

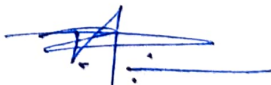
Sheth T.J. Education Society's
Sheth N.K.T.T College of Commerce &
Sheth J.T.T College of Arts (Autonomous) Thane

S.Y.B.Sc (Artificial Intelligence and Machine Learning) 2026-27

	Semester III	Credits		Semester IV	Credits
Major			Major		
BAID301	Data Mining	2	BAIB401	Big Data Analytics	2
BAIDP302	Data Mining Practical	2	BAIBP402	Big Data Analytics Practical	2
BAIF303	Fundamentals of Artificial Intelligence	2	BAIM403	Machine Learning	2
BAIFP304	Fundamentals of Artificial Intelligence Practical	2	BAIMP404	Machine Learning Practical	2
Minor			Minor		2
BAIP305	Data Structure & Algorithm using Python	2	BAID405	Data Analysis & Visualization	2
BAIPP306	Data Structure & Algorithm using Python Practical	2	BAIDP406	Data Analysis & Visualization Practical	2
OE		2	OE		2
BAIR307	Research Methodology/	2	BAIF407	Fuzzy Logic /	2
BAIL308	Linear Algebra/	2	BAIT408	Testing of Hypothesis /	2
BAIE309	Fundamentals Of Digital Electronics	2	BAIE409	Econometrics	2
VSC		2	SEC		2
BAIRP310	R Programming	2	BAIW410	Web Development	2
AEC		2	AEC		2
BAIH311/ BAIM311	Hindi/Marathi	2	BAIH411/ BAIM411	Hindi/ Marathi	2
FP		2	CEP		2
BAIFP312	FP	2	BAICE412	CEP	2
CC		2	CC		2
BAIN313/ BAIY313	NSS/ Sports/ Cultural/ Yoga	2	BAIN413/ BAIY413	NSS/ Sports/ Cultural/ Yoga	2
	Total	22			22


Dr. Yogeshwari Patil
Head of the Department


Prof. H.A. Chande
NEP Coordinator


Dr. Dilip Patil
Principal

Vision: Empowering learners through academic excellence, experiential learning and innovation



**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc.(AI & ML)		Semester:IV
Course Category: Major		
Name of the Dept: Science & Technology		
Course Title: Big Data Analytics		
Course Code: BAIB401		Course Level:4.5
Type: Theory		
Course Credit: 02		
Hours Allotted: 30 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. Overview of an exciting growing field of big data analytics 2. To provide a sound understanding of Big Data Processing Systems, platforms, management, Big Data Replay on Multicore		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: introduce the tools required to manage and analyze big data like Hadoop, No Sql MapReduce. CO2: teach the fundamental techniques and principles in achieving big data analytics with scalability, streaming capability and Big Data Replay on Multicore.		
Description of the course:		This course introduces the fundamentals of Big Data Analytics, focusing on tools and technologies such as Hadoop, NoSQL, and MapReduce. It covers Big Data processing systems, platforms, and techniques for managing and analyzing large-scale data. The course also emphasizes scalability, streaming, and multicore processing concepts, enabling learners to build efficient and scalable data analytics solutions.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	Big Data Science: Introduction and Historical Interpretation of Big Data, From 3Vs to 3 ² Vs , Big Data Analytics and Machine Learning, Big Data Analytics and Cloud Computing, Hadoop, HDFS, MapReduce, Spark, and Flink Real-Time Analytics: Computing Abstractions for Real-Time Analytics, Real-Time Processing for Big Data, Data Stream Processing Platforms, Data Stream Analytics Platforms, Data Analysis and Analytic Techniques, Finance Domain Requirements Database Techniques for Big Data: Background, NoSQL Movement, NoSQL Solutions for Big Data Management, NoSQL Data Models Resource Management, Big Data Processing Systems and Platforms, Single-Resource Management in the Cloud, Multi resource Management in the Cloud, Related Work on Resource Management.	15
II	Local Resource Consumption Shaping: A Case for MapReduce: Local Resource Shaper, Evaluation System Optimization for Big Data Processing: Basic Framework of the Hadoop Ecosystem, Parallel Computation Framework : MapReduce, Job Scheduling of Hadoop, Performance Optimization of HDFS and HBase. Packing Algorithms for Big Data Replay on Multicore: Performance Bottlenecks, The Replay Method, Packing Algorithms	15
	Total Hours	30

References:

1. Big Data Principles and Paradigms, Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Publisher: Morgan Kaufmann
2. Big Data: Principles and best practices of scalable real-time data systems By Nathan Marz and James Warren Publisher: Manning Publications
3. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph By David Loshin Publisher: Morgan Kaufmann

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc.(AI & ML)		Semester: IV
Course Category: Major		
Name of the Dept: Science & Technology		
Course Title: Big Data Analytics Practical		
Course Code: BAIBP402		Course Level:4.5
Type : Practical		
Course Credit: 02		
Hours Allotted: 60 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. Learners must understand tools required to manage and analyze big data like Hadoop, NoSQL, MapReduce. 2. Understanding of techniques and principles in achieving big data analytics with scalability and streaming capability.		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: introduce the tools required to manage and analyze big data like Hadoop, NoSQL, MapReduce. CO2: teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.		
Description of the course:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.	

