financial Literacy – NUCS307

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides a comprehensive introduction to the Indian financial system, offering foundational knowledge of its structure, components, and functioning. It delves into the role of banks and other financial institutions in economic development and explores various banking services available to individuals and businesses. The course also introduces students to the basics of insurance and personal financial planning, enabling them to make informed financial decisions and develop sound saving and investment strategies. Through real-world examples, case studies, and practical insights, students will gain a deeper understanding of how financial instruments, services, and institutions interact to support the financial stability of individuals and the economy.
2	**Vertical:**	**Open Electives**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Familiarity with different aspects of financial literacy such as savings, investment, taxation, and insurance. 2. Understand the relevance and process of financial planning. **3.** To promote financial well-being.	
8	**Course Outcomes (CO):** **After completing this course, students will have the knowledge and skills to** • **CO1:** Learners will develop proficiency for personal and family financial planning. • **CO2:** Learners will develop the ability to analyse banking and insurance products. • **CO3:** Learners will Apply the concept of investment planning.	
•	**Modules:-** **Module 1 (10 hours): Financial Planning and Financial Products Introduction** A) Introduction to Saving, Management of spending and financial discipline: Meaning and importance of saving, theoretical principles of financial discipline, Impact of inflation and consumption patterns on personal finance. **B)** Banking products and services, Digitization of financial transactions: Types of bank accounts (Savings, Current, and Fixed Deposits), Services offered by banks: loans,	

overdrafts, etc. Concept and working of debit cards, credit cards, Introduction to digital banking: Features of Net Banking and UPI and theoretical benefits and limitations of digitization in finance.

Module 2 (10 hours): Investment Planning and Management

A) Investment opportunity and financial products: Overview of asset classes: equity, debt, mutual funds, real estate, and gold. Risk and return theory. Time value of money (conceptual level). Role of SEBI and regulatory environment.

B) Insurance Planning: Basic principles of insurance: risk pooling, premium, and insurable interest. Types of insurance: life vs non-life (health, motor, property).

C) Introduction to basic Tax Structure in India for personal taxation, Aspects of Personal tax planning: Importance of tax planning in personal finance.

10 Text Books

- ✓ Halan, Monika. *Let's Talk Money*, Harper Business
- ✓ Pathak, Bharati V. *The Indian Financial System* (selected basic chapters)
- ✓ RBI's "Financial Literacy" booklets and SEBI's student guides

11 Reference Books

1. Introduction to Financial Planning (4th Edition 2017) - Indian Institute of Banking & Finance.
2. Bhasham, A.L, Wonder that was India: A Survey of the Culture of the Indian Subcontinent Before the Coming of the Muslims. London, Sidgwick and Jackson, 1954'
3. Sinha, Madhu. Financial Planning: A Ready Reckoner July 2017, McGraw Hill.
4. Halan, Monika, Let's Talk Money: You've Worked Hard for It, Now Make It Work for You, July 2018 Harper Business.
5. Pandit, Amar The Only Financial Planning Book that You Will Ever Need, Network 18 Publications Ltd.

12	**Internal Continuous Assessment: 40%**	**External Assessment : 60%**
13	**Continuous Evaluation through:**	**Semester End Examination (30 Marks)**

Sr. No	Particular	Marks
1.	Class Test	15
2.	Class participation	05
	Total	**20**

14	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)**

Questions	Type & Module	Marks
Q1.	Objective Question A) Multiple choice questions B) True or False	 08 Marks 07 Marks
Q2.	Theory Question	15 Marks
	OR	
Q2.	Theory Question	15 Marks
	Total	**30**

Vertical – IV

Name of the Course: Linear Algebra

Sr.No.	Heading	Particulars
1	**Description the course:**	● **Introduction:** This course introduces the fundamental concepts of linear algebra essential for understanding data science and machine learning. ● **Relevance and Usefulness:** Linear algebra forms the backbone of algorithms in data analysis, statistics, computer graphics, AI, and machine learning. ● **Applications:** Used in dimensionality reduction (PCA), optimization, regression, neural networks, image processing, and recommendation systems. ● **Interest and Connection with Other Courses:** Connects directly with Probability, Statistics, Data Mining, Machine Learning, and Artificial Intelligence. ● **Demand in the Industry:** Knowledge of linear algebra is essential for careers in data science, analytics, machine learning, and AI. ● **Job Prospects:** Data Analyst, Machine Learning Engineer, Research Scientist, Data Scientist.
2	**Vertical :**	VSC
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** 1. To understand the core concepts of vector spaces and matrices. 2. To apply linear algebra techniques to solve systems of equations. 3. To analyze transformations and their applications in data science. 4. To link linear algebra with real-world problems in machine learning and optimization.	
8	**Course Outcomes (OC):** After completing this course, students will be able to: ● Solve linear equations using matrix methods. ● Understand vector spaces, basis, and dimension. ● Compute eigenvalues and eigenvectors and apply them in data reduction. ● Apply linear algebra concepts in machine learning algorithms like PCA and regression.	
9	**Modules:-** **Module 1: Vector Spaces & Linear Transformations (15 Hrs)**	
	● Vectors and vector spaces, subspaces ● Basis and dimension, linear independence ● Linear transformations and matrix representation ● Rank, nullity, and the rank-nullity theorem ● Applications in data representation and dimensionality reduction	
	Module 2: Eigenvalues, Eigenvectors & Applications (15 Hrs)	
	● Determinants and their properties ● Eigenvalues and eigenvectors, diagonalization ● Orthogonality and orthogonal transformations ● Singular Value Decomposition (SVD)	

<table>
<tr><td></td><td colspan="2">• Applications in PCA, regression, and machine learning</td></tr>
<tr><td>10</td><td colspan="2">Reference Books

• Sheldon Axler – Linear Algebra Done Right
• Hoffman & Kunze – Linear Algebra
• Schaum's Outline Series – Linear Algebra</td></tr>
<tr><td>11</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>12</td><td>Continuous Evaluation through:
Class test of 15 marks

Quizzes/ Presentations/ Assignments: 5 marks
Total: 20 marks</td><td>Format of Question Paper: External Examination (30 Marks)– 1 hr duration</td></tr>
<tr><td>13</td><td colspan="2">Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)
<table>
<tr><th>Questions</th><th>Based On</th><th>Options</th><th>Marks</th></tr>
<tr><td>Q.1</td><td>Module 1</td><td>Any 2 out of 4</td><td>10</td></tr>
<tr><td>Q.2</td><td>Module 2</td><td>Any 2 out of 4</td><td>10</td></tr>
<tr><td>Q.3</td><td>Module 1 & 2</td><td>Any 2 out of 4</td><td>10</td></tr>
</table></td></tr>
</table>

Nirmala Memorial Foundation College of Commerce and Science

(Autonomous)

Re-accredited by NAAC with B++, ISO 9001-2015 Certified, Recognised under section 2(f) & 12(B) of the UGC Act 1956

Permanently Affiliated to the University of Mumbai,

Syllabus

HINDI BHASHA : VYAVAHARIK PRAYOG

ABILITY ENHANCEMENT COURSE

(Semester III)

As Per New Education Policy (NEP) 2020

(To be implemented from the Academic Year 2026-2027)

