S P Mandali's R. A. PODAR COLLEGE OF COMMERCE AND ECONOMICS (EMPOWERED AUTONOMOUS), Matunga, Mumbai-400019

Course Structure Bachelor of Science (Data Science and Analytics)

Semester III and IV

College Website: www.rapodar.ac.in

S P Mandali's R. A. PODAR COLLEGE OF COMMERCE AND ECONOMICS (EMPOWERED AUTONOMOUS), Matunga, Mumbai-400019

Bachelor of Science (Data Science and Analytics) SYBSc Semester III

Syllabus And Question paper pattern of Course

As per National Education Policy 2020 To be implemented from Academic Year 2025- 2026

College Website: www.rapodar.ac.in

Bachelor of Science (Data Science and Analytics) Programme Syllabus as per National Education Policy 2020 Course Structure S.Y.B.Sc. (Data Science and Analytics) (Level 5) (To be implemented from Academic Year 2025-26)

No of Courses	Course Code	Semester III	Credits	
1	Major (09 credits)			
1.A	Discipline Specific Core			
1.A.a		Python in Data Science	03	
1.A.b		Artificial Intelligence	03	
1.A.c		Data Warehousing and Mining	03	
2		Minor (03 credits)		
2.A.a		Linear Algebra	03	
3		General Elective (GE)/ Open Elective (OE) (03 Credits)	
3.A.a		HR Analytics	03	
3.A.b		Blockchain Technology	03	
3.A.c		Data Visualisation using Power BI	03	
4		Vocational & Skill Enhancement Courses (VSEC) (02 cred	lits)	
4.A		Skill Enhancement Course		
4.A.a		Data Engineering	03	
5	Ability & Val	ue Enhancement Courses/Indian Knowledge System (AVEC	C/ IKS) (02 credits)	
5.A	Ability Enhancement Course			
5.A.a		Sanskrit-I	02	
5.A.b		Marathi-I	02	
5.A.c		Hindi-I	02	
6	Internship/Field Project / Research Project / Community Engagement (02 credits)			
6.A.a		Foundation of Research Skills - I	02	
	TOTAL CUMULATIVE CREDITS22			

Exit option at the end of the Second year (on completion of Semester III and semester IV): Under Graduate Certificate in Data Science and Analytics will be awarded to a learner on fulfillment of the following conditions:

1. The learner should have acquired 44 credits in Semester III and IV considered together.

2. The learner should acquire an additional 4 credits as per norms by completing recognized courses under the National Skill Qualification Framework (NSQF) such as a certificate course on Introduction to Cloud Computing, a Course on Generative AI concepts, and an Internship.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 1.Major 1.A. Discipline Specific Core Courses 1.A.a Python in Data Science (3 Credits) Semester III

1. Major			
1.A Discipline Specific Core			
1.A.a Python in Data Science			
Course Objectives and Course Outcomes			
Course Objectives			
CObj 1	To learn Basic programming concepts in Python		
CObj 2	To learn about Object Oriented concepts in Python		
CObj 3	To perform coding practices to implement advanced programming in Python		
CObj 4	To acquire knowledge of how to use python for Exception handling and develop GUI interface		
	Course Outcomes		
COut 1	Learners will be able to implement basic knowledge in complex structure.		
COut 2	Learners will be able to implement OOP concepts in coding.		
COut 3	Learners will acquire knowledge of various modules and their application.		
COut 4	Learners will be able to use the exception handling in Python.		
COut 5	Learners will be able to design GUI using Python.		

Modules at a Glance

Python in Data Science				
Sr. No.	Modules	No. of Lectures		
1	Introduction to Python Programming	15		
2	Object Oriented Programming, Numpy and Pandas	15		
3 Advanced Python Programming		15		
	Total 45			

Sr. No.	Modules		
1	Introduction to Python Programming		
	Overview: Python and its Applications in Data Science IDEs: Installing Python and IDEs (e.g., Anaconda, Jupyter Notebook) Coding: Writing and Running Python Scripts, Variables, Data Types, and Type Conversion, Input/Output Operations, Basic Operators: Arithmetic, Relational, Logical, and Assignment, Variables,		
2	Object-Oriented Programming, Numpy and Pandas		
	 Object Oriented Programming (OOP): Class and object creation, inheritance, and polymorphism, abstract class, Exception handling in python. Arrays in NumPy: Creation, Indexing, Slicing, and Operations, Mathematical Operations on Arrays, Broadcasting and Vectorization, Common NumPy Functions: linspace(), arange(), reshape(), etc. Series and DataFrames in Pandas: Series & related operations, DataFrame Operations, Indexing, Sorting and Slicing, Handling Missing Data, Merging, Joining, and Concatenation of DataFrames 		
3	Advanced Python Programming		
	 Data Handling & Visualization: Reading and writing files in Python, Design O using Tkinter library, Creating Basic Plots: Line, Bar, Histogram, Scatter, Customiz Plots: Titles, Legends, Labels, Colors, and Styles, Statistical Plots: Pairplots, Heatma Boxplots, Violin Plots, Customizing Themes and Style Database & Python: Connecting to databases using Python, Performing CR operations on databases using Python, Handling Missing Data and Outliers Feature Scaling: Normalization and Standardization, Encoding Categorical Variab Understanding Distributions, Identifying Patterns and Relationships in D Summarizing Data with Descriptive Statistics 		

	List of Practicals to be Conducted
1	To practice data types and type conversion
2	To create a simple calculator using Python
3	To create a class and object, implement inheritance, polymorphism, and abstract classes
4	Demonstrate method overriding and method overloading
5	Develop an employee management system using OOP
6	Implement try-except-finally block
7	Create and manipulate NumPy arrays & Perform array indexing, slicing, and reshaping
8	Use vectorization and broadcasting for matrix operations
9	Create and manipulate Series and DataFrames & Perform indexing, filtering, sorting, and slicing operations
10	Handle missing values using Pandas functions
11	Merge, join, and concatenate multiple DataFrames
12	Read and write CSV, JSON, Text and Excel files
13	Create a login form with username/password fields using TKinter
14	Develop a simple calculator using Tkinter GUI components
15	Create basic plots (line, bar, histogram, scatter) & Customize plot aesthetics (titles, legends, colors)
16	Generate statistical plots (pairplots, heatmaps, box plots, violin plots) and style modifications
17	Connect Python with SQLite/MySQL & Perform CRUD operations (Create, Read, Update, Delete) on a database
18	Apply Normalization & Standardization on datasets
19	Visualize data distributions using histograms and density plots.

Practical Work (20 Marks)

Question Paper Pattern (Academic Year: 2025-2026)

Python in Data Science Semester End Examination and Practical Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	 Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question 	5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- Department Programming, Dusty Phillips, Packt, 2015
- Depthon Standard Library, Fredrik Lundh, O'reilly, 2001
- Department Python Threading Jump-Start, Jason Brownlee, SuperFastPython, 2020

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 1.Major 1.A Discipline Specific Core Courses 1.A.b Artificial Intelligence (3 Credits) Semester III

1. Major			
1.A Discipline Specific Core			
	1.A.b Artificial Intelligence		
	Course Objectives and Course Outcomes		
	Course Objectives		
CObj 1	To introduce and appreciate use of AI and the theory underlying for solving problems.		
CObj 2	To learn about representing difficult real life problems as state space representation and solving them using AI techniques.		
CObj 3	To understand the basic issues of knowledge representation and develop skills for reasoning and handling uncertainty.		
CObj 4	To introduce advanced topics of AI for solving complex problems.		
	Course Outcomes		
COut 1	Learners understand the building blocks of AI.		
COut 2	Learner is analyzing a problem and solving it by implementing suitable techniques.		
COut 3	Learner is applying logic based techniques to solve examples.		
COut 4	Learners are able to implement Bayesian approaches.		
COut 5	Learners are able to explore various applications of AI.		

Modules at a Glance

Artificial Intelligence				
Sr. No.	Modules	No. of Lectures		
1	Intelligent agents and Search Algorithms	15		
2	Problem solving and Knowledge reasoning	15		
3 Uncertainty and Applications of AI		15		
	Total 45			

Sr. No.	Modules		
1	Intelligent agents and Search Algorithms		
	 Introduction to AI & Intelligent Agents: AI Problems and AI techniques, Solving problems by searching, Problem Formulation. State Space Representation, Structure of Intelligent agents, Types of Agents Uninformed Search: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. Informed Search: Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A* algorithm 		
2	Problem solving and Knowledge reasoning		
	Constraint Satisfaction Programming: Cryptarithmetic, Map Coloring, NQueens. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning Knowledge and Reasoning: Knowledge Based Agent, Overview of Propositional Logic, First Order Predicate Logic, Inference in First Order Predicate Logic: Forward and Backward Chaining, Resolution.		
3	Uncertainty and Applications of AI		
	 Uncertainty: Representing Knowledge in an Uncertain Domain, Bayesian Network, Conditional Probability, Joint Probability, Bayes' theorem, Belief Networks, Simple Inference in Belief Networks, Sequential decision problems AI Applications & Case Studies: AI in Healthcare, Finance, Autonomous Vehicles, and Cybersecurity, AI-powered Recommendation Systems, Case Studies: Google DeepMind, OpenAI's GPT, IBM Watson, Hybrid AI Techniques (Neuro-Symbolic AI), Combining Symbolic AI with Deep Learning, Hybrid AI models for complex problem solving 		

List of Practicals to be Conducted		
1	Implement Depth First Search	
2	Implement Breadth First Search	
3	Implement A* Search	
4	Implement AO* Search	
5	Simulate tic – tac – toe game using Min-Max Search	
6	Implement Alpha Beta Pruning	
7	Simulate solution for 4-Queen / N-Queen problem	
8	Simulate solution for Map Coloring	
9	Simulate solution for Missionaries and Cannibals	
10	Implement two class decision tree for suitable problems	
11	Implement multi class decision tree for suitable problems	
12	Design knowledge base using propositional logic	

Practical Work (20 Marks)

Question Paper Pattern (Academic Year: 2025-2026)

Artificial Intelligence Semester End Examination and Practical Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ Russell, Stuart J., and Peter Norvig. Artificial Intelligence: A Modern Approach. 4th ed., Pearson, 2020.
- □ Poole, David L., and Alan K. Mackworth. Artificial Intelligence: Foundations of Computational Agents. 2nd ed., Cambridge University Press, 2017.
- □ Knight, Kevin, and Elaine Rich. Artificial Intelligence. 3rd ed., McGraw Hill, 2017.
- □ Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. The Elements of Statistical Learning. Springer, 2013.
- □ Khemani, Deepak. A First Course in Artificial Intelligence. 1st ed., TMH, 2017.

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 1.Major 1.A. Discipline Specific Core Courses 1.A.c Data Warehousing and Mining (3 Credits) Semester III

1. Major			
1.A Discipline Specific Core			
1.A.c Data Warehousing and Mining			
	Course Objectives and Course Outcomes		
	Course Objectives		
CObj 1	Understand the fundamentals of Data Warehousing, including architecture, design principles, and metadata management.		
CObj 2	Develop knowledge of ETL (Extract, Transform, Load) processes for data extraction, transformation, and loading in data warehouses.		
CObj 3	Explore the principles of dimensional modeling, including Star Schema, Snowflake Schema, and Fact Tables, and their applications in business intelligence.		
CObj 4	Analyze the fundamentals of Data Mining, including classification, clustering, and association rule mining techniques for extracting insights from large datasets.		
CObj 5	Apply data mining techniques in real-world scenarios, such as finance, healthcare, marketing, and cybersecurity, while addressing ethical considerations and challenges.		
	Course Outcomes		
COut 1	Explain the need for data warehousing and its role in decision support systems and business intelligence.		
COut 2	Design and implement data warehouse architectures, including data marts, metadata management, and ETL workflows.		
COut 3	Apply dimensional modeling techniques, such as Star Schema, Snowflake Schema, and Fact Tables, to optimize data storage and retrieval.		
COut 4	Implement ETL processes to clean, transform, and load data from various		

	sources into data warehouses.	
COut 5	Differentiate between Data Mining and Machine Learning, and apply data mining techniques in real-world applications.	
COut 6	Use classification algorithms (Decision Trees, Naïve Bayes) to solve predictive modeling problems in data mining.	
COut 7	Implement clustering techniques (K-Means, Hierarchical Clustering) to analyze data patterns and segmentation.	
COut 8	Perform association rule mining (Apriori Algorithm) for discovering frequent itemsets and market basket analysis.	