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content (List of Practicals)	Hours
1	a. Install, configure and run Hadoop and HDFS b. Implement word count/ frequency program using MapReduce Hadoop/R	
2	Implement an Mapreduce program that process a weather dataset	
3	Exploring Hadoop Distributed File System (HDFS)	
4	Implement an application that store big data in Hbase/ Mongoddb/ Pig using Hadoop/R	
5	Implement a program in Pig	
6	Configure the Hive and implement the application in Hive	
7	Illustrate the working of Jaql	
8	a. Implement Decision tree classification technique b. Implement SVM Classification technique	
9	Regression Model: a. Import a data from web storage. Name the dataset and do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not require (foreign), require (Mass) b. b MULTIPLE REGRESSION MODEL: Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.	
10	CLASSIFICATION MODEL: a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.	
11	CLUSTERING MODEL a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.	
	Total Hours	60

References:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Pact Publishing House.
2. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (Wiley and SAS Business Series), Wiley

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc. (AL&ML)		Semester: IV
Course Category: Major		
Name of the Dept: Science & Technology		
Course Title: Machine Learning		
Course Code: BAIM403		Course Level:4.5
Type: Theory		
Course Credit: 2		
Hours Allotted: 30 Hours		
Total Marks: 50 Marks		
Course Objectives: 1. To understand the fundamental concepts of Machine Learning 2. To study and apply various Machine Learning algorithms 3. To evaluate and improve Machine Learning models		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: understand fundamental Machine Learning concepts and implement various algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, regression, and clustering techniques for solving data-driven problems. CO2: evaluate and improve Machine Learning models using performance metrics, dimensionality reduction techniques like PCA, and association rule mining methods.		
Description of the course:		This course introduces the core concepts and techniques of Machine Learning, focusing on supervised and unsupervised learning methods. It covers key algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, regression, and clustering techniques like K-means and hierarchical clustering. The course also includes model evaluation metrics, dimensionality reduction using PCA, and association rule mining for pattern discovery in data.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	Introduction to Machine Learning: Machine Learning(ML), Need for Machine Learning, ML from Knowledge-driven to Data Driven, Applications of Machine Learning, Problems suitable for Machine Learning, Advantages, Disadvantages and Challenges of Machine Learning, Challenges of ML. General architecture of ML systems, Underlying Concepts in Machine Learning: Inductive Learning, Generalization, Bias and Variance, Overfitting and Underfitting, Parametric and Non Parametric algorithms . Types of Machine Learning: Supervised and Unsupervised Learning, Workflow, Semi supervised Learning, Reinforced Learning, Introduction to Classification Algorithms: Concept of Classification, Binary classification, Multi-Class Classification, Multi Label Classification K-Nearest Neighbor Method: need and Working of KNN, Computing Distance, Pros and Cons of KNN. Decision Tree based Algorithm: Terminologies and assumptions, Working of Decision Trees, ID3 Algorithm, Attribute selection Methods(Entropy, Gini Impurity, Information Gain)	15
II	Performance Evaluation: Classification Metrics-Accuracy, Sensitivity, Precision, F1 Score, ROC/AUC Curve, Cross Validation Dimensionality Reduction: Criteria for Reduction, Feature Reduction and Selection, Principal Component Analysis(PCA) Probabilistic Learning: Introduction to Bayes Learning, Interpretation of Bayes Rule, Benefits and shortfalls of Bayesian Learning, Naïve Bayes Classifier, Characteristics of Naïve Bayes Support Vector Machines: Working of SVM, SVM Concepts :Support Vectors, Hard Margin, soft Margin, Kernels, Advantages and Disadvantages of SVM Regression Methods: Linear Regression Models, Logistic Regression Unsupervised Learning: Concept of unsupervised Learning, Importance and Challenges of unsupervised Learning, Clustering and its applications Hierarchical Clustering: Introduction, Types of Hierarchical Clustering, Issues with Hierarchical Clustering Partition algorithm: K-means Clustering, steps of K-means Clustering, Issues, Strength and Weakness of K-means clustering. Association rule Mining: Basic Concepts, Market Basket Analysis, and Apriori algorithm.	15
	Total Hours	30