Approved in the Academic Council Meeting held on 7th ***October 2025***

Title of Paper- हिंदी भाषा:व्यावहारिक प्रयोग

Sr. No.	Heading	Particulars
1	**Description of the course:**	भाषा का जीवन में सदैव महत्व रहा है। जीवन और भाषा का चोली-दामन का संबंध है। जब हमारी भाषा मधुर और सार्थक होती है तो श्रोता पर विशिष्ट प्रभाव पड़ता है। भाषा का यदि सही और सार्थक रूप से प्रयोग किया जाए तो मनुष्य जीवन में कहीं भी असफल नहीं हो सकता है। इसी भाषा के माध्यम से हम सभी को अपनी ओर आकर्षित भी करते हैं। वर्तमान युग में रोज़गार में बहुत से क्षेत्र भाषा से जुड़े हुए हैं, जिसके माध्यम से विद्यार्थी इनका लाभ ग्रहण कर सकते हैं। भाषाई क्षमता हमारे विचारों की संवाहक होती है। आज डिजिटल युग में अभिव्यक्ति के कई माध्यमों का प्रसार हुआ है, इन माध्यमों में भाषा ही सशक्त तत्व है जो आपकी अभिव्यक्ति को पूरे जगत को अवगत कराती है। भाषा का महत्व हर समय, हर माध्यम में रहा है, परंतु भाषा का सार्थक रूप का प्रयोग आज बहुत आवश्यक है। आज हिंदी अंतरराष्ट्रीय स्तर पर प्रयोग में लाई जा रही है, तकनीक, सूचना प्रौद्योगिकी सोशल मीडिया, राजनीति की भाषा हिंदी बन चुकी है। जीवन में कई क्षेत्रों में व्यावहारिक स्तर पर हमें अपनी भाषा के लिखित स्वरूप के कार्यों को करना होता हैऔर ऐसे में कार्य-दक्षता महत्व रखती है। हिंदी भाषा में व्यावहारिक प्रयोग को केंद्र में रखकर और इन्हीं पहलुओं को ध्यान में रखते हुए इस पाठ्यक्रम का गठन किया गया है। हम हिंदी भाषा को सही और शुद्ध रूप में प्रयोग कर अभिव्यक्ति को सफल बनाएं और बिना व्याकरण के यह संभव नहीं है। इस दृष्टि से पाठ्यक्रम सर्वाधिक लाभकारी सिद्ध होगा।
2	**Vertical:**	AEC
3	**Type:**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives:** 1. विद्यार्थियों को राजभाषा हिंदी का विधिवत ज्ञान प्रदान करना।	

	2. विद्यार्थियों को राजभाषा हिंदी के व्याकरण से परिचय करवाना। 3. विद्यार्थियों को संज्ञा आदि का ज्ञान प्रदान करना। 4. विद्यार्थियों को कारकों, वाक्य रचना एवं भाषिक चिह्नों आदि का ज्ञान प्रदान करना।
8	**Course Outcomes:** 1. विद्यार्थियों को राजभाषा हिंदी का ज्ञान प्राप्त होगा, एवं दक्षता प्राप्त होगी। 2. विद्यार्थियों को राजभाषा हिंदी के व्याकरणिक प्रयोग की जानकारी प्राप्त होगी। 3. विद्यार्थियों को हिंदी-संज्ञा आदि का ज्ञान प्राप्त होने के साथ भाषा के शुद्ध, व्यावहारिक रूप का ज्ञान होगा। 4. विद्यार्थियों को कारकों, वाक्य रचना एवं भाषिक चिह्नों आदि का ज्ञान प्राप्त होगा।
9	Modules (Per credit one module can be created)
	इकाई-1 व्याख्यान-15 क्रेडिट-01
	1. हिंदी भाषा : सामान्य परिचय
	2. राजभाषा हिंदी : संवैधानिक महत्त्व
	3. वर्णमाला : स्वर एवं व्यंजन
	4. शब्द भेद : सामान्य परिचय (संज्ञा आदि)
	इकाई-2 व्याख्यान-15 क्रेडिट-01
	1. वाक्य : सामान्य परिचय
	2. वर्तनी : शुद्धता का प्रयोग एवं सावधानियाँ
	3. कारक एवं विराम चिह्न
	4. पत्र लेखन : (बधाई, निमंत्रण, सुझाव, शिकायत, आभार, आवेदन, RTI लेखन)
10	**संदर्भ ग्रंथ-** 1. बाबूराम सक्सेना- सामान्य भाषा विज्ञान, हिंदी साहित्य सम्मेलन, प्रयाग 2. कामताप्रसाद गुरु- हिंदी व्याकरण, लोकभारती प्रकाशन, इलाहाबाद 3. आचार्य देवेंद्र नाथ शर्मा- भाषा विज्ञान की भूमिका, राधाकृष्ण प्रकाशन, दिल्ली 4. भाषा विज्ञान एवं भाषाशास्त्र- कपिलदेव द्विवेदी, विश्वविद्यालय प्रकाशन, वाराणसी 5. भोलानाथ तिवारी- भाषा विज्ञान, किताब महल, इलाहाबाद

11	**Internal Continuous Assessment : 40%**	**External : Semester End Examination : 60%**
12	**Continuous Evaluation through:** ● रचनात्मक कार्य/प्रकल्प इत्यादि- 10 अंक ● प्रस्तुति/परिसंवाद सहभागिता इत्यादि- 05 अंक ● अकादमिक, व्यावसायिक एवं कौशल संवर्धन गतिविधियाँ- 05 अंक **कुल 20 अंक**	**लिखित परीक्षा** **अंक : 30** **समयावधि : 01 घंटा**

13	**Format of Question Paper:** for the semester end examination **अंक : 30**	**लिखित परीक्षा** **समयावधि : 01 घंटा**
	निर्देश- 1. दोनों इकाइयों से प्रश्न पूछे जाएं। 2. तीन प्रश्न पूछे जाएं, किन्हीं दो प्रश्नों के उत्तर अपेक्षित हैं।	15x2 = **30 अंक** कुलयोग- **30 अंक**

Vertical – VI

Title of Paper: Yoga and Wellness I – NUCC303

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	India is growing rapidly as a global super-power. To face the challenges of the century and to keep up with the pace of the world, maintaining health is of prime importance. Giving thrust to healthy society, Physical Education, Sports, Health & fitness and Yoga are of great significance in today's world. The Government of India insists on Physical Fitness, Mental Health and Overall Development of Personality for every citizen. However, creating efficient and skilled human resource in the field of Physical Education, Sports and Yoga is identified as the need of the hour. Thus, the Governments of India and Government of Maharashtra have included Physical Education, Sports and Yoga as a key area under the NEP 2020.
2	**Vertical :**	Co-Curricular
3	**Type :**	Activity Based
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: The students will be able to: • **To introduce students to the historical roots and philosophical foundations of Yoga,** with emphasis on Patanjali's Yoga Sutras. • **To develop awareness and practical skills in different forms of Yoga** by learning basic asanas and understanding their physical and mental health benefits.	
8	**Course Outcomes**: **CO1:** Understand the origin, philosophy, and importance of Yoga as described in Patanjali's Yoga Sutras. **CO2:** Identify various types of Yoga and perform basic asanas effectively, demonstrating their benefits on physical and mental well-being.	