Data Warehousing and Mining		
Sr. No.	Modules	No. of Lectures
1	Data Warehousing & Metadata Management	15
2	Dimensional Modeling, ETL & Data Mining	15
3	Data Mining Process & Techniques	15
	45	

Sr. No.	Modules		
1	Data Warehousing & Metadata Management		
	 The Compelling Need For Data Warehousing: Escalating Need for Strategic Information, Failures of Past DecisionSupport Systems, Operational Versus Decision-Support Systems, Data Warehousing—The Only Viable Solution, Data Warehouse Defined, The Data Warehousing Movement, Evolution of Business Intelligence Data Warehouse: The Building Blocks: Defining Features, Data Warehouses and Data Marts, Architectural Types, Overview of The Components, Metadata in The Data Warehouse Trends In Data Warehousing: Continued Growth in Data Warehousing, Significant Trends, Emergence of Standards, Web-Enabled Data Warehouse Architectural Components: Understanding Data Warehouse Architecture, Distinguishing Characteristics, Architectural Framework, Technical Architecture, Architectural Types The Significant Role Of Metadata: Why Metadata is important, Metadata Types By 		
2	Dimensional Modeling, ETL & Data Mining		
	 Principles Of Dimensional Modeling: From Requirements to Data Design, The Stat Schema, Star Schema Keys, Advantages of The Star Schema, Star Schema: Examples Advanced Dimensional Modeling: Updates to The Dimension Tables, Miscellaneou Dimensions, The Snowflake Schema, Aggregate Fact Tables, Families of Stars Data Extraction, Transformation, And Loading: ETL Overview, ETL Requirements and Steps, Data Extraction, Data Transformation, Data Loading, ETL Summary, Othe Integration Approaches Fundamentals of Data Mining: Definition and importance of data mining Applications of data mining in industries (finance, healthcare, marketing cybersecurity), Understanding the difference between Data Mining and Machin 		

Modules at a Glance

	Learning, Challenges and ethical considerations in data mining		
3	Data Mining Process & Techniques		
	Data Mining Process: Overview of the data mining workflow, Steps involved in Knowledge Discovery in Databases (KDD), Data Collection & Preprocessing: Data cleaning (handling missing values, duplicates, noise), Data transformation (scaling, normalization, encoding categorical variables), Feature selection and reduction techniques, Data Exploration: Understanding datasets through summary statistics & visualizations, Using correlation and distribution analysis to identify patterns. Data Mining Techniques & Applications: Supervised vs. Unsupervised Learning in Data Mining, Classification Techniques: Introduction to classification problems, Overview of Decision Trees & Naïve Bayes, Understanding training vs. testing datasets, Performance metrics for classification (accuracy, precision, recall, F1-score), Clustering Techniques: Introduction to clustering and its applications, Partitioning Clustering: k-means algorithm and its working, Hierarchical Clustering: Agglomerative & Divisive approaches, Evaluating clustering results (inertia, silhouette score), Association Rule Mining: Definition and real-world applications (e.g., Market Basket Analysis), Apriori Algorithm for discovering frequent itemsets, Support, confidence, and lift measures in association rules		

Practical Work (20 Marks)

List of Practicals to be Conducted		
1	 Data warehouse design a. Design dimension tables. b. Design fact tables. c. Create an indexed view and rebuild column store indexes. 	
2	 Data Warehouse with Azure a. Create an Azure SQL Data Warehouse Project. b. Develop tables in Azure SQL Data Warehouse. c. Migrate Data Warehouse to Azure. d. Pause and remove Azure data warehouse. 	
3	 Data Warehouse implementation and use a. Cleanse data with SQL Server Data Quality Services. b. Create a custom knowledge base. c. Install Master Data Services and IIS. d. Configure MDS and deploy sample MDS models. e. Install MDS excel add-in and Update master data in excel. f. Consume the data from the warehouse. 	
4	Working with Data and Data Preprocessing	

	 a. Demonstrate the use of ARFF files taking input and display the output of the files. b. Create your own excel file. Convert the excel file to .csv format and prepare it as ARFF files. c. Preprocess and classify Customer dataset. http://archive.ics.uci.edu/ml/ d. Perform Preprocessing, Classification techniques on Agriculture dataset. http://archive.ics.uci.edu/ml/ e. Preprocess and classify Weather dataset. http://archive.ics.uci.edu/ml/ f. Perform data Cleansing of customer dataset. http://archive.ics.uci.edu/ml/ www.kdnuggets.com/datasets/
5	Performing classification on data sets a. Applying Naïve Bayes on Dataset for classification b. Creating the Testing Dataset c. Decision Tree Operation with R d. Naïve Bayes Operation using R e. Classify the dataset using a decision tree. www.kdnuggets.com/datasets/
6	Simple Clustering a. Perform Clustering technique on Customer dataset. http://archive.ics.uci.edu/ml/ b. Perform Clustering technique on Agriculture dataset. http://archive.ics.uci.edu/ml/ c. Perform Clustering technique on Weather dataset.http://archive.ics.uci.edu/ml/
7	Implementing Clustering with R a. Clustering Fisher's Iris Dataset with the Simple k-Means Algorithm b. Handling Missing Values c. Results Analysis after Applying Clustering d. Classification of Unlabeled Data e. Clustering in R using Simple k-Means
8	Implementing Apriori Algorithm with R a. Applying Predictive Apriori in Weka b. Applying the Apriori Algorithm in Weka on a Real World Dataset c. Applying the Apriori Algorithm in Weka on a Real World Larger Dataset d. Applying the Apriori Algorithm on a Numeric Dataset
9	Implementing Association Mining with R a. Applying Association Mining in R b. Application of Association Mining on Numeric Data in R c. Perform Association technique on Agriculture dataset. http://archive.ics.uci.edu/ml/,www.kdnuggets.com/datasets/ d. Perform Association technique on Agriculture dataset. http://archive.ics.uci.edu/ml/ www.kdnuggets.com/datasets/ e. Perform Association technique on Weather dataset.
10	Web Mining a. Implement Hyperlink Induced Topic Search (HITS) algorithm b. Implement PageRank Algorithm

Question Paper Pattern (Academic Year: 2025-2026)

Data Warehousing and Mining Semester End Examination and Practical Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- Data Warehousing Fundamentals for IT Professionals, Paulraj Ponniah, Wiley, Second, 2010
- □ Data Mining and Data Warehousing : Principles and Practical Techniques, Parteek Bhatia, Cambridge University Press, First, 2019
- □ The Data Warehouse Toolkit, Ralph Kimball, Margy Ross, Wiley, Third, 2013
- Encyclopedia of Data Warehousing and Mining, John Wang, Information Science Reference, Second, 2008
- Data Mining and Data Warehousing, S.K.Mourya, Shalu Gupta, Alpha Science International Ltd, First, 2013

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 2. Minor 2.A.a Linear Algebra (3 Credits) Semester III

2. Minor		
2.A.a Linear Algebra		
Course Objectives and Course Outcomes		
Course Objectives		
CObj 1	To develop proficiency in matrix operations and solution methods and understand their geometric interpretation in the context of vector spaces.	
CObj 2	To comprehend the concepts of orthogonality, inner products, and eigenvalues and learn the process of diagonalizing matrices.	
CObj 3	To apply numerical methods, including Singular Value Decomposition (SVD), for solving real-world problems involving matrices.	
	Course Outcomes	
COut 1	Learners will perform matrix operations and solve linear equations, demonstrating mastery of matrix algebra and geometric interpretations.	
COut 2	Learners will apply advanced eigenvalue and eigenvector concepts to successfully diagonalize matrices.	
COut 3	Learners will apply numerical methods, including direct and iterative approaches, to solve real-world problems involving large-scale datasets.	

Modules at a Glance

Linear Algebra		
Sr. No.	Modules	No. of Lectures
1	Systems of Linear Equations and Vector Spaces	15
2	Orthogonality and Diagonalization	15
3	Numerical Linear Algebra	15
	45	

Sr. No.	Modules
1	Systems of Linear Equations and Vector Spaces
	 Prerequisite: Basic concepts of matrices and matrix operations, Types of matrices (zero, identity, scalar, diagonal, upper and lower triangular, symmetric, skew-symmetric, and invertible matrices). (No questions to be asked) Systems of Linear Equations: Homogeneous and non-homogeneous systems of linear equations. Solution by elimination method and geometric interpretation. Matrix representation of a system of linear equations. Elementary row operations and row echelon form. Solution by Gaussian elimination and Gauss-Jordan method. Vector Spaces: Definition and examples of real vector spaces. Subspaces: definition, examples, and the space of all solutions of a system of linear equations. Linear independence, basis, and dimension Fundamental matrix spaces and their applications. Linear Transformations: Definition and properties. Rank-Nullity Theorem (statement only) with examples. Matrix representation of a linear transformation. The rank of a matrix and its relation to transformations. Similar matrices and their applications in dimensionality reduction
2	Orthogonality and Diagonalization
	 Determinants: Determinants and their properties. Linear dependence and independence of vectors. Existence and uniqueness of solutions for Ax=b Orthogonality: Inner product, norm, and angle between vectors. Orthogonality of vectors and orthogonal projections. Gram-Schmidt process and QR decomposition. Orthogonal basis and its role in dimensionality reduction. Diagonalization: Eigenvalues and eigenvectors: definition and properties. Diagonalization of a matrix and applications in machine learning. Orthogonal diagonalization of real symmetric matrices. Similarity transformations and their role in feature extraction.
3	Numerical Linear Algebra

Quadratic Forms: Quadratic Forms and their applications in optimization. Positive Definite and Semi-Positive Definite Matrices.

SVD and PCA: Singular values, singular vectors, and their properties. Singular Value Decomposition (SVD) and its applications. Principal Component Analysis (PCA) for feature extraction and dimensionality reduction.

Numerical Methods for Large Systems: Direct Methods: Triangularization methods for solving linear systems. Iterative Methods: Jacobi and Gauss-Seidel methods for handling large datasets. Eigenvalue Computation: Power Method and Inverse Power Method (for dominant eigenvalues). Norm of a matrix and its significance. Condition number and its role in numerical stability.

Practical Work (20 Marks)

List of Practicals to be Conducted		
1	Solving Systems of Linear Equations (Gaussian Elimination and Gauss-Jordan Method) Aim: To solve homogeneous and non-homogeneous linear equations using Gaussian elimination and Gauss-Jordan methods.	
2	Vector Spaces and Subspaces Aim: To define vector spaces, and subspaces, and demonstrate linear independence, basis, and dimension.	
3	Orthogonality and Projections Aim: To perform orthogonal projections and find the angle between vectors using the inner product.	
4	Gram-Schmidt Process and QR Decomposition Aim: To apply the Gram-Schmidt process and perform QR decomposition.	
5	Diagonalization of Matrices Aim: To find eigenvalues and eigenvectors of a matrix and use them for diagonalization.	
6	Singular Value Decomposition (SVD) and PCA Aim: To perform Singular Value Decomposition (SVD) and apply Principal Component Analysis (PCA) for dimensionality reduction.	
7	Quadratic Forms and Positive Definite Matrices Aim: To apply quadratic forms in optimization and identify positive definite matrices.	
8	Solving Linear Systems using Iterative Methods (Jacobi and Gauss-Seidel) Aim: To solve linear systems using iterative methods like Jacobi and Gauss-Seidel.	

Question Paper Pattern (Academic Year: 2025-2026)

Linear Algebra Semester End Examination and Practical Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 2) A. Numerical/ Theory Based question B. Numerical/ Theory Based question C. Numerical/ Theory Based question	10 10 10	20
Q2.	Answer the following questions (Any 2) A. Numerical/ Theory Based question B. Numerical/ Theory Based question C. Numerical/ Theory Based question	10 10 10	20
Q3.	Answer the following questions (Any 2) A. Numerical/ Theory Based question B. Numerical/ Theory Based question C. Numerical/ Theory Based question	10 10 10	20
	Total	90	60

Note: Each 10 - mark question may be split into 5+5 if required.

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- H. Anton, Elementary linear algebra: Applications version, Wiley Plus Products, Wiley, 2010.
- □ Sheldon Axler, Linear algebra done right, 3rd ed., Springer, New York, 1996.
- Kenneth Hoffman and Ray Kunze, Linear Algebra, Prentice-Hall, Englewood Cliffs, NJ, 1971.
- □ M. K. Jain, S. R. K. Iyengar, and R. K. Jain, Numerical methods for scientific and engineering computation,
- □ New Age International Publications, New Delhi, 2007.
- □ S. Kumaresan, Linear Algebra: A geometric approach, CRC Press, Boca Raton, FL, 2018.
- □ Serge Lang, Linear Algebra, 3rd ed., Springer, New York, 1987

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 3.General Elective/ Open Elective 3.A.a HR Analytics (3 Credits) Semester III

3. General Elective/ Open Elective			
	3.A.a HR Analytics		
	Course Objectives and Course Outcomes		
	Course Objectives		
CObj 1	To understand the role of HR analytics in workforce planning and decision making.		
CObj 2	To learn the tools and techniques for collecting and analyzing HR data.		
CObj 3	To develop skills in data visualization and storytelling for effective communication.		
CObj 4	To Apply analytics to core HR areas like recruitment, performance management, engagement, and retention.		
	Course Outcomes		
COut 1	The learner understands the basics of HR Analytics .		
COut 2	The learner understands the relationship between Fintech and its Impact.		
COut 3	The learner is able to get mastery of key HR analytics tools and techniques.		
COut 4	There is increased ability to perform data-driven analysis to solve HR challenges.		
COut 5	The learner becomes proficient in visualizing and communicating insights effectively.		
COut 6	Preparedness to contribute to strategic HR decision-making.		
COut 7	There is better understanding of the regulatory framework.		
COut 8	The learner is aware of the tools and methodology involved in digitalization concepts.		