Reference:

Sr. No	Title	Author	Publisher	Edition	Year
1.	Machine Learning: Concepts, Techniques and Applications	T V Geetha S, Sendhilkumar	CRC Press, Taylor and Francis	First	2023
2.	Machine Learning for Decision Sciences with Case Studies in Python	S. Sumathi, Suresh V. Rajappa	CRC Press, Taylor and Francis	First	2022
3.	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media, Inc.	First	2016
4.	Machine Learning	S Sridhar	Oxford University Press	First	2021
5.	Machine Learning	Ruchi Doshi, Kamal Kant Hiran	BPB	First	2021

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc. (AL & ML)		Semester: IV
Course Category: Major		
Name of the Dept: Science & technology		
Course Title: Machine Learning Practical		
Course Code: BAIMP404		Course Level:4.5
Type: Practical		
Course Credit: 2		
Hours Allotted: 60 Hours		
Total Marks: 50 Marks		
Course Objectives: 1. To implement and analyze Machine Learning algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, and regression models for classification and prediction tasks. 2. To apply clustering and dimensionality reduction techniques such as K-means, hierarchical clustering, and PCA for data analysis and pattern discovery. 3. To evaluate the performance of Machine Learning models using metrics like accuracy, precision, recall, and F1 score.		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: implement and apply Machine Learning algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, and regression models to solve classification and prediction problems. CO2: apply clustering and dimensionality reduction techniques like K-means, hierarchical clustering, and PCA for data analysis. CO3: evaluate Machine Learning models using performance metrics such as accuracy, precision, recall, and F1 score.		
Description of the course:		This course focuses on implementing Machine Learning algorithms such as KNN, Decision Trees, Naïve Bayes, SVM, regression, clustering methods, and evaluating models using performance metrics and PCA.

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content(List of Practicals)	Hours
1.	Implementing a K-Nearest Neighbor (KNN) algorithm (e.g. to classify handwritten digits).	
2	Building a decision tree model using the ID3 algorithm (e.g. to predict whether a customer will churn or not).	
3.	Developing a Support Vector Machine (SVM) model (e.g. to classify email messages as spam or not spam).	
4.	Building a Naïve Bayes classifier (e.g. to classify movie reviews as positive or negative sentiment).	
5.	Implementing linear regression (e.g. to predict housing prices based on features such as size and location).	
6.	Using logistic regression (e.g. to predict whether a credit card transaction is fraudulent or not).	
7.	Evaluating a classification model using metrics such as accuracy, precision, recall, and F1 score.	
8.	Applying hierarchical clustering (e.g. to group customer segments based on their purchasing behavior).	
9.	Implementing the K-means clustering algorithm (e.g. to identify distinct clusters in a customer demographic dataset).	
10.	Utilizing Principal Component Analysis (PCA) for dimensionality reduction to improve the efficiency and interpretability of a model.	
	Total Hours	60

Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts (AUTONOMOUS), Thane (W)
Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc (AI & ML)		Semester: IV
Course Category: Minor		
Name of the Dept: Science and Technology		
Course Title: Data Analysis & Visualisation		
Course Code: BAID405		Course Level:4.5
Type: Theory		
Course Credit: 2 credits		
Hours Allotted: 30 Hours		
Marks Allotted: 50 Marks		
Course Objectives: - To introduce students to Python libraries such as NumPy and Pandas for performing data manipulation, cleaning, and analysis. - To develop skills in applying exploratory data analysis and visualization techniques to interpret and present data effectively.		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: apply Python libraries to perform data cleaning, transformation, and statistical analysis on datasets. CO2: create and interpret data visualizations using appropriate graphical techniques to derive meaningful insights.		
Description of the course:		This course introduces the fundamentals of data analysis and visualization using Python. It covers essential tools such as NumPy and Pandas for data manipulation, cleaning, and transformation. The course also focuses on exploratory data analysis and graphical visualization techniques using Matplotlib and Seaborn to discover patterns and insights from data.