9	**Module :** This module introduces the meaning, origin, and significance of Yoga with reference to Patanjali's Yoga Sutras. It explains various types of yoga such as Hatha, Ashtanga, and Vinyasa. Students learn basic asanas like Tadasana, Bhujangasana, Trikonasana, and Vajrasana. The module highlights yoga's benefits in improving both physical fitness and mental well-being.
10	**Reference Books:** • Iyengar, B.K.S. (2001). Light on Yoga. London: Thorsons. • Tiwari, O.P. (1996). Asana: Why and How? Lonavla: Kaivalyadhama Yoga Institute.
11	**Internal Continuous Assessment: 40% (20 Marks)** ❖ Yoga Report/Assignment
12	External Assessment: 60% : **(30 Marks)** • Scanned copy of the Yoga participation certificate. • A short report on Yogasana (handwritten or typed). *Note: Students participating in sports competitions conducted by University at State or National Level, students who have represented Mumbai University or College at Intercollegiate / Inter Zonal / West Zone Inter University / All India Inter University/ International tournament are exempt from submission of report.*

Semester – IV

SEMESTER IV

COURSE STRUCTURE

VERTICAL		COURSE CODE	SUBJECT	CREDIT
Vertical 1	Major	NUDS401	Optimization Techniques	**2**
	Major	NUDS402	Machine Learning (Unsupervised and Reinforcement) II	**2**
	Major	NUDS403	Optimization Techniques - **Lab**	**2**
	Major	NUDS404	Machine Learning (Unsupervised and Reinforcement) II - **Lab**	**2**
Vertical 2	Minor	NUDS405	UI/UX Design	2
	Minor	NUDS406	UI/UX Design - **Lab**	2
Vertical 3	OE	NUDS407	Digital Payment Systems and Security	2
Vertical 4	SEC	NUDS408	Data Visualization using Tableau - **Lab**	2
Vertical 5	AEC	NUHN401	Hindi Bhasha – Kaushal ke Aadhar	**2**
Vertical 6	CC	NUCC403	Yoga and Wellness – II	2
	CEP	NUCP401	Community Engagement Projects	**2**
			Total Credits	**22**

Vertical – I

Mandatory Courses

Name of the Course: Optimization Techniques

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** This course introduces the fundamental principles and methods of optimization with a focus on applications in Data Science and Machine Learning. • **Relevance and Usefulness:** Optimization is the backbone of model training, feature selection, dimensionality reduction, and decision-making in Data Science. • **Applications:** Machine learning model training, regression, clustering, portfolio optimization, logistics, and supply chain management. • **Interest and Connection with Other Courses:** Connects with Linear Algebra, Probability, Statistics, Machine Learning, and Artificial Intelligence. • **Demand in the Industry:** Optimization skills are in high demand in analytics, operations, AI, ML, and finance. • **Job Prospects:** Data Scientist, Machine Learning Engineer, Optimization Specialist, AI Engineer, Business/Data Analyst.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credits :**	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To understand the fundamentals of optimization in the context of Data Science. • To apply linear and nonlinear optimization techniques to solve data-driven problems. • To introduce transportation models for real-world applications. • To connect optimization concepts with machine learning and analytics.	
8	**Course Outcomes (CO):** After completing this course, students will be able to: CO 1. Formulate real-world data problems as optimization problems. CO 2. Solve linear programming problems using simplex and transportation methods. CO 3. Apply constrained and unconstrained optimization techniques to machine learning models. CO 4. Use optimization approaches for regression, logistic regression, clustering, and classification tasks.	
9	**Modules:-** **Module 1: Linear & Classical Optimization (15 Hrs)**	
	• Introduction to optimization: definitions, classification (linear, nonlinear, constrained, unconstrained) • Linear Programming Problem (LPP): formulation and data science applications • Graphical method (2 variables)	

	• Simplex method and its variants (Big-M, Two-Phase method)
	Module 2: Transportation Problem & Nonlinear Optimization (15 Hrs)
	• Transportation Problem: formulation, balanced/unbalanced cases, North-West Corner Rule, Least Cost Method, Vogel's Approximation Method, MODI Method • Unconstrained optimization: Gradient Descent, Newton's Method (applications in ML model training) • Constrained optimization: Lagrange multipliers, Karush–Kuhn–Tucker conditions • Applications in Data Science: Regression as optimization, Logistic Regression, Clustering and Classification as optimization tasks
10	**Reference Books** • H.A. Taha – Operations Research: An Introduction • Hillier & Lieberman – Introduction to Operations Research • Frederick S. Hillier – Optimization in Operations Research • S.S. Rao – Engineering Optimization • Satya Prakash Singh – Optimization Models for Machine Learning (for DS applications)
11	**Internal Continuous Assessment: 40%** / **Semester End Examination: 60%**
12	**Continuous Evaluation through:** Class test of 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks **Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
13	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)**

Questions	Based On	Options	Marks
Q.1	Module 1	Any 2 out of 4	10
Q.2	Module 2	Any 2 out of 4	10
Q.3	Module 1 & 2	Any 2 out of 4	10

Mandatory Courses

Name of the Course : Machine Learning (Unsupervised and Reinforcement) II

Sr. No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** This course introduces advanced machine learning techniques focusing on **unsupervised learning** and **reinforcement learning (RL)**. Students will explore clustering, dimensionality reduction, association rule mining, anomaly detection, and recommender systems, followed by fundamentals of RL, including dynamic programming, Monte Carlo, temporal difference methods, and deep RL basics. • **Relevance and Usefulness:** Unsupervised methods are widely applied in data exploration, pattern discovery, recommendation engines, and fraud detection, while RL powers decision-making in robotics, games, and adaptive systems. • **Applications:** Customer segmentation, market basket analysis, anomaly detection in finance/cybersecurity, recommender systems, intelligent agents in gaming, robotics, and autonomous systems. • **Interest and Connection with Other Courses:** Closely linked with *Supervised Machine Learning, Artificial Intelligence, Deep Learning, Optimization Techniques, and Data Science applications.* • **Demand in the Industry:** Skills in clustering, recommender systems, and reinforcement learning are highly demanded in analytics, e-commerce, healthcare, finance, and AI-driven automation. • **Job Prospects:** Data Scientist, Machine Learning Engineer, AI Engineer, Business Intelligence Analyst, Robotics Engineer, Game AI Developer.
2	**Vertical:**	**Major**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To introduce concepts and techniques of **unsupervised learning**, including clustering, dimensionality reduction, and association rule mining. 2. To provide exposure to **evaluation methods** for clustering and unsupervised models. 3. To develop skills in implementing **real-world applications** such as recommender systems, anomaly detection, and customer segmentation.	

	4. To introduce the fundamentals of **reinforcement learning**, including agent-environment interaction, MDP, and exploration-exploitation trade-offs. 5. To apply RL algorithms such as **dynamic programming, Monte Carlo methods, SARSA, Q-learning, and basics of deep RL** in practical scenarios.
8	**Course Outcomes:** After successful completion of this course, students would be able to – CO1. Understand unsupervised learning techniques. CO2. Apply clustering, dimensionality reduction, and association rule mining. CO3. Implement anomaly detection and recommender systems. CO4. Understand reinforcement learning fundamentals and apply basic algorithms.
9	**Modules:-** **Module 1 (15 hours):**
	Module I: Unsupervised Learning (15 Hrs) ● Introduction to Unsupervised Learning ● Clustering: k-Means, Hierarchical, DBSCAN, Gaussian Mixture Models ● Cluster Evaluation (Silhouette Score, Davies–Bouldin Index) ● Dimensionality Reduction: PCA, t-SNE (basics) ● Association Rule Mining: Apriori, FP-growth ● Applications: Market Basket Analysis, Customer Segmentation
	Module 2 (15 hours):
	Module II: Reinforcement Learning (15 Hrs) ● RL Basics: Agent, Environment, Reward, Policy ● Markov Decision Process (MDP) ● Exploration vs Exploitation ● Dynamic Programming: Value Iteration, Policy Iteration ● Monte Carlo Methods ● Temporal Difference Learning: SARSA, Q-learning ● Introduction to Deep Reinforcement Learning (DQN overview) ● Applications: Games, Robotics, Recommender Systems
11	**Reference Books** • **Machine Learning**, E. Balagurusamy, McGraw Hill India • **Data Mining: Concepts and Techniques (Indian Edition)**, Jiawei Han, Micheline Kamber, Jian Pei, Elsevier India • **Introduction to Data Mining (Indian Edition)**, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson India • **Machine Learning with Python**, Prateek Joshi, BPB Publications • **Data Science and Analytics**, Anil Maheshwari, Wiley India • **Reinforcement Learning: Theory and Applications**, S. N. Sivanandam, S. Sumathi, Springer India