Modules at a Glance

HR Analytics			
Sr. No.	Modules	No. of Lectures	
1	Introduction to HR Analytics	15	
2	Tools and Techniques for HR Analytics	15	
3	Performance and Productivity Analytics	15	
	Total 45		

Sr. No.	Modules
1	Introduction to HR Analytics
	Definition of HR Analytics, Importance and Scope, HR Metrics vs. HR Analytics,
	Ethical Considerations in HR Data Usage
	Data Management and HR Systems : Basics of Data Collection and Storage, HR
	Information Systems (HRIS), Data Sources in HR: Internal vs. External, Data Quality and Cleaning Techniques. Ensuring Data Privacy and Compliance
2	Tools and Techniques for HR Analytics
	Application Tools: Excel Power BI Tableau R Python Data Analysis Techniques:
	Descriptive, Diagnostic, Predictive, and Prescriptive Analytics, Statistical Foundations
	for HR Analytics, Applications of Machine Learning in HR
	Advanced HR Analytics Applications: Organizational Network Analysis (ONA),
	Workforce Forecasting and Scenario Planning, Leadership and Succession Planning,
	Workforce Planning and Talent Acquisition Analytics: Analyzing Workforce
	Supply and Demand, Recruitment Metrics-Time-to-Fill, Cost-per-Hire,
	Quality-of-Hire, Predictive Modeling for Talent Acquisition, Employer Branding and
	Candidate Experience Analytics
	Diversity, Equity, and Inclusion (DEI) Analytics- Measuring DEI Metrics, Identifying and Mitigating Diag in HB Processes, Building on Inclusive Workforce
	through Analytics
3	Performance and Productivity Analytics
	Key Performance Metrics Linking Performance Data to Business Outcomes
	Measuring Employee Productivity, Advanced Techniques: Sentiment Analysis for
	Performance Reviews

]]]	Employee	Engagement	and F	Retention	Analytics:	Understanding	Engagement
	Surveys and	Metrics, Ana	lyzing 7	Furnover a	nd Retention	, Building Predi	ctive Models
1	for Attrition	Designing Int	ervention	ns Using D	Data Insights		
	Data Visua	lization and	Storytel	l ling- Desi	igning Effect	ive Dashboards	, Storytelling
r.	Techniques	for Impactful	Present	tations, Ca	ase Studies	on Successful H	IR Analytics
]	Projects						

Question Paper Pattern (Academic Year: 2025-2026)

HR Analytics Semester End Examination and Internal Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Internal Evaluation - 40 Marks

Method of Evaluation	Marks
Assignment/ Case Study/ Project	20
PowerPoint Presentation/ Quiz/ Viva	20
Total	40

Books and References:

- □ Digital Gold: Bitcoin and the Inside Story of the Misfits and Millionaires Trying to Reinvent Money" by Nathaniel Popper
- □ "The Age of Cryptocurrency: How Bitcoin and Digital Money are Challenging the Global Economic Order" by Paul Vigna and Michael J. Casey
- □ "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher
- □ "The Basics of Bitcoins and Blockchains" by Antony Lewis

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 3. General Elective/ Open Elective 3.A.b Blockchain Technology (3 Credits) Semester III

3. General Elective/ Open Elective			
	3.A.b Blockchain Technology		
	Course Objectives and Course Outcomes		
Course Objectives			
CObj 1	To understand core concepts and technologies underlying blockchain technology		
CObj 2	To gain in-depth knowledge of cryptocurrencies, their fundamentals, and the surrounding ecosystem.		
CObj 3	To explore the diverse applications of blockchain technology across various sectors		
	Course Outcomes		
COut 1	Acquire knowledge of Fundamentals of Blockchain and its different components		
COut 2	Understand the role of cryptocurrencies and working of wallets		
COut 3	Understand Role and how to implement Blockchain in various sectors		

Blockchain Technology			
Sr. No.	Modules	No. of Lectures	
1	Blockchain fundamentals	15	
2	Cryptocurrency	15	
3	Blockchain Applications	15	
Total 45			

Sr. No.	Modules	
1	Blockchain Fundamentals	
	Distributed Ledger Technology (DLT): Concept of DLT, its advantages over	
	centralized databases, use of DLT in blockchain Demugtifying Plashahain, Dafing Plashahain, its core components (blasha hash	
	functions consensus mechanisms) and the chain structure	
	Security and Transparency: Encryption and immutability inherent in blockchain.	
	Data security and transparent record-keeping.	
	Consensus Mechanisms: Compare popular consensus mechanisms like PoW, PoS, and	
	their impact on performance and energy consumption.	
	DApps: Decentralized Applications, Ethereum dApps, Advantages and Disadvantages.	
2	Cryptocurrency	
	Introduction: History of Cryptocurrency, Types of Cryptocurrencies based on their	
	purpose, consensus mechanisms, and unique features	
	Understanding Cryptography and Mining: Cryptographic basis, Public Key, Private Key, Digital signatures. Mining process for securing transactions	
	Wallets and Cryptocurrency Exchanges: Different types of cryptocurrency wallets	
	(hot, cold, hardware) and explore centralized and decentralized exchanges for buying,	
	selling, and trading digital assets	
	Smart Contracts and DeF1 Applications: Smart contracts for decentralized finance (DaFi) Applications like lending horrowing and trading on blockshoin platforms	
2	(Der), Applications like fending, borrowing, and trading on blockenam platforms.	
3	Blockchain Applications	
	Financial Applications: Role of blockchain in revolutionizing areas like	
	cryptocurrencies, digital payments, and secure financial transactions.	
	Supply Unain Management: Blockchain to track and verify the provenance of goods,	
	Healthcare and Identity Management: Blockchain to secure patient data facilitate medical	
	record sharing, and enable secure digital identities.	

Question Paper Pattern (Academic Year: 2025-2026)

Blockchain Technology

Semester End Examination and Internal Examination – 100 Marks

Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
	Total	75	60

B] Internal Evaluation - 40 Marks

Method of Evaluation	Marks
Assignment/ Project/ Case Study/ PowerPoint Presentation	20
Report on guest lecture/ activity	20
Total	40

Books and References:

- □ Elisa Bertino, Hai Jiang, Kuan-Ching Li, Xiaofeng Chen, "Essentials of Blockchain Technology", CRC Press, 2019
- □ E. Golden Julie, J. Jesu Vedha Nayahi, Noor Zaman Jhanjhi, "Blockchain Technology Fundamentals, Applications, and Case Studies", CRC Press, 2020
- □ Quinn DuPont, "Cryptocurrencies and Blockchains", Polity Press, 2019
- □ Anita Ravani, Sashi Edupuganti, Jeannette Pugh, Sooraj Sushama, "Applications of Blockchain Technology An Industry Focus", CRC Press, 2024

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 3. General Elective/ Open Elective 3.A.c Data Visualisation using Power BI (3 Credits) Semester III

3. Major				
3.A.c Data Visualisation using Power BI				
	Course Objectives and Course Outcomes			
Course Objectives				
CObj 1	To Learn how to integrate Excel and Power BI			
CObj 2	To learn different usage of Power Bi Reporting			
CObj 3	To learn how to manage relationships between data			
CObj 4	To learn about filters and dashboards in Power BI			
Course Outcomes				
COut 1	Learner should acquire knowledge of using Power Bi with Excel			
COut 2	Learners should be able to aggregate data in one location saving time and effort.			
COut 3	Learners should be able to use different filters Power BI			
COut 4	Learners should be able to create visualizations to display the analytics you need to answer crucial business questions.			
COut 5	Learners should be able to create a dashboard for KPI growth tracking.			
Data Visualisation using Power BI				
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Sr. No.	Modules	No. of Lectures		
1	Introduction to Power BI	15		
2	Data Modeling	15		
3	Filters and Dashboards	15		
	45			

Sr. No.	Modules		
1	Introduction to Power BI		
	BI Reporting, parts of Power BI, architecture of Power BI, Power BI Components, Licensing in Power BI, overview on creation of report Transformation of imported data, use of query editor for shaping data, combine data from multiple sources, Apply filter on data in query editor / Parameter based filtering, Power BI query editor functionalities		
2	Data Modeling		
	How to manage your data relationships, Data modeling, Cardinality options/ Types of relationships, Calculated measures, Difference between calculated column and measures, Evaluation of measures, Creation of calculated table, Creation of master calendar table, Explore time-based data, Exploring Drill down functionality of data Creation of Custom hierarchy apart from date hierarchy		
3	Filters and Dashboards		
	Types of Filters, applying Filter to a Visual, applying Filter to a Page Applying Filter to a Report, How to manage action of visuals onto another visual/ Edit interactions, managing RLS(Row level security) in Power BI, Manage Roles, page navigation in Power BI Make use of bookmarks, Clearing drill through, Clearing slicer, KPI Identification, Dashboard Design Principles, Clarity and Hierarchy		

Practical Work (20 Marks)

List of Practicals to be Conducted			
1	Data Acquisition and Cleaning		
	a. Excel PivotTables & Power Query b. Data Cleansing in Power Query c. Merge & Filter in Power Query		
2	Data Modelling		
	a. Relationship Diagram toolb. Calculated Columns & Measuresc. Dates in Power BI		
3	Visual Storytelling with Power BI		
	a. Dashboard Designb. Slicers and report filters in Power BIc. Choosing Maps and Chart acc to data		
4	Navigation and Collaboration:		
	a. Bookmarks & Drill Down b. Excel Linkages c. Power BI Service Sharing		
5	KPI Dashboard		
	a. Identify and Define KPIsb. Create a Dashboard using appropriate Visualizationsc. Use conditional Formatting		
6	Data Acquisition and Cleaning		
	a. Excel PivotTables & Power Queryb. Data Cleansing in Power Queryc. Merge & Filter in Power Query		

Data Visualization using Power BI Semester End Examination and Practical Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- Dever BI Data Analysis and Visualization, Suraj Gaurav, Suren Machiraj, De/G Press, 2018
- □ Analyzing Data with Power BI and Power Pivot for Excel, Alberto Ferrari, Microsoft Press, First, 2017
- □ Basics of Power BI Modeling, Reza Rad, Radacad Systems Ltd., 2020
- Dever BI Data Analysis and Visualization, Suraj Gaurav, Suren Machiraj, De/G Press, 2018

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 4.Vocational & Skill Enhancement Courses 4.A. Skill Enhancement Course 4.A.a Data Engineering (3 Credits) Semester III

4.Vocational & Skill Enhancement Courses			
4.A. Skill Enhancement Course			
4.A.a Data Engineering			
Course Objectives and Course Outcomes			
	Course Objectives		
CObj 1	Provide foundational knowledge of data engineering concepts, data storage, and distributed computing.		
CObj 2	Introduce students to Big Data processing frameworks, focusing on Hadoop and MapReduce.		
CObj 3	Develop expertise in data pipeline architecture, workflow orchestration, and real-time data processing.		
CObj 4	Equip students with skills to design scalable, fault-tolerant, and high-performance data systems for industry applications.		
	Course Outcomes		
COut 1	Explain the role of data engineering in modern data-driven applications.		
COut 2	Understand the principles of Big Data, distributed computing, and the Hadoop ecosystem.		
COut 3	Implement data storage solutions using SQL, NoSQL, and distributed file systems.		
COut 4	Develop and optimize MapReduce programs for large-scale data processing.		
COut 5	Design and manage scalable and efficient data pipelines for batch and real-time processing.		
COut 6	Utilize workflow orchestration tools like Apache Airflow for automating data workflows.		

COut 7	Implement fault tolerance, high availability, and performance optimization techniques in data pipelines.
COut 8	Work on real-world data engineering projects applying industry-standard technologies.