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	Introduction to Data Analysis: Concept of Data Analysis, Data Analysis Process, Types of Data and Data Sources Foundations of Data Manipulation: NumPy Basics & Pandas Data Structures: Series and DataFrame objects; Essential Functionality: Reindexing, Dropping entries, Arithmetic, and Data Alignment. Data Loading & Storage : Reading and Writing data in Text Format (CSV, JSON, HTML), Web APIs, and Interacting with Databases (SQL). Data Cleaning & Preparation: Handling Missing Data, Data Transformation (Removing duplicates, mapping, replacing), String Manipulation, and Regular Expressions in Pandas. Data Wrangling: Join, Combine, Reshape : Hierarchical Indexing; Combining and Merging Datasets (Merge/Join); Reshaping and Pivoting (stack, unstack, pivot).	15
II	Aggregation & Visualization Data Aggregation & Group Operations : The GroupBy Mechanics; Data Aggregation (Column-wise and multiple function application); Pivot Tables and Cross-Tabulation. Introduction to Data Visualization : Importance of visualization in data analysis, Types of charts and graphs Data Visualization with Matplotlib & Seaborn : The Anatomy of a Figure: Figures, Subplots, Ticks, Labels, and Legends. Plotting Functions in Pandas: Line plots, Bar plots, Histograms, and Density plots. Statistical Graphics with Seaborn: Categorical data plots, Regression plots, and Facet Grids. Visualization Principles: Choosing scales, color palettes, and saving plots to file.	15
	Total Hours	30

References:

1. Python for Data Analysis, McKinney, W. (2018). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed.). Sebastopol, CA: O'Reilly
2. Python Data Analytics, Nelli, F. (2018). *Python data analytics: Data analysis and science using Pandas, Matplotlib, and the Python programming language* (2nd ed.). Apress.
3. Hands-On Data Visualization, Dougherty, J., & Ilyankou, I. (2021). *Hands-on data visualization: Interactive storytelling from spreadsheets to code*. O'Reilly Media.
4. Pandas for Everyone, Chen, D. Y. (2017). *Pandas for everyone: Python data analysis*. Addison-Wesley Professional.

Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts (AUTONOMOUS), Thane (W)

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc (AI & ML)		Semester: IV
Course Category: Minor		
Name of the Dept: Science and Technology		
Course Title: Data Analysis & Visualisation Practical		
Course Code: BAIDP406		Course Level: 4.5
Type: Practical		
Course Credit: 2 credits		
Hours Allotted: 60 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. To introduce students to Python libraries such as NumPy and Pandas for performing data manipulation, cleaning, and analysis. 2. To develop skills in applying exploratory data analysis and visualization techniques to interpret and present data effectively.		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: apply Python libraries to perform data cleaning, transformation, and statistical analysis on datasets. CO2: create and interpret data visualizations using appropriate graphical techniques to derive meaningful insights.		
Description of the course:	This course introduces the fundamentals of data analysis and visualization using Python. It covers essential tools such as NumPy and Pandas for data manipulation, cleaning, and transformation. The course also focuses on exploratory data analysis and graphical visualization techniques using Matplotlib and Seaborn to discover patterns and insights from data.	

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content(List of Practicals)	Hours
I	1.NumPy Foundations & Vectorization Create a multi-dimensional NumPy array. Perform element-wise arithmetic operations, slicing, and boolean indexing 2.Pandas Series & DataFrame Essentials Construct a DataFrame from a dictionary of lists. Practice reindexing, dropping rows/columns, and using .loc and .iloc for precise data selection. 3.Data Ingestion & Storage Load a messy CSV file and an Excel sheet. Clean column headers, handle encoding issues, and export the modified data into a JSON format and a SQLite database. 4. Data Cleaning: Handling Missing Values & Outliers Use the isnull(), dropna(), and fillna() methods on a real-world dataset. Implement logic to detect and cap outliers using the Interquartile Range (IQR) method. 5.Advanced String Manipulation & Regular Expressions Apply Pandas .str methods and the re (Regular Expression) module to parse complex text columns (e.g., extracting email domains or phone numbers from a text block). 6.Hierarchical Indexing & Reshaping Create a Multi-indexed DataFrame. Use stack() and unstack() to reshape data between "long" and "wide" formats. Practice using the pivot() and melt() functions. 7.Data Wrangling: Merging & Joins Take three separate DataFrames (e.g., Customers, Orders, and Products). Perform Inner, Outer, Left, and Right joins to create a unified master dataset for analysis. 8.Data Aggregation & GroupBy Mechanics Use the groupby() function to split a dataset by categorical variables. Apply multiple aggregation functions (Mean, Sum, Count) simultaneously using the .agg() method. 9.Basic Visualization with Matplotlib & Pandas Create a multi-panel figure using plt.subplots(). Plot a line chart, a bar chart, and a histogram on the same figure with customized titles, legends, and axis labels. 10. Advanced Statistical Graphics with Seaborn Build a correlation heatmap to identify relationships between variables. Create a PairPlot to visualize multivariate distributions and a FacetGrid to compare categories across subplots.	15
	Total Hours	60

References:

1. Python for Data Analysis, McKinney, W. (2018). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd ed.). Sebastopol, CA: O'Reilly Media.
2. Python Data Analytics, Nelli, F. (2018). *Python data analytics: Data analysis and science using Pandas, Matplotlib, and the Python programming language* (2nd ed.). Apress.
3. Hands-On Data Visualization, Dougherty, J., & Ilyankou, I. (2021). *Hands-on data visualization: Interactive storytelling from spreadsheets to code*. O'Reilly Media.
4. Pandas for Everyone, Chen, D. Y. (2017). *Pandas for everyone: Python data analysis*. Addison-Wesley Professional.