<table>
<tr><td></td><td colspan="2">Artificial Intelligence and Soft Computing, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Pearson India
Machine Learning, E. Balagurusamy, McGraw Hill India
Python Machine Learning Projects, Prateek Joshi, BPB Publications</td></tr>
<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
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<tr><td>Q.2</td><td>Module 2</td><td>Any 2 out of 4</td><td>10</td></tr>
<tr><td>Q.3</td><td>Module 1 & 2</td><td>Any 2 out of 4</td><td>10</td></tr>
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Name of the Course: Optimization Techniques - Lab

Sr.No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** • **Relevance and Usefulness:** • **Applications:** • **Interest and Connection with Other Courses:** • **Demand in the Industry:** • **Job Prospects:**
2	**Vertical :**	Major
3	**Type :**	Practical
4	**Credits :**	2 credits (1 credit = 15 Hours of Practical work in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To implement classical optimization algorithms in Python. • To model and solve transportation and unconstrained/constrained problems using Python libraries. • To connect algorithmic optimization with ML tasks (regression, logistic regression). • To develop coding, analysis and reporting skills required for optimization tasks.	
8	**Course Outcomes (CO):** After completing this course, students will be able to: CO 1. Formulate and solve LPPs using Python (PuLP). CO 2. Implement transportation solution methods in Python and compute optimal cost. CO 3. Implement gradient-based optimizers for ML problems and compare methods. CO 4. Use scipy.optimize and other Python tools for constrained optimization and interpret results.	
9	**Modules:-** **Module 1: Linear & Classical Optimization (15 Hrs)**	
	• **Practical 1:** Q1. Formulate and solve an LPP with two variables in Python; plot the feasible region. Q2. Identify the optimal solution graphically and numerically. • **Practical 2:** Q1. Solve an LPP using the Simplex Method in Python (PuLP). Q2. Display the optimal values of variables and the objective function. • **Practical 3:** Q1. Implement the Big-M Method in Python for solving an LPP with ≥ constraints. Q2. Implement the Two-Phase Method in Python for the same problem and compare results. • **Practical 4:** Q1. Perform sensitivity analysis by varying RHS values of constraints in Python.	

	Q2. Perform sensitivity analysis by changing coefficients of the objective function and analyze results. • **Practical 5:** Q1. Solve a real-life production planning / resource allocation problem in Python. Q2. Visualize the allocation and compute total profit/cost.	
	Module 2: Transportation Problem & Nonlinear Optimization (15 Hrs)	
	• **Practical 6:** Q1. Solve a Transportation Problem using the North-West Corner Method in Python. Q2. Solve the same problem using the Least Cost Method and compare results. • **Practical 7:** Q1. Solve a Transportation Problem using Vogel's Approximation Method (VAM) in Python. Q2. Implement the MODI (u-v) method to test and improve the solution to optimality. • **Practical 8:** Q1. Implement Gradient Descent in Python for Linear Regression on a dataset. Q2. Compare results with the closed-form solution (Normal Equation). • **Practical 9:** Q1. Implement Newton's Method for optimization of a quadratic function in Python. Q2. Compare Newton's Method with Gradient Descent in terms of iterations and accuracy. • **Practical 10:** Q1. Solve a constrained optimization problem in Python using scipy.optimize.minimize (SLSQP). Q2. Verify whether the solution satisfies the constraints (KKT conditions).	
10	**Reference Books** • H.A. Taha – Operations Research: An Introduction • Hillier & Lieberman – Introduction to Operations Research • Frederick S. Hillier – Optimization in Operations Research • S.S. Rao – Engineering Optimization • Satya Prakash Singh – Optimization Models for Machine Learning	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Practical journal submission, viva, assignments • Journal Submission : 10 Marks • Assignments: 10 Marks • Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
13	Format of Question Paper: (Semester End Practical Examination: 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Name of the Course: Machine Learning (Unsupervised and Reinforcement) II - Lab

Sr. No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** This course provides practical experience in implementing **unsupervised learning** and **reinforcement learning** algorithms using Python. Students will work on clustering, dimensionality reduction, association rule mining, and reinforcement learning techniques including dynamic programming, Q-learning, and deep RL. • **Relevance and Usefulness:** The lab enhances hands-on skills in building machine learning systems for **pattern discovery, customer segmentation, anomaly detection, and intelligent agents**. • **Applications:** Customer analytics, recommender systems, fraud detection, robotics, and AI-driven decision-making. • **Interest and Connection with Other Courses:** Builds upon *Machine Learning (Theory)* and connects with *Artificial Intelligence, Deep Learning, Optimization Techniques, and Data Science Applications*. • **Demand in the Industry:** Clustering, recommender systems, and reinforcement learning are highly relevant in **e-commerce, finance, gaming, healthcare, and robotics**. • **Job Prospects:** Data Scientist, Machine Learning Engineer, AI Engineer, Robotics Engineer, Game AI Developer.
2	**Vertical:**	**Major**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** This course aims to provide students with practical and theoretical knowledge of unsupervised learning and reinforcement learning techniques. It also aims to - • To implement **unsupervised learning algorithms** including clustering, dimensionality reduction, and association rule mining. • To evaluate and visualize clustering results using appropriate metrics. • To gain practical experience in designing and training **reinforcement learning agents**. • To apply dynamic programming, Monte Carlo, and temporal difference learning methods. • To implement a basic **Deep Q-Network (DQN)** for decision-making in simple environments.	
8	**Course Outcomes:** After successful completion of this course, students will be able to: CO1. Implement and visualize clustering algorithms for real datasets. CO2. Apply PCA and association rule mining for dimensionality reduction and pattern discovery.	

	CO3. Design reinforcement learning agents using value iteration, policy iteration, and Q-learning. CO4. Understand the basics of Deep Reinforcement Learning by implementing a DQN on simple environments.
9	**Modules:-**
	Module I: Unsupervised Learning (15 Hrs) **Practical 1: Implement k-Means Clustering** ● **AIM:** To cluster data points into distinct groups using k-Means algorithm. ● **Task:** Load a dataset (e.g., Iris), apply k-Means clustering, visualize clusters, and evaluate using Silhouette Score. **Practical 2: Hierarchical Clustering** ● **AIM:** To perform hierarchical clustering and visualize dendrograms. ● **Task:** Apply agglomerative clustering on a dataset, plot dendrogram, identify optimal clusters, and compare with k-Means results. **Practical 3: DBSCAN Clustering** ● **AIM:** To detect clusters of varying density and identify outliers. ● **Task:** Apply DBSCAN on a dataset, visualize clusters, label noise points, and analyze results. **Practical 4: Dimensionality Reduction using PCA** ● **AIM:** To reduce data dimensions while retaining maximum variance. ● **Task:** Apply PCA on a high-dimensional dataset (e.g., Wine dataset), visualize first two principal components, and interpret variance explained. **Practical 5: Association Rule Mining (Apriori Algorithm)** ● **AIM:** To find frequent itemsets and generate association rules. ● **Task:** Apply Apriori on a dataset (e.g., Market Basket Analysis), generate rules with minimum support & confidence, and interpret results.
	Module 2
	Module II: Reinforcement Learning (15 Hrs) **Practical 6: Implement Gridworld Environment**