Data Engineering			
Sr. No.	Modules	No. of Lectures	
1	Introduction to Data Engineering	15	
2	Big Data Basics & Tools	15	
3	Data Pipeline Orchestration	15	
	45		

Sr. No.	Modules		
1	Introduction to Data Engineering		
	Fundamentals of Data Engineering: Role of data engineering in modern data-driven applications, Overview of data lifecycle: ingestion, storage, processing, analysis, and visualization, Differences between data engineering, data science, and data analytics Data Storage & Database Systems: SQL Databases: MySQL, PostgreSQL, indexing, query optimization, NoSQL Databases: MongoDB, Cassandra, DynamoDB, Data Warehouses vs. Data Lakes Scalability & Performance Optimization: Partitioning, sharding, and replication techniques, Caching strategies for efficient query performance, Load balancing and high availability strategies		
2	Big Data & MapReduce		
	Introduction to Big Data & Distributed Computing: Understanding Big Data & its importance, The Four Vs of Big Data (Volume, Variety, Velocity, Veracity), Role of Distributed File Systems (HDFS, Amazon S3, GCS), Batch vs. Real-time data processing Hadoop & MapReduce Framework: Introduction to Hadoop Ecosystem & its components, HDFS (Hadoop Distributed File System) architecture & advantages, MapReduce Programming Model, Implementing MapReduce algorithms for data processing, Use cases of MapReduce in large-scale data analytics Scalability & Performance in Big Data Processing: Distributed data processing optimizations, Memory management in MapReduce, Handling large-scale data queries efficiently, Comparing Hadoop MapReduce with Apache Spark for performance optimization		
3	Data Pipeline Architecture & Orchestration		
	Data Pipeline Architecture: Designing end-to-end data pipelines, Lambda & Kappa		

architectures, Data movement strategies: Batch vs. Streaming pipelines, Event-driven architectures in data pipelines, Real-time Data Processing with Kafka & Flink
Workflow Orchestration & Automation: Introduction to Apache Airflow, Prefect, and Luigi, Scheduling and automating workflows, Managing dependencies & retries in workflows
Scalability & Reliability in Data Pipelines: Ensuring fault tolerance & high availability, Handling large-scale real-time data ingestion, Designing efficient and resilient data architectures

Practical Work (20 Marks)

List of Practicals to be Conducted			
1	Data Storage & Retrieval		
	a. Implement relational & NoSQL databases for structured/unstructured data.b. Perform query optimization techniques in SQL & NoSQL.		
2	Big Data Processing with Hadoop & MapReduce		
	a. Write and execute a simple MapReduce program.b. Perform batch processing on large datasets using Hadoop.c. Compare Hadoop MapReduce vs. Spark performance.		
3	Real-time Data Processing with Kafka & Flink		
	a. Set up a real-time data pipeline using Apache Kafka.b. Implement stream processing with Apache Flink.		
4	Pipeline Orchestration & Workflow Automation		
	a. Build and manage workflows using Apache Airflow.b. Implement dependency management & scheduling in data pipelines.		
5	Distributed Computing & Performance Optimization		
	a. Implement parallel data processing using Apache Spark.b. Optimize query performance with indexing and partitioning.c. Conduct fault tolerance testing in distributed data environments.		

Data Engineering Semester End Examination and Practical Examination – 100 Marks Semester III

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ Armbrust, Michael, et al. Learning Spark: Lightning-Fast Big Data Analysis. O'Reilly Media, 2020.
- □ Karau, Holden, and Matei Zaharia. High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark. O'Reilly Media, 2017.
- □ Gourav, Arshdeep Bahga, and Vijay Madisetti. Big Data Science & Analytics: A Hands-On Approach. CreateSpace Independent Publishing, 2016.
- □ Dean, Jeffrey, and Sanjay Ghemawat. MapReduce: Simplified Data Processing on Large Clusters. Morgan & Claypool, 2008.
- □ Kleppmann, Martin. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems. O'Reilly Media, 2017.
- □ Karamel, Nitin. Data Engineering with Python: Work with Massive Datasets Using Data Pipelines and Machine Learning. Packt Publishing, 2020.

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 5. Ability & Value Enhancement Courses/Indian Knowledge System 5.A. Ability Enhancement Course 5.A.a Sanskrit - I (2 Credits) Semester III

5. Ability & Value Enhancement Courses/Indian Knowledge System			
5.A. Ability Enhancement Course			
	5.A.a Sanskrit - I		
Course Objectives and Course Outcomes			
Course Objectives			
CObj 1	To create curiosity in the minds of learns about the chosen language		
CObj 2	To help the learners understand the need to learn the chosen language		
CObj 3	To introduce learners to the structure of the chosen language		
CObj 4	To understand the richness of Indian selected languages with reference to consonants and vowels		
CObj 5	To understand unique characteristics of the chosen language		
CObj 6	To understand the use of gender and tenses		
CObj 7	To understand the use of idioms and phrases		
CObj 8	To know the various dialects of the chosen language		
CObj 0	To understand the application of technology for communication by alternatively abled		
CObj 10	To understand the need of learning functional languageTo understand the need of learning functional language		
CObj 11	To get familiarized with the literature of the chosen language		
CObj 12	To get familiarized with the literature translated to the chosen language from other languages		
CObj 13	To learn to appreciate the other literary forms of the chosen language		

Course Outcomes		
COut 1	The learner will be curious to learn the chosen language	
COut 2	The learner will be able to understand the need to learn the chosen language	
COut 3	The learner will get familiar with the structure of the chosen language	
COut 4	To understand the richness of Indian selected languages with reference to constants and vowels	
COut 5	To understand unique characteristics of the chosen language	
COut 6	To understand the use of gender and tenses	
COut 7	To understand the use of idioms and phrases	
COut 8	To know the various dialects of the chosen language	
COut 9	To understand the application of technology for communication by alternatively abled	
COut 10	To understand the need of learning functional language	
COut 11	To get familiarized with the literature of the chosen language	
COut 12	To get familiarized with the literature translated to the chosen language from other languages	
COut 13	To learn to appreciate the other literary forms of the chosen language	

Sanskrit - I		
Sr. No.	Modules	No. of Lectures
1	Introduction to Linguistic Studies	10
2	Languages in Communication	10
3	Select Studies in the chosen Language (Sanskrit/Marathi/Hindi)	10
Total 30		

Sr. No.	Modules	
1	Introduction to Linguistic Studies	
	Structure of languages English language compared with the select Indian languages – viz, (Marathi, Hindi and Sanskrit) Richness of Indian languages with reference to Vowels, consonants (maatra) Rhythmic characteristics of Indian languages. Unique characteristics of language (such as Repeat words like Sarsarahat) Logic behind numbers in regional languages Use of Tenses and Gender	
2	Languages in Communication	
	Use of Idioms and Phrases Oral and Written Dialects Communication for alternatively abled Use of Sign language Language learning – Use of Technology Need for learning functional language	
3	Select Studies in the chosen Language (Sanskrit/Marathi/Hindi)	
	The faculty member shall discuss with the learners about the richness of literature of the chosen language. Subsequently the entire class will choose two authors and two poets. The chosen literary work needs to be read and discussed in the class. Based on this module, internal evaluation shall be done.	

Sanskrit - I Semester End Examination and Internal Evaluation – 50 Marks Semester III

A] Semester End Examination (SEE)- 30 Marks

Maximum Marks: 30

Duration: 1 Hour

Note: 1. All questions are compulsory.

2. The learners can write answers in the chosen language or in English/ Marathi/ Hindi.

Question No.	Particulars (Nature of Questions)	Marks
Questions with sub questions	Flexibility is given to the faculty to decide the paper pattern and depending on learners ability will design the question paper. It can contain questions like identifying or changing gender, identifying or changing tenses, making rhythmic words, answer in one sentence etc.	30
	Total	30

B] Internal Evaluation - 20 Marks

The faculty will decide the means of taking internal evaluation. It can be oral quiz, dialogue exchange, role play, reading comprehension, listening comprehension etc.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 5. Ability & Value Enhancement Courses/Indian Knowledge System 5.A. Ability Enhancement Course 5.A.b Marathi - I (2 Credits) Semester III

5. Ability & Value Enhancement Courses/Indian Knowledge System			
5.A. Ability Enhancement Course			
	5.A.b Marathi - I		
Course Objectives and Course Outcomes			
Course Objectives			
CObj 1	To create curiosity in the minds of learns about the chosen language		
CObj 2	To help the learners understand the need to learn the chosen language		
CObj 3	To introduce learners to the structure of the chosen language		
CObj 4	To understand the richness of Indian selected languages with reference to consonants and vowels		
CObj 5	To understand unique characteristics of the chosen language		
CObj 6	To understand the use of gender and tenses		
CObj 7	To understand the use of idioms and phrases		
CObj 8	To know the various dialects of the chosen language		
CObj 0	To understand the application of technology for communication by alternatively abled		
CObj 10	To understand the need of learning functional languageTo understand the need of learning functional language		
CObj 11	To get familiarized with the literature of the chosen language		
CObj 12	To get familiarized with the literature translated to the chosen language from other languages		
CObj 13	To learn to appreciate the other literary forms of the chosen language		

Course Outcomes		
COut 1	The learner will be curious to learn the chosen language	
COut 2	The learner will be able to understand the need to learn the chosen language	
COut 3	The learner will get familiar with the structure of the chosen language	
COut 4	To understand the richness of Indian selected languages with reference to constants and vowels	
COut 5	To understand unique characteristics of the chosen language	
COut 6	To understand the use of gender and tenses	
COut 7	To understand the use of idioms and phrases	
COut 8	To know the various dialects of the chosen language	
COut 9	To understand the application of technology for communication by alternatively abled	
COut 10	To understand the need of learning functional language	
COut 11	To get familiarized with the literature of the chosen language	
COut 12	To get familiarized with the literature translated to the chosen language from other languages	
COut 13	To learn to appreciate the other literary forms of the chosen language	

Marathi - I		
Sr. No.	Modules	No. of Lectures
1	Introduction to Linguistic Studies	10
2	Languages in Communication	10
3	Select Studies in the chosen Language (Sanskrit/Marathi/Hindi)	10
Total 30		30

Sr. No.	Modules	
1	Introduction to Linguistic Studies	
	Structure of languages English language compared with the select Indian languages – viz, (Marathi, Hindi and Sanskrit) Richness of Indian languages with reference to Vowels, consonants (maatra) Rhythmic characteristics of Indian languages. Unique characteristics of language (such as Repeat words like Sarsarahat) Logic behind numbers in regional languages Use of Tenses and Gender	
2	Languages in Communication	
	Use of Idioms and Phrases Oral and Written Dialects Communication for alternatively abled Use of Sign language Language learning – Use of Technology Need for learning functional language	
3	Select Studies in the chosen Language (Sanskrit/Marathi/Hindi)	
	The faculty member shall discuss with the learners about the richness of literature of the chosen language. Subsequently the entire class will choose two authors and two poets. The chosen literary work needs to be read and discussed in the class. Based on this module, internal evaluation shall be done.	

Marathi - I Semester End Examination and Internal Evaluation – 50 Marks Semester III

A] Semester End Examination (SEE)- 30 Marks

Maximum Marks: 30

Duration: 1 Hour

Note: 1. All questions are compulsory.

2. The learners can write answers in the chosen language or in English/ Marathi/ Hindi.

Question No.	Particulars (Nature of Questions)	Marks
Questions with sub questions	Flexibility is given to the faculty to decide the paper pattern and depending on learners ability will design the question paper. It can contain questions like identifying or changing gender, identifying or changing tenses, making rhythmic words, answer in one sentence etc.	30
	Total	30

B] Internal Evaluation - 20 Marks

The faculty will decide the means of taking internal evaluation. It can be oral quiz, dialogue exchange, role play, reading comprehension, listening comprehension etc.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 5. Ability & Value Enhancement Courses/Indian Knowledge System 5.A. Ability Enhancement Course 5.A.c Hindi- I (2 Credits) Semester III

5. Ability & Value Enhancement Courses/Indian Knowledge System			
5.A. Ability Enhancement Course			
	5.A.c Hindi- I		
Course Objectives and Course Outcomes			
Course Objectives			
CObj 1	To create curiosity in the minds of learns about the chosen language		
CObj 2	To help the learners understand the need to learn the chosen language		
CObj 3	To introduce learners to the structure of the chosen language		
CObj 4	To understand the richness of Indian selected languages with reference to consonants and vowels		
CObj 5	To understand unique characteristics of the chosen language		
CObj 6	To understand the use of gender and tenses		
CObj 7	To understand the use of idioms and phrases		
CObj 8	To know the various dialects of the chosen language		
CObj 0	To understand the application of technology for communication by alternatively abled		
CObj 10	To understand the need of learning functional languageTo understand the need of learning functional language		
CObj 11	To get familiarized with the literature of the chosen language		
CObj 12	To get familiarized with the literature translated to the chosen language from other languages		
CObj 13	To learn to appreciate the other literary forms of the chosen language		

	Course Outcomes		
COut 1	The learner will be curious to learn the chosen language		
COut 2	The learner will be able to understand the need to learn the chosen language		
COut 3	The learner will get familiar with the structure of the chosen language		
COut 4	To understand the richness of Indian selected languages with reference to constants and vowels		
COut 5	To understand unique characteristics of the chosen language		
COut 6	To understand the use of gender and tenses		
COut 7	To understand the use of idioms and phrases		
COut 8	To know the various dialects of the chosen language		
COut 9	To understand the application of technology for communication by alternatively abled		
COut 10	To understand the need of learning functional language		
COut 11	To get familiarized with the literature of the chosen language		
COut 12	To get familiarized with the literature translated to the chosen language from other languages		
COut 13	To learn to appreciate the other literary forms of the chosen language		

Hindi- I			
Sr. No.	Modules	No. of Lectures	
1	Introduction to Linguistic Studies	10	
2	Languages in Communication	10	
3	Select Studies in the chosen Language (Sanskrit/Marathi/Hindi)	10	
	Total 30		

Sr. No.	Modules	
1	Introduction to Linguistic Studies	
	Structure of languages English language compared with the select Indian languages – viz, (Marathi, Hindi and Sanskrit) Richness of Indian languages with reference to Vowels, consonants (maatra) Rhythmic characteristics of Indian languages. Unique characteristics of language (such as Repeat words like Sarsarahat) Logic behind numbers in regional languages Use of Tenses and Gender	
2	Languages in Communication	
	Use of Idioms and Phrases Oral and Written Dialects Communication for alternatively abled Use of Sign language Language learning – Use of Technology Need for learning functional language	
3	Select Studies in the chosen Language (Sanskrit/Marathi/Hindi)	
	The faculty member shall discuss with the learners about the richness of literature of the chosen language. Subsequently the entire class will choose two authors and two poets. The chosen literary work needs to be read and discussed in the class. Based on this module, internal evaluation shall be done.	