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: S.Y.BSc (AI & ML)		Semester: IV
Course Category: Open Elective		
Name of the Dept: Artificial Intelligence and Machine Learning		
Course Title: Fuzzy Logic and Application		
Course Code: BAIF407		Course Level:4.5
Type: Theory		
Course Credit: 2		
Hours Allotted: 30 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. To introduce the fundamental concepts of fuzzy logic and fuzzy sets, including membership functions, fuzzy set operations, fuzzy relations, and fuzzy numbers, enabling students to understand how uncertainty and imprecision can be modeled in intelligent systems. 2. To develop an understanding of fuzzy inference systems, fuzzy rule-based systems, and defuzzification methods, and to enable students to apply fuzzy logic techniques in artificial intelligence, decision-making systems, and real-world applications.		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: analyze and represent fuzzy sets, perform operations on fuzzy sets, and work with fuzzy relations and fuzzy numbers to model uncertain and imprecise information. CO2: design and apply fuzzy inference systems, implement defuzzification methods, and use fuzzy rule-based models in applications such as control systems, pattern recognition, and AI-based decision-making problems.		
Description of the course:	This course introduces the basic concepts of Fuzzy Logic and Fuzzy Sets, which are used to handle uncertainty and imprecision in artificial intelligence systems. It covers topics such as fuzzy sets, membership functions, fuzzy set operations, fuzzy relations, and fuzzy numbers, along with fuzzy inference systems, fuzzy rule-based models, and defuzzification methods including Mamdani and Sugeno models. The course also discusses applications of fuzzy logic in AI and machine learning, such as control systems, decision-making, pattern recognition, image processing, and real-world systems like washing machines, traffic control, and robotics.	

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	Fundamentals of Fuzzy Logic and Fuzzy Sets Introduction to Fuzzy Logic : Concept of uncertainty and imprecision, Crisp sets vs fuzzy sets, History and motivation of fuzzy logic, Applications in Artificial Intelligence and Machine Learning. Fuzzy Sets: Definition and representation of fuzzy sets, Membership functions (Triangular, Trapezoidal, Gaussian, Sigmoid), Linguistic variables, α -cuts and properties of fuzzy sets. Operations on Fuzzy Sets: Union, intersection, complement, Algebraic operations on fuzzy sets, De Morgan's laws for fuzzy sets. Fuzzy Relations: Cartesian product of fuzzy sets, Fuzzy relations and their properties, Composition of fuzzy relations. Fuzzy Numbers and Fuzzy Arithmetic: Fuzzy numbers, Arithmetic operations on fuzzy numbers.	15
II	Fuzzy Inference Systems and Applications Fuzzy Logic Systems: Architecture of a fuzzy logic system, Fuzzification process, Knowledge base and rule base, Inference engine. Defuzzification Methods: Centroid method, Mean of maxima, Weighted average method. Fuzzy Rule-Based Systems: Fuzzy IF–THEN rules, Mamdani fuzzy inference model, Sugeno fuzzy inference model. Applications of Fuzzy Logic: Fuzzy control systems, Decision-making systems, Pattern recognition, Image processing, Fuzzy logic in AI and Machine Learning, Industrial and real-world applications (washing machines, traffic control, robotics).	15
	Total Hours	30

References:

Sr. No.	Title	Author/s	Publisher	Edition
1	Fuzzy Logic with Engineering Applications	Timothy J. Ross	John Wiley & Sons	4th Edition 2016
2	Fuzzy Sets and Fuzzy Logic: Theory and Applications	George J. Klir, Bo Yuan	Prentice Hall (Pearson Education)	1st Edition, 1995
3	Fuzzy Set Theory and Its Applications	H. J. Zimmermann	Springer	4th Edition, 2001
4	Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications	S. Rajasekaran, G. A. Vijayalakshmi Pai	Prentice-Hall of India	1st Edition, 2003