	• **AIM:** To simulate a simple RL environment for learning agent behavior. • **Task:** Create a Gridworld environment, define states, actions, and rewards, and observe agent exploration. **Practical 7: Value Iteration** • **AIM:** To find optimal policy using dynamic programming. • **Task:** Implement Value Iteration algorithm on a small MDP, compute value function, and determine optimal policy. **Practical 8: Policy Iteration** • **AIM:** To determine optimal policy by iterative evaluation and improvement. • **Task:** Apply Policy Iteration on a toy MDP environment and compare results with Value Iteration. **Practical 9: Q-Learning (Temporal Difference Learning)** • **AIM:** To train an agent using model-free reinforcement learning. • **Task:** Implement Q-learning on OpenAI Gym environment (e.g., FrozenLake), update Q-values, and evaluate agent performance. **Practical 10: Deep Q-Network (DQN) – Introductory** • **AIM:** To apply deep reinforcement learning for complex environments. • **Task:** Implement a basic Deep Q-Network on a simple environment (e.g., CartPole), train the agent, and observe learning behavior.	
11	**Reference Books** • **Machine Learning**, E. Balagurusamy, McGraw Hill India • **Data Mining: Concepts and Techniques (Indian Edition)**, Jiawei Han, Micheline Kamber, Jian Pei, Elsevier India • **Introduction to Data Mining (Indian Edition)**, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson India • **Machine Learning with Python**, Prateek Joshi, BPB Publications • **Data Science and Analytics**, Anil Maheshwari, Wiley India • **Reinforcement Learning: Theory and Applications**, S. N. Sivanandam, S. Sumathi, Springer India • **Artificial Intelligence and Soft Computing**, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Pearson India • **Machine Learning**, E. Balagurusamy, McGraw Hill India • **Python Machine Learning Projects**, Prateek Joshi, BPB Publications	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**

13	**Continuous Evaluation through:** Practical journal submission, viva, assignments • Journal Submission : 10 Marks • Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
14	Format of Question Paper: (Semester End Practical Examination: 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Vertical – II

Minor Courses

Name of the Course: UI/UX Design

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides students with practical and theoretical knowledge of User Interface (UI) and User Experience (UX) design. It covers the fundamentals of UI/UX, human-centered design, visual design principles, and information architecture, as well as hands-on experience in wireframing, prototyping, interactive design, usability testing, and responsive design. Students will work on practical exercises and a mini-project to design complete application interfaces for web or mobile platforms using modern design tools such as Figma, Adobe XD, Sketch, and Canva. The course emphasizes creating usable, visually appealing, and user-friendly interfaces through an iterative, user-centered design approach.
2	**Vertical:**	**Minor**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** • To introduce students to the fundamental principles of User Interface (UI) and User Experience (UX) design. • To develop the ability to apply human-centered design and design thinking processes for creating usable interfaces. • To enable students to create wireframes, prototypes, and interactive designs for web and mobile applications. • To teach methods for evaluating design usability through user testing, heuristic evaluation, and feedback analysis. • To equip students with skills in using modern UI/UX design tools such as Figma, Adobe XD, Sketch, and Canva for professional interface design.	
8	**Course Outcomes:** By the end of the course, students will be able to: 1. Understand fundamental principles of User Interface (UI) and User Experience (UX) design. 2. Apply design thinking and human-centered design methods to create usable interfaces. 3. Develop wireframes, prototypes, and interactive designs for web and mobile applications. 4. Evaluate design usability through user testing and feedback. 5. Utilize modern design tools for creating visually appealing and functional interfaces.	
9	**Modules:-** **Module 1 (15 hours):**	

	Module I: Fundamentals of UI/UX Design (15 Hrs)
	• Introduction to UI and UX
	  o Difference between UI and UX
	  o Importance in software and data-driven applications	

	• Human-Centered Design & Design Thinking Process
	  ○ Empathize, Define, Ideate, Prototype, Test
	  ○ Visual Design Principles
	• Layout, Color Theory, Typography, Iconography
	  ○ Consistency and visual hierarchy
	  ○ Information Architecture
	• User flows, Site maps, Navigation structures
	  ○ Introduction to Wireframing and Prototyping
	  ○ Low-fidelity vs High-fidelity wireframes	

	Module 2 (15 hours):	

	Module II: Practical UI/UX Design & Tools (15 Hrs)
	● Prototyping and Interactive Design
	  ○ Interactive wireframes
	  ○ Storyboarding for workflows
	● Usability Testing
	  ○ Heuristic evaluation
	  ○ User testing methods (A/B testing, surveys)
	● Responsive and Mobile-first Design
	  ○ Layout adaptation for different screen sizes
	● UI/UX Tools Overview
	  ○ Figma, Adobe XD, Sketch, Canva
	● Case Study: Designing a small application interface
	  ○ Data dashboard, e-commerce app, or student portal	

10	**Reference Books** • **UI/UX Design with Adobe XD**, Satyajit Sahoo, BPB Publications, 1st Edition • **Designing User Experience: A Practical Guide**, Pawan Shukla, Wiley India, 1st Edition • **User Experience Design: A Practical Playbook to Fuel Business Growth**, Smruti Ranjan Dash, Notion Press, 1st Edition • **Web & Mobile App Design: UI/UX Principles for Beginners**, Amit Kumar, BPB Publications, 1st Edition • **Don't Make Me Think: A Common Sense Approach to Web Usability**, Steve Krug, New Riders, 3rd Edition • **The Design of Everyday Things**, Don Norman, Basic Books, Revised and Expanded Edition • **About Face: The Essentials of Interaction Design**, Alan Cooper, Robert Reimann, David Cronin, Wiley, 4th Edition • **Lean UX: Applying Lean Principles to Improve User Experience**, Jeff Gothelf, O'Reilly, 2nd Edition • **Designing Interfaces: Patterns for Effective Interaction Design**, Jenifer Tidwell, O'Reilly, 2nd Edition • **Sketching User Experiences: The Workbook**, Bill Buxton, Morgan Kaufmann, 1st Edition	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Class test of 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**

13	**Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)**

Questions	Based On	Options	Marks
Q.1	Module 1	Any 2 out of 4	10
Q.2	Module 2	Any 2 out of 4	10
Q.3	Module 1 & 2	Any 2 out of 4	10

Name of the Course: UI/UX Design - Lab

Sr. No.	Heading	Particulars
1	**Description the course:**	This practical course focuses on hands-on learning of User Interface (UI) and User Experience (UX) design. Students will actively engage in designing low-fidelity and high-fidelity wireframes, creating user personas and journey maps, developing interactive prototypes, and conducting usability testing. The course emphasizes applying visual design principles, organizing information architecture, and building responsive interfaces across different devices. Using industry-standard design tools such as Figma, Adobe XD, Sketch, and Canva, students will complete exercises and a mini-project to integrate all UI/UX concepts into a fully functional application prototype, preparing them for real-world design challenges.
2	**Vertical:**	**Minor**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** • To enable students to understand and apply fundamental principles of User Interface (UI) and User Experience (UX) design. • To develop skills in creating low-fidelity and high-fidelity wireframes, user personas, and user journey maps. • To teach students how to apply visual design principles and organize information architecture for effective navigation. • To equip students with the ability to build interactive prototypes, conduct heuristic evaluations, and perform user testing. • To prepare students to design responsive interfaces and integrate all UI/UX principles into a complete application prototype.	
8	**Course Outcomes:** **By the end of the course, students will be able to:** 1. Understand and apply fundamental principles of UI and UX design in practical scenarios. 2. Create low-fidelity and high-fidelity wireframes, user personas, and user journey maps. 3. Apply visual design principles and organize information architecture for intuitive navigation. 4. Develop interactive prototypes, conduct heuristic evaluations, and perform user testing. 5. Design responsive interfaces and integrate all UI/UX principles into a complete application prototype.	
9	**Modules:-** **Module 1 (15 hours):**	

Module I: Fundamentals of UI/UX Design (15 Hrs)

Practical 1: Create Low-Fidelity Wireframes

- **AIM:** To design basic layouts and structure of an application interface.
  TASK: Sketch wireframes for a simple application (e.g., To-Do App, Student Portal) on paper or using Figma/Adobe XD; include main screens, navigation buttons, and placeholders for content.
  Tools/Output: Paper + Pencil or Figma; 3–5 screen wireframes.