Hindi - I

Semester End Examination and Internal Evaluation – 50 Marks

Semester III

A] Semester End Examination (SEE)- 30 Marks

Maximum Marks: 30

Duration: 1 Hour

Note: 1. All questions are compulsory.

2. The learners can write answers in the chosen language or in English/ Marathi/ Hindi.

Question No.	Particulars (Nature of Questions)	Marks
Questions with sub questions	Flexibility is given to the faculty to decide the paper pattern and depending on learners ability will design the question paper. It can contain questions like identifying or changing gender, identifying or changing tenses, making rhythmic words, answer in one sentence etc.	30
	Total	30

B] Internal Evaluation - 20 Marks

The faculty will decide the means of taking internal evaluation. It can be oral quiz, dialogue exchange, role play, reading comprehension, listening comprehension etc.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 6. Internship/Field Project / Research Project / Community Engagement 6.A.a Foundation of Research Skills - I (2 Credits) Semester III

6. Internship/Field Project / Research Project / Community Engagement			
	6.A.a Foundation of Research Skills - I		
	Course Objectives and Course Outcomes		
	Course Objectives		
CObj 1	Identify ways and means of learning by doing		
CObj 2	Understand the importance of research orientation		
CObj 3	Engage with the outside world and understand the power of observation		
CObj 4	Develop skills of questioning		
CObj 5	Analyzes data into information		
CObj 6	Create documents that are simple and easily comprehensible		
CObj 7	Acquire oral and written presentation skills		
	Course Outcomes		
COut 1	Learners Recognize the difference between research projects, field projects and internships and define the benefits and limitations of them		
COut 2	Learners identify various forms of observation and analysis		
COut 3	Learners identify the necessary skills required for conducting studies in the field		
COut 4	Learners list the qualities required of a researcher		
COut 5	Learners match skill sets possessed by them and the skill sets required		
COut 6	Learners appreciate the ethical aspects of research analysis		
COut 7	Learners become ready to define and design research projects/field projects		
COut 8	Learners become acquainted with office etiquette		
COut 9	The learner will be able to apply statistical tools for quantifying data		

Foundation of Research Skills - I			
Sr. No.	Modules	No. of Lectures	
1	Learning out of campus	05	
2	Field Projects and Internships	10	
3	Managing Data- Sources, Collection and Analysis	10	
4	Report Writing and Presentation	05	
	Total 30		

Sr. No.	Modules
1	Learning out of campus
	What constitutes learning out of campus, Difference between campus learning and out of campus learning-Benefits and prospects of learning out of campus-Few recommended methods of learning beyond campus Introduction to Research Projects: The research process, Basic approaches and terminologies used in researchDefining research questions and framing of hypotheses- preparing a research plan-Defining the road map for action
2	Field Projects and Internships
	Introduction to Field Projects: Defining the purpose and objectives for conducting field project, Narrating the expected outcome and usefulness of the study, Defining the field and designing the project plan, Identifying the limitation, Tools required and the methods to be adopted, Defining the road map for action Introduction to Internships: Defining the scope and learning outcome, Identifying options, inquiring and understanding and analyzing the bottlenecks/hurdles, Methods of solving, Procedure to be followed for becoming an intern-Compliances and formalities, Self appraisal and internship etiquettes. Defining the road map for action
3	Managing Data- Sources, Collection and Analysis
	Primary Data, Secondary Data, Cleaning and Editing, Coding of data, Statistical tools normally used for data analysis- Mean, Median, Mode, correlation, Skewness etc., (revision of FY Maths and Stats syllabus) Tabulation: Graphic presentation of data using Excel or data analysis.
4	Report Writing and Presentation

	Need for Effective Documentation, Importance of Report Writing, Types of research
	reports Report Structure, Acknowledgements, Bibliography, Ethical aspects of research
	findings right, Report preparation including PowerPoint Presentation. (revision of FY)

Foundation of Research Skills - I Semester End Examination – 50 Marks Semester III

A] Semester End Examination (SEE)- 50 Marks

Project Report (50 Marks)

The students are expected to submit a project report on the given topics for each module which will be evaluated by the faculty.

Books and References:

- □ Saunders- Research Methods for Business Students Pearson Education
- □ Research Methodology by D. K. Bhattacharyya Excel
- □ Kothari C. R Research Methodology.
- □ Donald Cooper and PS Schindler (2009) Business Research Methods, 9th edition, Tata McGraw Hill.
- □ Uma Sekaran (2010) Research Methods for Business, 4th edition, Wiley.
- □ Naresh Malhotra and S Dash (2009) Marketing Research, 5th edition, Pearson Prentice Hall.
- □ Ranjit Kumar (2009) Research Methodology, 2nd edition, Pearson Education
- □ Michael V. P Research Methodology. 7 Fred N. Kerlinger : Foundations of Behavioral Research.

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning

CRITERIA FOR EVALUATING POWERPOINT PRESENTATION/ CASE STUDY/ APPLICATION BASED ACTIVITY:

MARKS: 2	20
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FY/SY/TY BSc: Division A/B

Semester:

Name o	Jame of the Topic Date of Presentation:						
C. N.			Content	Team	Presentation skills		Total
Sr. No	Koll No	Name of the student	(5)	building (5)	Verbal (5)	Non Verbal (5)	(20)
1							
2							
3							
4							
Sign: 1_		34Faculty S	ign:				
Name o	of the Ton	c D	ate of Press	entation.			
					Preser	ntation skills	
Sr. No	Roll No	Name of the student	Content (5)	Team building (5)	Verbal	Non Verbal	Total (20)
					(3)	(3)	
$\frac{2}{3}$							
4							
Sign: 1_		34Faculty S	ign:		-		ł
Name o	of the Top	c Di	ate of Prese	entation:			
					Presentation skills		
Sr. No	Roll No	Name of the student	Content (5)	Team building (5)	Verbal (5)	Non Verbal (5)	Total (20)
1							
2							
3							
4							
Sign: 1_		234Faculty S	sign:				

S P Mandali's R. A. PODAR COLLEGE OF COMMERCE AND ECONOMICS (EMPOWERED AUTONOMOUS), Matunga, Mumbai-400019

Course Structure Bachelor of Science (Data Science and Analytics)

Semester III and IV

College Website: www.rapodar.ac.in

AC: 10/03/2025

S P Mandali's R. A. PODAR COLLEGE OF COMMERCE AND ECONOMICS (EMPOWERED AUTONOMOUS), Matunga, Mumbai-400019

Bachelor of Science (Data Science and Analytics) SYBSc Semester IV

Syllabus And Question paper pattern of Course

As per National Education Policy 2020 To be implemented from Academic Year 2025- 2026

College Website: www.rapodar.ac.in

Bachelor of Science (Data Science and Analytics) Programme Syllabus as per National Education Policy 2020 Course Structure S.Y.B.Sc. (Data Science and Analytics) (Level 5) (To be implemented from Academic Year 2025-26)

No of Courses	Course Code Semester IV Credits		Credits
1			
1.A		Discipline Specific Core	
1.A.a		Computer Vision and Image Processing	03
1.A.b		Machine Learning	03
1.A.c		Cloud Computing	03
2		Minor (03 credits)	
2.A.a		Inferential Statistics	03
3		General Elective (GE)/ Open Elective (OE) (03 Credits)
3.A.a	Digitalization of Financial Markets		03
3.A.b	Family Business Enterprise03		03
3.A.c	Robotic Process Automation		03
4	Vocational & Skill Enhancement Courses (VSEC) (03 credits)		
4.A	Skill Enhancement Course		
4.A.a		Operating Systems	03
5	Ability & Val	ue Enhancement Courses/Indian Knowledge System (AVEC	C/ IKS) (02 credits)
5.A		Ability Enhancement Course	
5.A.a		Sanskrit-I	02
5.A.b		Marathi-I	02
5.A.c		Hindi-I	02
6	Internsh	ip/Field Project / Research Project / Community Engageme	nt (02 credits)
6.A.a		Foundation of Research Skills - II	02
	T	OTAL CUMULATIVE CREDITS	22

Exit option at the end of the Third year (on completion of Semester III and Semester IV): Under Graduate Certificate in Data Science and Analytics will be awarded to a learner on fulfillment of the following conditions:

1. The learner should have acquired 44 credits in Semester III and VI considered together.

2. The learner should acquire an additional 4 credits as per norms by completing recognized courses under the National Skill Qualification Framework (NSQF) such as a certificate course on Data Warehousing and Mining, a Course on AI & ML concepts, and an Internship.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 1.Major 1.A. Discipline Specific Core Courses 1.A.a Computer Vision and Image Processing (3 Credits) Semester IV

	1. Major		
	1.A Discipline Specific Core		
	1.A.a Computer Vision and Image Processing		
	Course Objectives and Course Outcomes		
	Course Objectives		
CObj 1	Introduce students to the fundamentals of image formation, enhancement, and transformation techniques.		
CObj 2	Develop an understanding of computer vision concepts such as feature extraction, object recognition, and motion analysis.		
CObj 3	Provide practical experience in applying image processing techniques to real-world applications.		
CObj 4	Familiarize students with machine learning and deep learning approaches for image analysis.		
	Course Outcomes		
COut 1	Explain fundamental concepts of computer vision and image processing.		
COut 2	Implement basic image enhancement, filtering, and transformation techniques.		
COut 3	Perform feature extraction, edge detection, and object recognition.		
COut 4	Analyze motion and depth estimation using stereo vision and optical flow.		
COut 5	Design and implement machine learning-based image classification models.		
COut 6	Utilize deep learning frameworks (e.g., TensorFlow, OpenCV) for image processing tasks.		
COut 7	Apply computer vision techniques to real-world applications such as facial recognition, gesture recognition, and medical imaging.		

COut 8

Computer Vision and Image Processing				
Sr. No.	Modules	No. of Lectures		
1	Introduction to Computer Vision and Image Formation	15		
2	Image Processing Techniques	15		
3	Feature Extraction and Applications	15		
	45			

Sr. No.	Modules		
1	Introduction to Computer Vision and Image Formation		
	 Fundamentals: Definitions and applications, Goals and challenges, Basic Concepts of Image Formation Image acquisition: Radiometric models, Geometric transformations, Geometric Camera Models, Pinhole camera model, Intrinsic and extrinsic parameters, Camera calibration techniques Stereo Vision and 3D Reconstruction: Epipolar geometry, Depth estimation, 3D scene reconstruction Image Reconstruction Techniques: Reconstruction from projections, Tomographic reconstruction 		
2	Image Processing Techniques		
	Image Transforms: Fourier transform, Discrete cosine transform, Wavelet transform Image Enhancement: Spatial domain methods, Frequency domain methods, Histogram equalization Image Filtering: Linear and nonlinear filters, Smoothing and sharpening, Edge detection techniques Color Image Processing: Color models (RGB, HSV, YUV), Color transformations, Color segmentation Image Segmentation: Thresholding methods, Region-based segmentation, Clustering techniques (K-means, Mean Shift)		
3	Feature Extraction and Applications		
	Feature Detection and Description: Edges, corners, and blobs, SIFT, SURF, and ORB descriptors Object Recognition: Template matching, Bag of visual words, Convolutional Neural Networks (CNNs)		

Motion Analysis: Optical flow estimation, Background subtraction, Object tracking algorithms
 Advanced Applications: Gesture recognition, Facial recognition, Medical image analysis, Autonomous vehicles

List of Practicals to be Conducted				
1	Capture images using a camera and display them using image processing libraries.			
2	Apply scaling, rotation, and translation to images.			
3	Calibrate a camera using a checkerboard pattern and compute intrinsic parameters.			
4	Compute disparity maps and reconstruct 3D scenes from stereo image pairs.			
5	Implement histogram equalization and contrast adjustment techniques.			
6	Apply Sobel, Prewitt, and Canny edge detectors to images.			
7	Segment objects in images based on color information using different color spaces.			
8	Detect and match features between images using SIFT or SURF descriptors.			
9	Implement object tracking in video sequences using algorithms like Mean Shift or Kalman Filter.			
10	Develop a simple gesture recognition system using motion analysis techniques.			