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc (AI and ML)		Semester: IV
Course Category: Open Elective		
Name of the Dept: Science and Technology		
Course Title: Testing of Hypothesis		
Course Code: BAIT408		Course Level: 4.5
Type: Theory		
Course Credit: 2 credits		
Hours Allotted: 30 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. Understand the Fundamentals of Data Collection Process 2. Develop Skills to Formulate Research Problems and apply scientific process to test it		
Course Outcomes: After the completion of the course, the learners would be able to: CO 1: critical Thinking and apply analytical tools to interpret results effectively. CO 2: critically evaluate existing research, assess evidence, and make data-driven decisions.		
Description of the course:	Hypothesis testing are crucial for data analysts. Accurate data collection ensures reliable insights, while hypothesis testing helps validate assumptions with statistical evidence. This process supports data- driven decisions, reduces bias, and quantifies uncertainty. By combining clean data and rigorous analysis, data analysts provide businesses with trusted recommendations, driving smarter strategies and improving overall decision-making effectiveness in competitive environments.	

Syllabus: NEP 2020 w.e.f 2026-27

Unit No.	Content	Hours
I	Introduction to Hypothesis Testing: Hypothesis Tests, Stating a Hypothesis, Types of Errors and Level of Significance, Statistical Tests and P-Values, Making a Decision and Interpreting the Decision, Strategies for Hypothesis Testing, Characteristics of a good hypothesis, Steps for hypothesis testing Hypothesis Testing for the Mean (σ Known): Using P-Values to Make Decisions, Using P-Values for a z-Test, Rejection Regions and Critical Values, Using Rejection Regions for a z-Test, Critical Values in a t- Distribution, The t-Test for a Mean μ, Using P-Values with t- Tests, Sums and case studies Goodness of fit tests: Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner, Shapiro-Wilk, Jarque-Bera, Lilliefors Variance tests: Chi-square test of a single variance, F-tests of two variances, Tests of homogeneity Wilcoxon rank-sum/Mann-Whitney U test, Sign test Contingency tables: Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test	15
II	Analysis of variance and covariance: ANOVA, Single factor or oneway ANOVA, Two factor or two-way and higher-way ANOVA , MANOVA, ANCOVA Non-Parametric ANOVA: Kruskal-Wallis ANOVA, Friedman ANOVA test, Mood's Median Regression and smoothing: Least squares, Ridge regression, Simple and multiple linear regression, Polynomial regression, Generalized Linear Models (GLIM), Logistic regression for proportion data, Poisson regression for count data, Non-linear regression, Smoothing and Generalized Additive Models (GAM), Geographically weighted regression (GWR), Spatial series and spatial autoregression- SAR models, CAR models, Spatial filtering models Time series analysis and temporal autoregression: Moving averages, Trend Analysis, ARMA and ARIMA (Box-Jenkins) models, Spectral analysis	15
	Total Hours	30

References:

Sr. No	Title	Author/s	Publisher	Edition
1.	Hypothesis Testing	---	Pearson Higher Education	---
2.	Statistical Analysis Handbook	Dr. Michael J de Smith	The Winchelsea Press, Drumlin Security Ltd,	2018 Ed
3.	An Introduction to Statistical Methods and Data Analysis	R. Lyman Ott & Michael Longnecker	Thomson Learning	---
4.	Research Methodology – Methods and techniques	C. R. Kothari	New Age International (P) Ltd., Publishers	---

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w.e.f 2026-27

Programme Name: B.Sc.(AI & ML)		Semester: IV
Course Category: Open Electives		
Name of the Dept: Economics		
Course Title: Econometrics		
Course Code: BAIE409		Course Level: 4.5
Type: Theory		
Course Credit: 2 credits		
Hours Allotted: 30 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. To provide students with a comprehensive understanding of random variables and their distributions 2. To understand the joint and marginal distributions, and apply conditional probability concepts to solve real-world problems.		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: understand the concepts of random variable. CO2: understand and analyze joint distributions for bivariate random variables and their marginal distributions.		
Description of the course:	The objective of this course is to impart a basic understanding of econometrics. The student will be able to appreciate the theoretical basis of the subject. At the same time, it will enhance the student's ability to apply the theoretical techniques to the problems of the real world. Topics like forecasting have been introduced to impart this practical orientation.	