Practical 2: Develop User Personas and User Journey Maps

- **AIM:** To understand target users and visualize their interaction with the system.
  TASK: Create 2–3 user personas including demographics, goals, and pain points. Map user journeys showing steps users take to complete key tasks in the application.
  Tools/Output: Miro, Canva, or Figma; Persona sheets and journey maps.

Practical 3: Apply Visual Design Principles

- **AIM:** To design an aesthetically appealing interface using color, typography, and layout.
  TASK: Design a sample app interface screen applying principles of hierarchy, contrast, alignment, and typography. Include icons, colors, and call-to-action elements.
  Tools/Output: Figma, Adobe XD; at least one complete screen.

Practical 4: Design Information Architecture Diagram

- **AIM:** To organize app content and navigation logically.
  TASK: Create a site map or navigation flow for a website or dashboard. Include home page, subpages, and menu structure.
  Tools/Output: Miro, Figma, Lucidchart; 1–2 page diagram showing all navigational elements.

Practical 5: Convert Low-Fidelity to High-Fidelity Wireframes

- **AIM:** To enhance wireframes with real content, colors, and interactive components.
  TASK: Take previously created low-fidelity wireframes and convert them into high-fidelity mockups using a design tool, maintaining usability and visual hierarchy.
  Tools/Output: Figma, Adobe XD; fully designed screens ready for prototyping.

Module 2 (15 hours):

Module II: Practical UI/UX Design & Tools (15 Hrs)

Practical 6: Build Interactive Prototypes

- **AIM:** To simulate user interaction with the application.
  TASK: Using high-fidelity wireframes, create clickable prototypes linking screens, buttons, and menus for basic app workflows.
  Tools/Output: Figma, Adobe XD; interactive prototype with navigation.

Practical 7: Conduct Heuristic Evaluation

- **AIM:** To identify usability issues in an existing application.
  TASK: Select a website or app, apply Nielsen's 10 usability heuristics, document

issues, and suggest improvements.
Tools/Output: Document/Report; at least 5 usability issues identified and analyzed.

Practical 8: Perform User Testing

- **AIM:** To evaluate interface usability through user feedback.

- **TASK:** Recruit 3–5 users, ask them to complete predefined tasks on the prototype, record observations, collect feedback, and summarize findings.
  Tools/Output: Observation sheet, Google Forms; summary report with identified issues and suggested improvements.

Practical 9: Design a Responsive Interface

- **AIM:** To create layouts adaptable to multiple screen sizes.
  TASK: Take a previously designed interface and create responsive versions for desktop, tablet, and mobile screens; ensure readability and proper scaling.
  Tools/Output: Figma or Adobe XD; 3 versions of the same interface showing responsiveness.

Practical 10: Mini Project – Complete Application Prototype

- **AIM:** To integrate all UI/UX principles in a complete application design.
  TASK: Design a small application (e.g., Data Dashboard, E-commerce App, Student Portal) including:
  User Personas & Journey Maps
  High-fidelity screens & interactive prototype
  Information Architecture & Navigation Flow
  Usability evaluation & suggested improvements
  Tools/Output: Figma or Adobe XD; submission of complete prototype, documentation, and user feedback summary.

10	**Reference Books**

- UI/UX Design with Adobe XD, Satyajit Sahoo, BPB Publications, 1st Edition
- Designing User Experience: A Practical Guide, Pawan Shukla, Wiley India, 1st Edition
- User Experience Design: A Practical Playbook to Fuel Business Growth, Smruti Ranjan Dash, Notion Press, 1st Edition
- Web & Mobile App Design: UI/UX Principles for Beginners, Amit Kumar, BPB Publications, 1st Edition
- Don't Make Me Think: A Common Sense Approach to Web Usability, Steve Krug, New Riders, 3rd Edition
- The Design of Everyday Things, Don Norman, Basic Books, Revised and Expanded Edition
- About Face: The Essentials of Interaction Design, Alan Cooper, Robert Reimann, David Cronin, Wiley, 4th Edition
- Lean UX: Applying Lean Principles to Improve User Experience, Jeff Gothelf, O'Reilly, 2nd Edition
- Designing Interfaces: Patterns for Effective Interaction Design, Jenifer Tidwell, O'Reilly, 2nd Edition
- Sketching User Experiences: The Workbook, Bill Buxton, Morgan Kaufmann, 1st Edition

11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Practical journal submission, viva, assignments • Journal Submission: 10 Marks • Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
13	Format of Question Paper: (Semester End Practical Examination : 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Vertical – III

Name of the Course: Digital Payment Systems and Security

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides insights into digital payment systems, methods, and security frameworks. It covers electronic fund transfer systems, mobile wallets, UPI, card payments, and e-commerce transactions, while emphasizing fraud detection, data privacy, and regulatory standards. Students will gain a practical understanding of how digital payments operate in India and globally, along with challenges in ensuring security and trust.
2	**Vertical:**	**Open Electives**
3	**Type:**	**Theory**
4	**Credits:**	**2 credits**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. Understand the evolution and types of digital payment systems. 2. Familiarize with Indian and global digital payment infrastructure. 3. Learn security measures like encryption, authentication, and fraud prevention. 4. Explore regulatory and policy frameworks for digital payments. 5. Appreciate future innovations and trends in payment technologies.	
8	**Course Outcomes:** **After completing this course, students will have the knowledge and skills to** CO1: Describe the different digital payment methods and platforms. CO2: Explain UPI, wallets, card systems, and e-commerce transactions. CO3: Evaluate risks and security measures in digital payments. CO4: Understand RBI, NPCI, and international regulations in payment systems. CO5: Analyze emerging trends like contactless and biometric payments.	
	Modules:- Module 1 : Digital Payment Systems in India and Abroad (15 hours) • Introduction to digital payments – meaning, advantages, limitations • Evolution of payments – from cash to digital • Indian systems: UPI, IMPS, NEFT, RTGS, AePS (Aadhaar Enabled Payment System) • Mobile wallets (Paytm, PhonePe, Google Pay) and prepaid cards • Debit cards, credit cards, and Point-of-Sale (POS) terminals • E-commerce payment systems – Cash on Delivery (CoD), net banking, card payments • International payment platforms: PayPal, Apple Pay, Google Pay (global), Stripe	

Module 2 : Security, Regulation, and Future Trends (15 hours)

- Importance of security in digital payments
- Security measures: encryption, OTP, biometric authentication, tokenization
- Common cyber threats – phishing, malware, frauds in digital payments
- Role of NPCI (National Payments Corporation of India) and RBI regulations
- PCI-DSS compliance and data privacy rules
- Fraud detection tools and real-world examples of payment frauds
- Future trends: contactless payments, biometric payments, blockchain in payments

10 Text Books

1. R.K. Sinha. Digital Payment Systems.
2. NPCI & RBI official guidelines (latest versions).

11 Reference Books

6. Dave Birch. Identity is the New Money.
7. Bhaskar, R. Electronic Payment Systems: Security and Legal Issues.

12 **Internal Continuous Assessment: 40%** | **Semester End Examination : 60%**

13 **Continuous Evaluation through:** | **Semester End Examination (30 Marks)**

Sr. No	Particular	Marks
1.	Class Test	15
2.	Class participation	05
	Total	**20**

14 Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)