Practical Work (20 Marks)

Computer Vision and Image Processing Semester End Examination and Practical Examination – 100 Marks Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ Gonzalez, Rafael C., and Richard E. Woods. Digital Image Processing. 4th ed., Pearson, 2018.
- □ Szeliski, Richard. Computer Vision: Algorithms and Applications. 2nd ed., Springer, 2022.
- □ Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.
- □ Shapiro, Linda G., and George C. Stockman. Computer Vision. Prentice Hall, 2001.
- □ Solomon, Chris, and Toby Breckon. Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab. Wiley, 2011.
- □ Prince, Simon J. D. Computer Vision: Models, Learning, and Inference. Cambridge University Press, 2012.

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.
Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 1.Major 1.A. Discipline Specific Core Courses 1.A.b Machine Learning (3 Credits) Semester IV

1. Major	
1.A Discipline Specific Core	
	1.A.b Machine Learning
	Course Objectives and Course Outcomes
	Course Objectives
CObj 1	To introduce students to the fundamental concepts and principles of Machine Learning.
CObj 2	To familiarize students with various types of machine learning algorithms and their applications.
CObj 3	To provide hands-on experience in implementing and evaluating machine learning models.
CObj 4	To develop critical thinking and problem-solving skills in the context of machine learning.
CObj 5	To enable students to apply machine learning techniques to real-world problems and datasets.
CObj 6	To understand the limitations and challenges of machine learning and develop strategies to address them.
	Course Outcomes
COut 1	Understand the foundational concepts and principles of Machine Learning.
COut 2	Apply supervised and unsupervised learning techniques, including classification algorithms and clustering algorithms.
COut 3	Evaluate the performance of Machine Learning models using classification metrics.
COut 4	ROC/AUC curve analysis, and cross-validation techniques.

COut 5	Implement regression models (such as linear regression and logistic regression) and understand their applications in predictive analysis.
COut 6	Utilize dimensionality reduction techniques (Like PCA) for feature reduction and selection, and apply association rule mining algorithms (such as the Apriori algorithm) for discovering meaningful patterns in datasets.

Modules at a Glance

Machine Learning		
Sr. No.	Modules	No. of Lectures
1	Fundamentals of Machine Learning	15
2	Supervised Learning - Classification & Regression	15
3	Unsupervised Learning & Dimensionality Reduction	15
Total 45		

Sr. No.	Modules
1	Fundamentals of Machine Learning
	Introduction to Machine Learning: Definition & Importance of Machine Learning, Knowledge-driven vs. Data-driven ML, Applications & real-world use cases of ML, Advantages, Disadvantages & Challenges Machine Learning System Architecture: General architecture of ML systems, Understanding data pipeline & workflow, Introduction to ML model building process Underlying Concepts in ML: Inductive Learning & Generalization, Bias-Variance Tradeoff, Overfitting vs. Underfitting, Parametric vs. Non-Parametric ML algorithms Types of Machine Learning: Supervised Learning: Definition & Workflow, Unsupervised Learning: Importance & Challenges, Semi-Supervised Learning & Reinforcement Learning
2	Supervised Learning - Classification & Regression
	Classification Algorithms: Concept of Classification, Binary vs. Multi-Class vs. Multi-Label Classification, K-Nearest Neighbors (KNN), Decision Trees: ID3 Algorithm, Attribute Selection Methods (Entropy, Gini Impurity, Information Gain), Support Vector Machines (SVM): Support Vectors, Hard Margin, Soft Margin, Kernel Trick, Artificial Neural Networks (ANN): Basic Structure & Working Probabilistic Learning: Bayes Theorem & Naïve Bayes Classifier, Benefits and Shortfalls of Bayesian Learning Regression Methods: Linear Regression: Least Squares, Interpretation of Coefficients, Logistic Regression: Sigmoid Function, Decision Boundary Performance Evaluation in Machine Learning: Classification Metrics: Accuracy, Precision, Recall, F1 Score, ROC/AUC Curve & Cross Validation
3	Unsupervised Learning & Dimensionality Reduction
	Unsupervised Learning Concepts: Definition & Importance of Unsupervised

Learning, Challenges in unsupervised learning
Clustering Algorithms: Hierarchical Clustering: Types, Applications, Issues,
Partitioning Algorithm (K-means Clustering): Steps, Strengths & Weaknesses, Curse of
Dimensionality & Feature Engineering
Dimensionality Reduction: Feature Reduction & Feature Selection, Principal
Component Analysis (PCA): Working & Applications
Association Rule Mining: Market Basket Analysis, Apriori Algorithm

List of Practicals to be Conducted		
1	Implementing a K-Nearest Neighbour 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 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)	
6	Using logistic regression (e.g. to predict whether a credit card transaction is fraud)	
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 behaviour)	
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.	

Practical Work (20 Marks)

Question Paper Pattern (Academic Year: 2025-2026)

Machine Learning Semester End Examination and Practical Examination – 100 Marks Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ Machine Learning: Concepts, Techniques and Applications, T V Geetha S, Sendhil kumar CRC Press, Taylor and Francis, 1 st Edition, 2023
- □ Machine Learning for Decision Sciences with Case Studies in Python, S. Sumathi, Suresh V. Rajappa, CRC Press, Taylor and Francis, 1 st Edition, 2022
- □ Introduction to Machine Learning with Python, Andreas C. Müller, Sarah Guido O'Reilly Media, Inc. 1 st Edition, 2016
- □ Machine Learning for Beginners, Harsh Bhasin, BPB, 1st Edition, 2020
- □ Machine Learning S Sridhar, Oxford University, Press, 1 st Edition, 2021
- □ Machine Learning Ruchi Doshi, Kamal Kant Hiran, BPB, 1 St Edition, 2021

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 1.Major 1.A. Discipline Specific Core Courses 1.A.c Cloud Computing (3 Credits) Semester IV

1. Major	
1.A Discipline Specific Core	
	1.A.c Cloud Computing
	Course Objectives and Course Outcomes
Course Objectives	
CObj 1	To introduce cloud computing technology through its various aspects.
CObj 2	To understand virtualization technology and its functionality in cloud computing.
CObj 3	To get familiar with Mobile Cloud Computing Concept.
CObj 4	To be aware of different service and privacy aspects of cloud computing.
	Course Outcomes
COut 1	Learners will be able to understand cloud infrastructure.
COut 2	Learners will be able to work on different types of virtualization.
COut 3	Learners will acquire knowledge of mobile computing .
COut 4	Learners will be able to use cloud services.
COut 5	Learners will be able to implement measures for security and privacy.

Modules at a Glance

Cloud Computing		
Sr. No.	Modules	No. of Lectures
1	Introduction to Cloud Computing & Virtualization	15
2	Mobile Computing & Cloud Security	15
3	Cloud Services	15
Total 45		

Sr. No.	Modules
1	Introduction to Cloud Computing & Virtualization
	Basics of Cloud Computing: Definitions, Characteristics, Components, Evolutions of Cloud Computing, Models of Cloud, Deployment Types of Cloud, Cloud Computing Vs On Premise System, Cloud Computing Architecture, Opportunities and Challenges, Service Oriented architecture (SOA) and Cloud Computing Reference Architecture by IBM, Applications of Cloud Virtualization: Introduction, Virtualization Techniques, Hypervisors and types, Types of Virtualization, Virtualization and Cloud Computing, Containerization vs. Virtual Machines
2	Mobile Computing & Cloud Security
	 Mobile Computing: Introduction, Architecture, Need, Characteristics, Advantages and Disadvantages, Mobile Cloud Platforms, MBaaS, Emerging trends in Mobile Computing. Cloud Security: Cloud Security, Cloud Privacy, Regulations & Compliance, Cloud security Models, Data Sovereignty, Risk Assessment, Tools and Techniques used, Virtualization Security Management, Mobile Computing Security and Privacy, Container Security, Best Practices.
3	Cloud Services
	 Amazon Web Services: Overview, Compute, Storage, Database, Networking, AI & ML, Security. Microsoft Azure Web Services: Overview, Compute, Storage, Database, Networking, AI & ML, Security. Google Cloud Platform: Overview, Compute, Storage, Database, Networking, AI & ML, Security.

List of Practicals to be Conducted	
1	Create a cloud instance
2	Deploy a virtual machine
3	Connect to virtual machine and explore file systems
4	Configure basic security systems
5	Create a database
6	Implement storage
7	Experiment with AI/ML intergrations

Practical Work (20 Marks)

Question Paper Pattern (Academic Year: 2025-2026)

Cloud Computing Semester End Examination and Practical Examination – 100 Marks Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ "Distributed and Cloud Computing" From Parallel Processing to the Internet of Things By Kai Hwang, Geoffrey C. Fox, Morgen Kaufmann Publication.
- □ Fundamentals of Computers and information system, Harendra nath Tiwari, Dr. Hemchand Jain, International Boo House Pvt. Ltd.
- □ Cloud Computing, Implementation, Management, and Security, Jhon W. Rittinghouse, James F. Ransome, CRC Press.
- □ Cloud Security and Privacy, Tim Mather, Subra Kumarswamy, Shahad Latif, O'REILLY, Shroff Publication and Distribution.
- □ Cloud Computing A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeterm, McGraw Hill Education (India)
- □ Enterprise Cloud Computing, Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press.
- □ Cloud Computing Bible. Barrie Sosinsky, Wiley Publication
- □ Mastering Cloud Computing, Rajkumar Buyya, Chritian Vecchiola, S Thamarai, McGraw Hill Education (India)

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 2. Minor 2.A.a Inferential Statistics (3 Credits) Semester IV

1. Major		
2.A.a Inferential Statistics		
	Course Objectives and Course Outcomes	
	Course Objectives	
CObj 1	To understand the fundamentals of statistical hypothesis testing.	
CObj 2	To develop proficiency in applying appropriate parametric tests to analyze data and draw valid conclusions.	
CObj 3	To evaluate the appropriateness of non-parametric tests and confidently apply them to handle situations where parametric assumptions are not met.	
	Course Outcomes	
COut 1	Learners will conduct hypothesis testing procedures, calculate p-values, and interpret statistical results for various tests to make informed decisions about data.	
COut 2	Learners will analyze data using both parametric and non-parametric approaches, understanding the assumptions, limitations, and justifications of each method.	
COut 3	Learners will communicate statistical findings effectively and critically evaluate the research implications of the results.	

Modules at a Glance

Inferential Statistics		
Sr. No.	Modules	No. of Lectures
1	Hypothesis Testing and Sampling Distributions	15
2	Analysis of Variance (ANOVA)	15
3	Non-Parametric Tests	15
	Total 60	

Sr. No.	Modules
1	Hypothesis Testing and Sampling Distributions
	 Testing of Hypothesis: Concept of hypothesis, Null and Alternative Hypothesis. Types of Errors, Critical Region, Level of Significance, and Power. Large sample tests for: a specified population mean, the difference between two population means, a specified population proportion, and the difference between two population proportions. Concept of the p-value. Chi-Square Distribution: Concept of degrees of freedom. Mean, Median, Mode, and Standard Deviation. Additive property, Distribution of the sum of squares of independent Standard Normal variables. Sampling Distributions of Sample mean and sample variance, and their independence for a Normal population. Applications: Test for a specified variance of a Normal population, Test for goodness of fit, Test for independence of attributes. t-Distribution: Mean, Median, Mode, and Standard Deviation. Applications: Test for significance of a Normal population mean, Test for significance of the difference between two Normal population means: Independent samples with equal variances, Dependent samples.
2	Analysis of Variance (ANOVA)
	F-Distribution: Mean, Mode, and Standard Deviation. Distribution of the reciprocal of an F variate. The ratio of two independent Chi-square variables divided by their respective degrees of freedom. Interrelationships: F-distribution with t-distribution, Chi-square distribution, and Normal distribution. Application: Test for equality of variances of two independent Normal populations Analysis of Variance (ANOVA): Introduction and Uses, Cochran's Theorem (Statement only). One-way classification: Equal and unequal observations per class. Mathematical model, assumptions, expectation of sums of squares. F-test and ANOVA table. Two-way classification: One observation per cell, Mathematical model, assumptions, the expectation of sums of squares, F-test, and ANOVA table. Parameter Estimation: Least square estimators and their expectation and variance, Estimation of treatment contrasts,

1

	Standard Error, and Confidence Limits.
3	Non-Parametric Tests
	Introduction to Non-Parametric Tests: Need for non-parametric tests, Differences
	between parametric and non-parametric tests, Concept of distribution-free statistics.
	Non-Parametric Tests and Applications: Mann–Whitney test, Wilcoxon's signed rank
	test, Kruskal-Wallis ANOVA, Friedman ANOVA, Fisher Exact Test. Assumptions for
	each test and Justification of test procedures for small and large samples.