Unit No.	Content	Hours
I	Idea of a random variable • Concept of a random variable: Discrete and continuous • Expected values of a random variable • Variance of a random variable • Discrete distribution: Bernoulli, Binomial, Poisson • Continuous random variables and distribution: Normal distribution	15
II	Jointly distributed Random variables • Joint and marginal distributions for bivariate random variables • Conditional probability • Conditional mean and variance • Covariance • Correlation and Partial correlation • Central limit theorem (without proof)	15
	Total Hours	30

References:

1. Gujarati Damodar : Basic Econometrics,
2. Hatekar Neeraj (2009), Econometrics: The First Principles A Friendly Introduction
3. Kapoor V. k. (2011), Operations Research Problems & Solutions, sultan chand & sons
4. Lipschutz (Schaum Series) Theory and Problems of Statistics
5. Lomba Paul : An Introduction to linear programming.

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, (Autonomous)
Thane (W)**

Syllabus: NEP 2020 w. e. f 2026-27

Programme Name: B.Sc. (AI & ML)		Semester: IV
Course Category: Skill Enhancement Course (SEC)		
Name of the Dept: Science & Technology		
Course Title: Web Development Practical		
Course Code: BAIW410		Course Level:4.5
Type : Practical		
Course Credit: 02		
Hours Allotted: 60 Hours		
Marks Allotted: 50 Marks		
Course Objectives: 1. To understand the concepts of Hyper Text Markup Language and Cascading Style Sheets. 2. To learn JavaScript for creating dynamic websites		
Course Outcomes: After the completion of the course, the learners would be able to: CO1: design valid, well-formed, scalable, and meaningful pages using emerging technologies. CO2: develop and implement client-side and server-side scripting language programs.		
Description of the course:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.	

Syllabus: NEP 2020 w.e.f 2026-27

Sr. No.	Content (List of Practicals)	Hours
1	a. Design a page having suitable background colour and text colour with title “My First Web Page” using all the attributes of the Font tag b. Create a HTML document giving details of your [Name, Age], [Address, Phone] and [Register Number, Class] aligned in proper order using alignment attributes of Paragraph tag, heading tag	
2	a. Create a web page for internal links; when the user clicks on different links on the web page it should go to the appropriate locations/sections in the same page. b. Write a HTML code to create a web page with pink color background and display moving message in red color.	
3	Design a web page that displays information in form of a. List Tags (all type) d. Image and Image Maps	
4	Design a webpage that makes use of a. Table tags b. Navigation across multiple pages	
5.	a. Create a web page which divides the page in two equal frames and place the audio and video clips in frame-1 and frame-2 respectively b. Wap in html to create a webpage with four frames (Picture, table, list, and hyperlink).	
6	. Form Tags (forms with various form elements)	
7	Design a webpage that make use of Cascading Style Sheets with a. CSS properties to change the background of a Page b. CSS properties to change Fonts and Text Styles c. CSS properties for positioning an element	
8	Write JavaScript code for Performing various mathematical operations such as a. calculating factorial b. finding Fibonacci Series c. Displaying Prime Numbers in a given range	
9.	Write JavaScript code for a. Evaluating Expressions b. Calculating reverse of a number c. Validating the various Form Elements	
10	Write JavaScript code for a. Demonstrating different JavaScript Objects such as String, RegExp, Math, Date b. Demonstrating different JavaScript Objects such as Window, Navigator, History, Location, Document c. Storing and Retrieving Cookies	
	Total Hours	60

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts,(Autonomous) Thane (W)**

Programme Name: B.Sc (AI & ML)	Semester:IV
Course Category: Co-Curricular Course (CC)	
Name of the Department: Sociology	
Course Title: National Integration and Community Harmony	
Course Code: BAIN413	Course Level: 5
Type: Theory / Practical	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. To develop an understanding of the significance of National Integration and Communal Harmony. 2. To enable students to appreciate the role of youth in fostering unity and peace in society.	
Course Outcomes: 1. Understand the principles of National Integration and Communal Harmony. 2. Develop leadership and teamwork skills through NSS activities focused on unity and peace.	
Introduction: National Integration and Communal Harmony are essential for a diverse country like India. This course introduces students to the importance of unity in diversity and the role of NSS in promoting peace, social justice, and inclusive development. Students will engage in activities and discussions to strengthen their commitment to harmony and national unity. Relevance and Usefulness: Given the challenges of communal tensions and social divisions, fostering National Integration is crucial. This course empowers students with the knowledge and skills to actively participate in building a more inclusive and peaceful society. Interest and Connection with Other Courses: This course complements subjects such as Sociology, Political Science, and Social Work, reinforcing the importance of civic responsibility, human rights, and peacebuilding in a democratic society.	