Questions	Type & Module	Marks
Q1.	Objective Question C) Multiple choice questions D) True or False	 08 Marks 07 Marks
Q2.	Theory Question	15 Marks
	OR	
Q2.	Theory Question	15 Marks
	Total	**30**

Vertical – IV

Vocational & Skill Enhancement Courses (VSEC)

Name of the Course: Data Visualization using Tableau - Lab

Sr. No.	Heading	Particulars
1	**Description the course:**	• **Introduction:** This course provides practical training in **data visualization using Tableau**, enabling students to transform raw data into meaningful and interactive visual insights. The lab covers connecting data sources, creating visualizations, dashboards, maps, and applying storytelling techniques. • **Relevance and Usefulness:** Data visualization is a critical skill for data analysts, business intelligence professionals, and data scientists. Tableau is widely used in industry to analyze trends, identify patterns, and communicate insights effectively. • **Applications:** Sales analysis, customer behavior analytics, financial dashboards, COVID-19 analysis, geographical insights, and business decision-making. • **Interest and Connection with Other Courses:** Connects with *Data Analytics, Business Intelligence, Database Systems, and Machine Learning*. • **Demand in the Industry:** Tableau is one of the most in-demand tools for analytics and visualization roles. • **Job Prospects:** Business Intelligence Analyst, Data Analyst, Visualization Specialist, Data Scientist, Business Consultant.
2	**Vertical:**	VSC
3	**Type:**	Practical
4	**Credits:**	2 credits (1 credit = 15 Hours of Practical work in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** • To train students in **connecting Tableau to different data sources**. • To create and format **basic and advanced visualizations**. • To implement **filters, parameters, and calculated fields** for analysis. • To design **interactive dashboards and geographical visualizations**. • To present insights effectively using **Tableau stories**.	
8	**Course Outcome:** After successful completion of this course, students will be able to: CO1. Connect Tableau with multiple data sources and prepare datasets. CO2. Create and customize visualizations including bar charts, line charts, pie charts, maps, and dashboards. CO3. Apply filters, parameters, hierarchies, and calculated fields for deeper insights. CO4. Present data-driven narratives using dashboards and stories for decision-making.	

9	**Modules:-** **Module: (15 hours)**
	Practical 1: Connecting Tableau to Data Sources ● **AIM:** To understand how to connect Tableau to various data sources. ● **TASK:** Connect Tableau to Excel/CSV dataset, explore data types, and prepare data for visualization. ● **Tools/Output:** Tableau Desktop; connected dataset ready for visualization. **Practical 2: Creating Basic Charts** ● **AIM:** To create simple visualizations to represent data. ● **TASK:** Create Bar Charts, Line Charts, and Pie Charts from the dataset; apply labels and formatting. ● **Tools/Output:** Tableau Desktop; 3 basic visualizations. **Practical 3: Creating Hierarchical and Drill-Down Charts** ● **AIM:** To implement hierarchies and drill-down functionality in visualizations. ● **TASK:** Create a hierarchy (e.g., Country → State → City) and implement drill-down on a bar or tree map chart. ● **Tools/Output:** Tableau Desktop; drill-down chart demonstrating hierarchy. **Practical 4: Using Filters, Sorting, and Highlighting** ● **AIM:** To filter and highlight relevant data dynamically. ● **TASK:** Apply filters on a dataset (e.g., date range, category), sort data, and use highlighting to emphasize key insights. ● **Tools/Output:** Tableau Desktop; filtered and highlighted visualization. **Practical 5: Calculated Fields and Basic Analytics** ● **AIM:** To perform basic data analysis using calculated fields.

	• **TASK:** Create calculated fields (e.g., profit margin, growth percentage), and visualize the results using charts. • **Tools/Output:** Tableau Desktop; chart with calculated metrics.
	Module: (15 hours)
	Practical 6: Creating Dashboards • **AIM:** To combine multiple visualizations into an interactive dashboard. • **TASK:** Create a dashboard with 3–4 charts, apply filters, legends, and interactivity. • **Tools/Output:** Tableau Desktop; interactive dashboard with multiple charts. **Practical 7: Using Parameters for Dynamic Visualizations** • **AIM:** To create dynamic visualizations using parameters. • **TASK:** Create a parameter (e.g., select year, product category) and update visualizations dynamically based on parameter selection. • **Tools/Output:** Tableau Desktop; interactive visualization with parameters. **Practical 8: Creating Maps and Geographical Visualizations** • **AIM:** To visualize data geographically. • **TASK:** Use Tableau's built-in mapping feature to create filled maps, symbol maps, or heat maps based on location data. • **Tools/Output:** Tableau Desktop; map visualizations with geographic data. **Practical 9: Storytelling with Tableau** • **AIM:** To present insights using Tableau Story feature. • **TASK:** Create a story using multiple sheets and dashboards to present a data narrative. • **Tools/Output:** Tableau Desktop; interactive story with 3–5 sheets. **Practical 10: Mini Project – End-to-End Data Visualization**

	• **AIM:** To apply all Tableau concepts to a real dataset and create an interactive visualization. • **TASK:** Using a dataset (e.g., sales, COVID-19, or customer data): ○ Clean and prepare the data in Tableau ○ Create multiple charts, calculated fields, and maps ○ Build an interactive dashboard and story ○ Present insights effectively **Tools/Output:** Tableau Desktop; final interactive dashboard and story showcasing insights	
11	**Reference Books** • Joshua N. Milligan – Learning Tableau • Daniel G. Murray – Tableau Your Data! • Jen Stirrup – Tableau Dashboard Cookbook • Shweta Sankhe-Savale – Tableau for Beginners • Molly Monsey & Paul Sochan – Learning Tableau 2022	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Practical journal submission, viva, assignments Journal Submission : 10 Marks Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
14	Format of Question Paper: (Semester End Practical Examination: 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Nirmala Memorial Foundation College of Commerce and Science

(Autonomous)

Re-accredited by NAAC with B++, ISO 9001-2015 Certified, Recognised under section 2(f) & 12(B) of the UGC Act 1956

Permanently Affiliated to the University of Mumbai,

Syllabus

HINDI BHASHA : KAUSHAL KE AADHAR ABILITY ENHANCEMENT COURSE

(Semester IV)

As Per New Education Policy (NEP) 2020

(To be implemented from the Academic Year 2026-2027)

Approved in the Academic Council Meeting held on 7th ***October 2025***

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	**हिन्दी भाषा : कौशल के आधार** हिंदी राजभाषा होने के साथ-साथ भारत में बोलीजने वाली एक प्रमुख भाषा है। भारत के अधिकांश निवासी और यहां तक कि भारत के बाहर बसनेवाले भारतवंशी भी अपने दैनिक आपसी वार्तालाप, कार्य-व्यवहार में हिंदी भाषा का ही प्रयोग करते हैं। विश्व की प्रमुख पांच भाषाओं के अंतर्गत हिंदी का अस्तित्व है, इस दृष्टि से हिंदी को लेकर विभिन्न प्रकार के कौशल सीखे और सिखाए जा सकते हैं। विद्यार्थियों के लिए हिंदी एक सामान्य भाषा होने के साथ विशेष भाषा तब बन जाती है जब वह हिंदी के माध्यम से अपने कौशल में अभिवृद्धि करें, हिंदी के माध्यम से रोजगार के कई अवसरों को प्राप्त करें। इस दृष्टि से पाठ्यक्रम अत्यंत लाभवर्धक और उपयोगी सिद्ध होगा। हिंदी भाषा में कौशल विकास की असीम संभावनाएं हैं और कौशल के विभिन्न आयाम जुड़े हुए हैं जो अलग-अलग दिशाओं में देखे जा सकते हैं। पाठ्यक्रम विद्यार्थियों में लेखन, वाचन कौशल की अभिवृद्धि करने के साथ रोजगारपरक अवसर प्रदान करता है।
2	**Vertical :**	AEC
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory in a semester)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: (List some of the course objectives) 1. विद्यार्थियों को लेखन, वाचन कौशल का ज्ञान देना एवं रोजगार के अवसरों से जोड़ना। 2. विद्यार्थियों को लेखन, वाचन कौशल से परिचय करते हुए अभिव्यक्ति की शैलियों का विकास करना। 3. विद्यार्थियों को भाषण कला के विविध रूपों को समझाना, मौलिकता में अभिवृद्धि लाना एवं विशेषज्ञता दिलाना। 4. विद्यार्थियों को श्रवण कौशल की विशेषताओं से परिचय कराते हुए श्रवण कौशल के लाभों से अवगत कराना।	