Practical Work (20 Marks)

List of Practicals to be Conducted	
1	Setting the Hypothesis, Level of Significance, and Power Aim: To formulate null and alternative hypotheses, determine the level of significance, and calculate the power of a statistical test.
2	Large Sample Tests Aim: To conduct large sample tests for a specified population mean, the difference between two population means, a specified population proportion, and the difference between two population proportions.
3	Chi-Square Distribution Aim: To apply the Chi-Square distribution for testing goodness of fit, independence of attributes, and variance of a Normal population.
4	t-Distribution Aim: To perform hypothesis tests for the significance of a population mean and the difference between two population means using the t-distribution, and compute effect size (Cohen's d) for independent and dependent samples.
5	Sampling Distributions Aim: To explore the sampling distributions of sample mean and variance, and their applications in hypothesis testing.
6	F-Distribution and Test for Equality of Variances Aim: To apply the F-distribution for testing the equality of variances of two independent normal populations.
7	One-Way ANOVA Aim: To perform one-way ANOVA to test for differences between multiple groups using equal and unequal observations per class, and understand the assumptions and F-test.
8	Two-Way ANOVA Aim: To conduct two-way ANOVA with one observation per cell, compute the F-test,

	and analyze treatment contrasts.
9	Non-Parametric Tests Aim: To apply non-parametric tests such as Mann–Whitney, Wilcoxon's signed rank, Kruskal-Wallis, and Friedman ANOVA for small and large sample sizes.
10	Resampling Methods Aim: To understand and perform resampling techniques like Permutation Tests and Bootstrap Methods.

Question Paper Pattern (Academic Year: 2025-2026)

Inferential Statistics Semester End Examination and Practical Examination – 100 Marks Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 2) A. Numerical/ Theory Based question B. Numerical/ Theory Based question C. Numerical/ Theory Based question	10 10 10	20
Q2.	Answer the following questions (Any 2) A. Numerical/ Theory Based question B. Numerical/ Theory Based question C. Numerical/ Theory Based question	10 10 10	20
Q3.	Answer the following questions (Any 2) A. Numerical/ Theory Based question B. Numerical/ Theory Based question C. Numerical/ Theory Based question	10 10 10	20
	Total	90	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ M. K. Goon, A. M. Gupta, and B. Dasgupta, Fundamentals of statistics, vol. II, The World Press Private Limited, Calcutta, 1968.
- □ S.C Gupta and V.K. Kapoor, Fundamentals of applied statistics, Sultan Chand & Sons, 2007.
- □ S.C. Gupta and V.K. Kapoor, Fundamentals of mathematical statistics, Sultan Chand & Sons, 2020.
- □ Robert V. Hogg and Elliot A. Tannis, Probability and statistical inference, MacMillan Publishing Co. Inc., 2001.
- □ C.R. Kothari, Research methodology: Methods and techniques, Wiley Eastern Limited, 2019.
- C. Radhakrishna Rao, Linear statistical inference and its applications, Wiley, 1973.

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 3. General Elective/ Open Elective 3.A.a Digitalization of Financial Markets (3 Credits) Semester IV

3. General Elective/ Open Elective	
3.A.a Digitalization of Financial Markets	
	Course Objectives and Course Outcomes
	Course Objectives
CObj 1	To enable learners to define, differentiate from traditional finance, and trace the historical evolution of financial markets.
CObj 2	To understand the drivers, categories, and disruptive potential of Fintech, along with the dynamics of digital marketplaces and platforms.
CObj 3	To evaluate the impact of digitalization on core financial services and understanding the mechanics and implications of digital payments.
CObj 4	To analyze the evolving regulatory landscape governing digital finance, balancing innovation with consumer protection.
CObj 5	To evaluate the cybersecurity risks , data privacy concerns and the ethical considerations surrounding the use of AI and other technologies in finance.
CObj 6	To analyze emerging trends and technologies shaping the future of finance, including the transformation of banking, the application of AI and machine learning.
	Course Outcomes
COut 1	Students are capable of defining, differentiating digital finance from traditional finance.
COut 2	Critically evaluate the key components of the digital finance landscape.
COut 3	Enables students to evaluate the mechanics and implications of digital payments, identifying the associated risks and opportunities.
COut 4	Students can critically assess the evolving regulatory landscape governing digital finance, the challenges of balancing innovation with consumer protection, and maintaining the integrity of the digital financial system.

COut 5	Learners can critically examine the ethical considerations in AI.	
COut 6	To analyze the broader social impact of digitalization on financial inclusion, economic inequality, and access to financial services.	
COut 7	Learners will be able to critically evaluate the challenges and opportunities presented by these advancements and their potential to reshape the financial landscape.	
COut 8	The learner is aware of the tools and methodology involved in digitization concepts.	
COut 9	There is a greater level of financial literacy.	
COut 10	The learner is able to make informed investment decisions.	

Digitalization of Financial Markets			
Sr. No.	Modules	No. of Lectures	
1	Introduction to Digital Finance and Market Evolution	15	
2	Digitalization of Financial Products and Services	15	
3	Digital Transformation and the Future of Finance	15	
	Total 45		

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Modules at a C	Hance
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Sr. No.	Modules		
1	Introduction to Digital Finance and Market Evolution		
	 Introduction: Defining digital finance and its core components, Distinguishing between traditional finance and digital finance, Exploring the historical evolution of financial markets (Money & Capital) and the role of technology in shaping their development, Introducing key concepts like Fintech, Insurtech, and Regtech. The Rise of Fintech: Examining the factors driving the growth of Fintech, Different categories of Fintech companies (e.g., payments, lending, investing, insurance), Analyzing the disruptive potential of Fintech on traditional financial institutions, Challenges and opportunities presented by Fintech innovation. Digital Marketplaces and Platforms: Understanding the concept of digital marketplaces and platforms in finance, Role of online platforms on market access, transparency, efficiency and network effects and platform business models. Data in Financial Markets: Different types of financial data (e.g., market data, economic data, social media data) and challenges of data management, Introducing basic concepts of data analytics and its applications in finance. The Changing Landscape of Financial Regulation: Overview of the regulatory landscape governing digital finance and its challenges, Role of regulators in balancing innovation and consumer protection, Introducing key regulatory concepts like KYC 		
2	Digitalization of Financial Products and Services		
	Digital Payments and Mobile Money: Impact of digital payments on financial inclusion and economic development, Security and privacy considerations related to digital payments.		
	Cryptocurrencies and Blockchain: Introduction to cryptocurrencies like Bitcoin and Ethereum, Understanding the underlying technology of blockchain and its potential applications beyond cryptocurrencies, Central Bank Digital Currencies (CBDCs),		

	High-Frequency Trading, Tokenization of Assets, Security Token Offerings (STOs),			
	Legal and Regulatory Considerations in Tokenized Assets, Risks and opportunities			
	associated with investing in crypto currencies, Concept of decentralized finance (DeFi).			
	Digital Lending and Crowdfunding: Examining the growth and impact of digital			
	lending platforms and crowdfunding platforms, Credit risk assessment and loan			
	management practices in digital lending.			
	Robo-Advisors and Algorithmic Trading: Introduction to robo-advisors and			
	automated investment platforms, Use of algorithms and AI in investment management,			
	Benefits and limitations of algorithmic trading, Risks and Ethical Implications of			
	Algorithmic Trading			
	Insurtech and Digital Insurance: Application of technology in the insurance industry,			
	Impact of Insurtech on traditional insurance models, Use of data analytics and IoT			
	devices in insurance underwriting and claims processing			
3	Digital Transformation and the Future of Finance			
3	Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and			
3	Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting			
3	Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance.			
3	 Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring 			
3	Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional			
3	 Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional banks, Introduction to the concepts of AI and machine learning and their applications in 			
3	Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional banks, Introduction to the concepts of AI and machine learning and their applications in finance, Exploring the use of AI for fraud detection, risk management, and customer			
3	 Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional banks, Introduction to the concepts of AI and machine learning and their applications in finance, Exploring the use of AI for fraud detection, risk management, and customer service. 			
3	 Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional banks, Introduction to the concepts of AI and machine learning and their applications in finance, Exploring the use of AI for fraud detection, risk management, and customer service. The Metaverse and Web 3.0: Introduction to the concepts of the metaverse and Web 			
3	 Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional banks, Introduction to the concepts of AI and machine learning and their applications in finance, Exploring the use of AI for fraud detection, risk management, and customer service. The Metaverse and Web 3.0: Introduction to the concepts of the metaverse and Web 3.0 and their potential implications for financial markets and use of virtual and 			
3	 Digital Transformation and the Future of Finance Cybersecurity and Data Privacy: Understanding the importance of cybersecurity and data privacy in digital finance, Strategies for mitigating these risks and protecting sensitive financial data, Ethical considerations related to the use of AI in finance. The Future of Banking: Impact of digitalization on the banking industry, Exploring the emergence and future trend of digital banks and the transformation of traditional banks, Introduction to the concepts of AI and machine learning and their applications in finance, Exploring the use of AI for fraud detection, risk management, and customer service. The Metaverse and Web 3.0: Introduction to the concepts of the metaverse and Web 3.0 and their potential implications for financial markets and use of virtual and augmented reality in finance, Challenges and opportunities presented by these 			

Question Paper Pattern (Academic Year: 2025-2026)

Digitalization of Financial Markets

Semester End Examination and Internal Evaluation – 100 Marks

Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	55555	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Internal Evaluation - 40 Marks

Method of Evaluation	Marks
Practical Work/Powerpoint presentation/ Quiz	20
Assignment/Projects	20
Total	40

Books and References:

- □ "Flash Boys: A Wall Street Revolt" by Michael Lewis
- □ "Digital Asset Markets: The Definitive Guide to Cryptocurrencies" by Antony Lewis
- □ "The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries" by Susanne Chishti and Janos Barberis
- □ "Quantitative Finance For Dummies" by Steve Bell
- □ "Capital Markets: Institutions, Instruments, and Risk Management" by Frank J. Fabozzi

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 3.General Elective/ Open Elective 3.A.b Family Business Enterprise (3 Credits) Semester IV

3. General Elective/ Open Elective			
3.A.b Family Business Enterprise			
Course Objectives and Course Outcomes			
Course Objectives			
CObj 1	To equip students with the knowledge and skills to effectively manage and lead family businesses in a global context.		
CObj 2	To develop critical thinking and decision-making skills to navigate the unique challenges and opportunities of family-owned enterprises.		
CObj 3	To gain understanding of the complex dynamics between family relationships and business operations in a globalizing world.		
CObj 4	To strategically expand family businesses into new markets and achieve sustainable growth.		
	Course Outcomes		
COut 1	Analyze the distinctive characteristics, strengths, and challenges of family businesses compared to non-family-owned enterprises.		
COut 2	Evaluate and recommend appropriate governance structures for family businesses to ensure effective decision-making and succession planning.		
COut 3	Develop strategies for managing interpersonal dynamics within the family context and minimizing conflict in business operations.		
COut 4	Conduct market research and assess national expansion opportunities for family businesses, considering legal and regulatory complexities.		
COut 5	Design and implement effective succession planning strategies for leadership transition and talent development within the family.		
COut 6	Manage the financial aspects of family businesses, including capital structure, risk management, and financial performance analysis.		

COut 7	Critically evaluate the feasibility and potential challenges of internationalizing family businesses.	
COut 8	Develop cross-cultural competence to navigate diverse business environments and effectively communicate in an international setting.	
COut 9	Identify and manage risks associated with global operations, including currency fluctuations, political instability, and cultural differences.	

Family Business Enterprise			
Sr. No.	Modules	No. of Lectures	
1	Introduction to Family Business	15	
2	Strategic Management in Family Businesses	10	
3	Financial Management & Governance Structures in Family Businesses	10	
4	Growth and Sustainability & Future Trends in Family Business	10	
	45		

Modules at a Glance

Sr. No.	Modules		
1	Introduction to Family Business		
	 Basics: Definition, Importance, Characteristics of Family Businesses Enterprises, Types of Family Businesses (e.g., small businesses, large conglomerates) Dynamics of Family Business: Family Dynamics and Governance, Roles of Family Members in Business, Succession Planning and Leadership Transition, Conflict Resolution within Family Firms, Case studies of real family businesses (both successful and failed) 		
2	Strategic Management in Family Businesses		
	Strategic Planning for Family Enterprises, Business Models and Innovation in Family Firms, Risk Management and Resilience, Family communication styles, Managing family expectations, Impact of family values on business decisions, Emotional challenges of succession, Role of family meetings, Conflicts of interest, Nepotism, Fair employment practices, Role of family values in shaping ethical behavior		
3	Financial Management & Governance Structures in Family Businesses		
	Financial Planning and Control, Funding Options for Family Enterprises, Valuation of Family Businesses, Establishing Governance Frameworks & Best Practices in Family Business Governance, Legal structures for family businesses (e.g., partnerships, limited liability companies), Tax implications, Estate planning, Shareholder agreements, Legal aspects of succession planning and conflict resolution		
4	Growth and Sustainability & Future Trends in Family Business		

Strategies for Growth in Family Businesses, Challenges of Professionalization, Sustainability and Corporate Social Responsibility, Impact of Technology on Family Enterprises, Globalization and Family Business, E-commerce strategies, Digital marketing, Data analytics, Cyber security for family businesses, Family business's methods of leveraging technology for Growth and efficiency, Emerging Trends and Challenges

Note: Small-scale project should be completed by every learner analyzing a local family business related to succession planning or conflict resolution, investment strategies, philanthropy, and family governance structures for wealth preservation.