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	UNIT I: Concept and Importance of National Integration and Communal Harmony A. Meaning and Significance of National Integration B. Factors Affecting National Integration in India C. Challenges to Communal Harmony	15
II	UNIT II: Role of NSS in Promoting National Integration and Communal Harmony A. NSS and Its Role in Community Development B. Social Service as a Tool for Unity C. Case Studies of Successful NSS Interventions for National Integration	15
	Total Hours	30

References:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. University of Mumbai National Service Scheme Manual 2009.
3. <http://nss.nic.in>
4. <https://www.rccmindore.com/wp-content/uploads/2023/04/NSS-Notes-II.pdf>

Scheme of Examination

Internal : 20 Marks

External: 30 Marks

Internal	Marks: 20
Assignment	5 marks
Active participation/Attendance	5 Marks
Class test	10 Marks

Paper Pattern for Internal and External Examination

Internal Examination – Class Test

Q.1. MCQ question .

10 marks

External Examination-

Assignment based on Community work.

30 marks

**Sheth T. J. Education Society's
Sheth N.K.T.T College of Commerce and
Sheth J.T.T College of Arts, Thane (W)
(Autonomous)**

Programme Name: B.Sc (AI & ML)		Semester: IV
Course Category/Vertical: Co-Curricular (CC)		
Name of the Dept: Psychology		
Course Title: Yoga		
Course Code: BAIY413		Course Level: 5
Type: Theory / Practical		
Course Credit: 2 credits		
Hours Allotted: 30 Hours		
Marks Allotted: 50 Marks		
Learning Objectives: 1. To impart to the students the knowledge of teachings and philosophy of yoga tradition. 2. To provide the knowledge of various Yoga therapy practices like asana (posture), pranayama (voluntarily regulated breathing techniques).		
Course Outcomes (CO): 1.Students will be able to understand the basic principles and applications of Yoga. 2.Students will be able to use the Practical knowledge in their day to day life.		
Description the course: (Including but not limited to)		Yoga practices will be important for the upcoming lifestyle hence students can seek a career in the same. Students will understand the importance of yoga in life. Students will be having practical exposure. Hence, practicing yoga will help students to maintain their health.

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	Theory of Yoga A) Yogic Sanchalan (Yogic Movements), Kapalbhati (Cleansing Breath Technique), Suryanamaskar (Sun Salutation) B) Anulom-Vilom (Alternate Nostril Breathing), Dirgha Shwasan (Deep Breathing), Bhramari (Humming Bee Breath)	15
II	Practical A) Vajrasana (Thunderbolt Pose), Paschimottanasana (Seated Forward Bend), Parivritta Janushirasana (Revolved Head-to-Knee Pose), Vakrasana (Twisting Pose), Marjarasana (Cat Pose), Naukasana (Boat Pose) B) Shalabhasana (Locust Pose), Dronasana (Warrior Boat Pose), Pavanmuktasana (Wind-Relieving Pose), Bramha Mudra (Sacred Gesture for Neck Strength), Utthita Dwipadasana (Raised Two-Leg Pose), Netra Sanchalan - 1 (Eye Movement Exercise - 1), Netra Sanchalan - 2 (Eye Movement Exercise - 2)	15
	Total Hours	30

References:

1. G. V Kadam - Yoga Life Sutra, Girish Vasant Kadam (2012)
2. ajayoga - Swami Vivekananda - Ramakrishna Ashrama Publications
3. C.D. Sharma: Critical Survey of Indian Philosophy, Motilal Banarsidass Publications
2003

Scheme of Examination

Course with Credit	External Examination	Internal Examination	Total
Credit 4	60 marks	40 marks	100 marks
Credit 2	30 marks	20 marks	50 marks

Internal Examination Structure(Theory)

Internal examination	40 marks	20 marks
Project Presentation/Case Study /Quiz/Group Discussion	10 marks	5 marks
Assignment /Active class Participation/Attendance	10 marks	5 marks
Class test	20 marks	10 marks
Total	40 marks	20 marks

Structure for Class Test(For 10 Marks)

For 10 Marks	
Q1. Multiple Choice Questions	5 Marks
Q2. Answer in one or two sentences	5 Marks

Structure for Class Test(For 20 Marks)

For 20 Marks	
Q1. Multiple Choice Questions	10 Marks
Q2. Answer in one or two sentences	10 Marks

External Examination (For 60 Marks)

Q. No.	External	Marks: 60
Q .1	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 3	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 4	Answer the following questions (Any 3) A B C D E F	15 Marks

External Examination (For 30 Marks)

Q. No.	External	Marks: 30
Q .1	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2	Answer the following questions (Any 3) A B C D E F	15 Marks

Practical External Exam: 50 marks

A Certified copy journal is essential to appear for the practical examination.

1	Practical Question 1	20
2	Practical Question 1	20
3	Journal	5
4	Viva Voce	5

OR

1	Practical Question 1	40
2	Journal	5
3	Viva Voce	5