8	**Course Outcomes**: (List some of the course outcomes) CO-1) विद्यार्थियों को लेखन, वाचन कौशल के ज्ञान प्राप्ति के साथ मौलिक अभिव्यक्ति में बदलाव आएगा। CO-2) विद्यार्थियों का लेखन, वाचन कौशल द्वारा मानसिक विकास होगा, पठन-शक्ति, शैली का विकास होगा। CO-3) विद्यार्थियों को लेखन, भाषण कौशल से भाषिक-शक्ति, शैलियों का संवर्धन होगा विशेषज्ञता आएगी। CO-4) विद्यार्थियों को लेखन, वाचन, श्रवण, भाषण कौशल की विशेषताओं और उपयोगिता का ज्ञान प्राप्त होगा।
9	**Modules**:-

इकाई	पाठ	व्याख्यान संख्या
इकाई -1	1. लेखन कौशल का अर्थ एवं स्वरूप 2. लेखन कौशल की उपयोगिता एवं महत्व 3. लेखन कौशल की विधियाँ 4. लेखन कौशल के भेद एवं विशेषताएँ 5. वाचन कौशल का अर्थ, स्वरूप एवं विशेषताएँ 6. वाचन कौशल की उपयोगिता 7. वाचन कौशल की विधियाँ एवं विशेषताएँ	व्याख्यान- 15 क्रेडिट- 01
इकाई -2	8. भाषण कौशल का अर्थ एवं स्वरूप 9. भाषण कौशल का महत्व एवं उपयोगिता 10. भाषण कौशल की विशेषताएँ 11. भाषण कौशल की विधियाँ 12. श्रवण कौशल का अर्थ एवं स्वरूप 13. श्रवण कौशल का महत्व एवं उपयोगिता 14. श्रवण कौशल की विशेषताएँ	व्याख्यान- 15 क्रेडिट- 01

10 **संदर्भ ग्रंथ सूची** -

1. हिंदी भाषा शिक्षण के विविध आयाम - प्राध्यापक डॉ. राठौर, किनले एडिशन
2. अभिनव पत्र लेखन - डॉ अनिल सिंह
3. हिंदी के व्यावहारिक रूप - डॉ संतोष मोटवानी, परिदृश्य प्रकाशन, मुंबई
4. हिंदी भाषा लेखन कौशल - गुलीबाबा पब्लिकेशन प्राइवेट लिमिटेड

11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60%** **Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** **मूल्यांकन प्रारूप** ***आंतरिक मूल्यांकन- 20- अंक*** रचनात्मक कार्य, प्रकल्प इत्यादि- 10 अंक, कक्ष शिक्षण के दौरान सहभागिता इत्यादि - 05 अंक अकादमिक, व्यावसायिक एवं कौशल संवर्धन गतिविधियाँ- 05 अंक कुलयोग -**20 अंक**	
13	**Format of Question Paper:** ***बाह्य मूल्यांकन- लिखित परीक्षा- 30- अंक*** ***परीक्षा अवधि- 01 घंटा*** ***निम्नलिखित तीन में से किन्हीं दो प्रश्नों के उत्तर लिखिए*** ***30 अंक*** कुलयोग- **30 अंक**	

Vertical – VI

Name of the Course: Yoga and Wellness II – NUCP403

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	India is growing rapidly as a global super-power. To face the challenges of the century and to keep up with the pace of the world, maintaining health is of prime importance. Giving thrust to healthy society, Physical Education, Sports, Health & fitness and Yoga are of great significance in today's world. The Government of India insists on Physical Fitness, Mental Health and Overall Development of Personality for every citizen. However, creating efficient and skilled human resource in the field of Physical Education, Sports and Yoga is identified as the need of the hour. Thus, the Governments of India and Government of Maharashtra have included Physical Education, Sports and Yoga as a key area under the NEP 2020.
2	**Vertical :**	Co-Curricular
3	**Type :**	Activity Based
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: The student should be able to: • **To create awareness about the negative effects of a sedentary lifestyle** and highlight the importance of exercise in preventing lifestyle diseases. • **To encourage the development of time management skills** for incorporating regular fitness activities into daily life across all age groups and genders. • **To introduce advanced yoga practices and meditation techniques** for enhancing physical health and managing stress, anxiety, and related conditions.	
8	**Course Outcomes**: **CO1:** Identify the effects of a sedentary lifestyle and explain the role of regular exercise in preventing lifestyle-related diseases. **CO2:** Apply time management strategies to incorporate fitness into daily routines across different age groups and genders.	

	CO3: Demonstrate proficiency in advanced yoga techniques, including pranayama, meditation, and therapeutic asanas for mental and physical well-being.
9	**Module :** This course focuses on the impact of a sedentary lifestyle and the importance of exercise in preventing lifestyle diseases like diabetes, obesity, and hypertension. It emphasizes time management and integrating fitness into daily routines for all age groups and genders. The module also introduces advanced yoga practices including pranayama, mindfulness meditation, and complex asanas. Students will explore the therapeutic use of yoga for stress, anxiety, and back pain. Overall, the course promotes holistic health through physical activity and mental well-being.
10	**Reference Books:** 1. McCall, T. (2007). Yoga as Medicine: The Yogic Prescription for Health and Healing. New York: Bantam Books. 2. 5. Brown, D. & Gerbarg, P.L. (2012). The Healing Power of the Breath. Boston: Shambhala Publications.
11	**Internal Continuous Assessment: 40 %(20 Marks)** • Yoga Report/Assignment
12	**External Assessment: 60% : (30 Marks)** • Scanned copy of the Advanced Yoga participation certificate. • A short report on Yogasana (handwritten or typed). *Note: Students participating in sports competitions conducted by University at State or National Level, students who have represented Mumbai University or College at Intercollegiate / Inter Zonal / West Zone Inter University / All India Inter University/ International tournament are exempt from submission of report.*

Letter Grades and Grade Points:

Semester GPA/ Program CGPA Semester/ Program	% of Marks	Alpha-Sign / Letter Grade Result		Grade Points
9.00-10.00	90.0-100	O	(Outstanding)	10
8.00-<9.00	80.0-<90.0	A+	(Excellent)	9
7.00-<8.00	70.0-<80.0	A	(Very Good)	8
6.00-<7.00	60.0-<70.0	B+	(Good)	7
5.50-<6.00	55.0-<60.0	B	(Above Average)	6
5.00-<5.50	50.0-<55.0	C	(Average)	5
4.00-<5.00	40.0-<50.0	P	(Pass)	4
Below 4.00	Below 40	F	(Fail)	0
Ab (Absent)	-	AB	(Absent)	0

Signature of BOS Chairman
Dr. Bhakti Chaudhari
BOS (Computer Science)

Signature of Faculty Member
Ms. Rhucha Patil
(Computer Science)

Signature of I/C Principal
Dr. Swiddle D'Cunha