Question Paper Pattern (Academic Year: 2025-2026)

Family Business Enterprise Semester End Examination and Internal Evaluation – 100 Marks Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	55555	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Internal Evaluation - 40 Marks

Method of Evaluation	Marks
Assignment/ Quiz/ Written Test/ PowerPoint Presentation	20
Individual Small-Scale Project	20
Total	40

Books and References:

- □ "Family Business: Innovative On-Site Strategies for Sustaining Competitive Advantage" by Craig E. Aronoff, John L. Ward, and Stephen L. McClure
- □ "Family Business Succession: Your Roadmap to Continuity" by Daniela Montemerlo
- □ "Family Wars: Classic Conflicts in Family Business and How to Deal with Them" by Grant Gordon and Nigel Nicholson

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 3.General Elective/ Open Elective 3.A.c Robotic Process Automation (3 Credits) Semester IV

3. General Elective/ Open Elective			
3.A.c Robotic Process Automation			
Course Objectives and Course Outcomes			
	Course Objectives		
CObj 1	To understand foundations of Robotic Process Automation		
CObj 2	To introduce the platform interface		
CObj 3	To explore different RPA strategies		
CObj 4	To evaluate and compare different RPA tools		
	Course Outcomes		
COut 1	Learners will be able to clearly define RPA, explain its benefits and limitations compared to traditional automation.		
COut 2	Learners will be able to navigate the UiPath Studio interface, build workflows using control flow activities and various techniques.		
COut 3	Learners will understand RPA project management best practices.		
COut 4	Learners will be able to analyze features and functionalities of different RPA tools.		
COut 5	Learners will gain practical experience by developing and implementing RPA solutions for real-world scenarios.		

	Robotic Process Automation		
Sr. No.	Modules	No. of Lectures	
1	Introduction of RPA and UiPath Studio	15	
2	Building Workflows	15	
3	Strategies and Other RPA Tools	15	
Total		45	

Sr. No.	Modules
1	Introduction of RPA and UiPath Studio
	Basics of RPA, Benefits, Limitations, and comparison to traditional automation, Application of RPA, UiPath Studio Interface Overview, Basic Navigations and workspace components, Data types, Storing information and basic operations, Recording and Playback for User Actions
2	Building Workflows
	Control Flow Activities, Screen Scraping and Data Extraction, Data Entry and Form Filing, Accessing Excel, Manipulating Data in Excel, Error handling and Debugging, Sharing and Exporting Workflows
3	Strategies and Other RPA Tools
	RPA Project Management, Security and Ethical Automation Practices in RPA, Orchestrating Robots, Other Tools for RPA Implementation, Choosing the right RPA Tool

Modules at a Glance

List of Practicals to be Conducted	
1	Install and Explore interface of UiPath Studio
2	Automate Data Entry in Web Form
3	Automate Sending Email Notifications
4	Extract data from Spreadsheets
5	Extract data from PDFs
6	Rename downloaded files
7	Data Cleaning and Validation
8	Download Files from a Website
9	Searching data over the internet and creating a Comparison Table
10	Connect with External APIs

Practical Work (20 Marks)

Question Paper Pattern (Academic Year: 2025-2026)

Robotic Process Automation

Semester End Examination and Practical Examination – 100 Marks

Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ The Robotic Process Automation Handbook A Guide to Implementing RPA Systems, Tom Taulli, Apress Publisher, First Edition, 2020
- □ Robotic Process Automation Management, Technology, Applications, Christian Czarnecki, Peter Fettke, De Gruyter Publisher, First Edition, 2021
- UiPath Associate Certification Guide, Niyaz Ahmed, Lahiru Fernando, Rajaneesh Balakrishnan, Packt Publisher, First Edition, 2022

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 4. Vocational & Skill Enhancement Courses 4.A Skill Enhancement Courses 4.A.a Operating Systems (3 Credits) Semester IV

4. Vocational & Skill Enhancement Courses		
4.A Skill Enhancement Courses		
4.A.a Operating Systems		
Course Objectives and Course Outcomes		
Course Objectives		
CObj 1	To introduce basic concepts and functions of modern operating systems.	
CObj 2	To understand the concept of process, thread management and scheduling.	
CObj 3	To learn the commands used in different operating systems	
CObj 4	To study various Memory Management techniques	
Course Outcomes		
COut 1	Explain the role of Modern Operating Systems.	
COut 2	Apply the concepts of process and thread scheduling.	
COut 3	Illustrate the concept of algorithms in operating system processes.	
COut 4	Implement the concepts of various memory management techniques.	

Modules at a Glance

Operating Systems		
Sr. No.	Modules	No. of Lectures
1	Overview of OS	15
2	Process Management	15
3	Memory Management	15
Total 45		45

Sr. No.	Modules
1	Overview of OS
	Operating System Objectives and Functions, The Evolution of Operating Systems, Developments Leading to Modern Operating Systems, Virtual Machines, Introduction to Linux OS, BASH Shell scripting: Basic shell commands.
2	Process Management
	 Process: Concept of a Process, Process States, Process Description, Process Control Threads: Processes and Threads, Concept of Multithreading, Types of Threads, Thread programming Using Pthreads. Scheduling: Types of Scheduling, Scheduling Algorithms, First Come First Served, Shortest Job First, Priority, Round Robin
3	Memory Management
	Memory Management: Memory Management Requirements, Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Buddy System, Relocation, Paging, Page table structure, Segmentation Virtual Memory: Background, Demand Paging, Page Replacement (FIFO, LRU, Optimal), Allocation of frames, Thrashing

Practical Work (20 Marks)

List of Practicals to be Conducted		
1	Installation of Operating Systems (Linux Distros & Windows)	
2	Linux commands: Working with Directories: a. pwd, cd, absolute and relative paths, ls, mkdir, rmdir,	
	b. file, touch, rm, cp. mv, rename, head, tail, cat, tac, more, less, strings, chmod	
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3	Linux commands: Working with files: a. ps, top, kill, pkill, bg, fg, b. grep, locate, find, locate. c. date, cal, uptime, w, whoami, finger, uname, man, df, du, free, whereis, which. d. Compression: tar, gzip.	
4	Windows (DOS) Commands – 1 a. Date, time, prompt, md, cd, rd, path. b. Chkdsk, copy, xcopy, format, fidsk, cls, defrag, del, move.	
5	Windows (DOS) Commands – 2 a. Diskcomp, diskcopy, diskpart, doskey, echo b. Edit, fc, find, rename, set, type, ver	

Operating Systems Semester End Examination and Practical Examination – 100 Marks Semester IV

A] Semester End Examination (SEE)- 60 Marks

Maximum Marks: 60

Duration: 2 Hours

Note: 1. All questions are compulsory.

2. All questions carry equal marks.

Question No.	Particulars (Nature of Questions)	Marks (Given)	Marks (To be Attempted)
Q1.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
Q2.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5	20
Q3.	Answer the following questions (Any 4) A. Theory/Concept Based question B. Theory/Concept Based question C. Theory/Concept Based question D. Theory/Concept Based question E. Theory/Concept Based question	5 5 5 5 5	20
	Total	75	60

B] Practical Examination - 40 Marks

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

1.	Practical Work	20
2.	Journal	10
3.	Viva Voce	10

Books and References:

- □ Operating System: Internals and Design Principles, William Stallings, Prentice Hall Publisher, Eighth Edition, 2014
- □ Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, John Wiley & Sons, Ninth Edition, 2012
- Linux System Administration, Tom Adelstein and Bill Lubanovic, O'Reilly Media Publisher
- □ Advanced Shell Scripting, Mendel Cooper, Linux Documentation Project
- □ Operating Systems, Harvey M. Deitel, Prentice Hall Publisher

Teaching Pedagogy:

Lectures/ tutorials/ field work/ outreach activities/ project work/ vocational training/ viva/ seminars / term papers/ assignments / presentations / self-study/case studies etc. or a combination of some of these. Sessions shall be interactive in nature to enable peer group learning

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 5. Ability & Value Enhancement Courses/Indian Knowledge System 5.A. Ability Enhancement Course 5.A.a Sanskrit - II (2 Credits) Semester IV

5. Ability & Value Enhancement Courses/Indian Knowledge System		
5.A. Ability Enhancement Course		
5.A.a Sanskrit - II		
Course Objectives and Course Outcomes		
	Course Objectives	
CObj 1	To create curiosity in the minds of learns about the chosen language	
CObj 2	To help the learners understand the need to learn the chosen language	
CObj 3	To introduce learners to the structure of the chosen language	
CObj 4	To understand the richness of Indian selected languages with reference to consonants and vowels	
CObj 5	To understand unique characteristics of the chosen language	
CObj 6	To understand the use of gender and tenses	
CObj 7	To understand the use of idioms and phrases	
CObj 8	To know the various dialects of the chosen language	
CObj 0	To understand the application of technology for communication by alternatively abled	
CObj 10	To understand the need of learning functional languageTo understand the need of learning functional language	
CObj 11	To get familiarized with the literature of the chosen language	
CObj 12	To get familiarized with the literature translated to the chosen language from other languages	
CObj 13	To learn to appreciate the other literary forms of the chosen language	

Course Outcomes		
COut 1	The learner will be curious to learn the chosen language	
COut 2	The learner will be able to understand the need to learn the chosen language	
COut 3	The learner will get familiar with the structure of the chosen language	
COut 4	To understand the richness of Indian selected languages with reference to constants and vowels	
COut 5	To understand unique characteristics of the chosen language	
COut 6	To understand the use of gender and tenses	
COut 7	To understand the use of idioms and phrases	
COut 8	To know the various dialects of the chosen language	
COut 9	To understand the application of technology for communication by alternatively abled	
COut 10	To understand the need of learning functional language	
COut 11	To get familiarized with the literature of the chosen language	
COut 12	To get familiarized with the literature translated to the chosen language from other languages	
COut 13	To learn to appreciate the other literary forms of the chosen language	

Modules at a Glance

Sanskrit - II		
Sr. No.	Modules	No. of Lectures
1	Select Studies in Translated Literature	10
2	Functional and Commercial Language	10
3	Forms of Literary Expressions	10
Total 30		

Sr. No.	Modules	
1	Select Studies in Translated Literature	
	Translated Literature and Cultural Exchange, Review of Translated Literature using Translated Literary work from another language to chosen language. (The choice of the texts should be made by the learner with due discussion with the faculty). Based on this module, internal evaluation shall be done.	
2	Functional and Commercial Language	
	Newspaper reading of the chosen language in the class along with faculty Watching and understanding News channel of the chosen language Translation of often used words in office circulars and government communications Simple conversations in the chosen language Banking and financial terms in the chosen language	
3	Forms of Literary Expressions	
	Appreciation of select forms of literature like Films, Theatre, Performing Arts, Fine Arts The faculty member shall discuss with the learners about the richness of other forms of Literary expressions in chosen language and learn to appreciate the creativity and present the creativity in a lighter form. Also, they are expected to appreciate the cultural dimensions behind it.	

Sanskrit - II Semester End Examination and Internal Evaluation – 50 Marks Semester IV

A] Semester End Examination (SEE)- 30 Marks

Maximum Marks: 30

Duration: 1 Hour

Note: 1. All questions are compulsory.

2. The learners can write answers in the chosen language or in English/ Marathi/ Hindi.

Question No.	Particulars (Nature of Questions)	Marks
Questions with sub questions	Flexibility is given to the faculty to decide the paper pattern and depending on learners ability will design the question paper. It can contain questions like identifying or changing gender, identifying or changing tenses, making rhythmic words, answer in one sentence etc.	30
	Total	30

B] Internal Evaluation - 20 Marks

The faculty will decide the means of taking internal evaluation. It can be oral quiz, dialogue exchange, role play, reading comprehension, listening comprehension etc.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 5. Ability & Value Enhancement Courses/Indian Knowledge System 5.A. Ability Enhancement Course 5.A.b Marathi - II (2 Credits) Semester IV

5. Ability & Value Enhancement Courses/Indian Knowledge System			
5.A. Ability Enhancement Course			
5.A.b Marathi - II			
	Course Objectives and Course Outcomes		
	Course Objectives		
CObj 1	To create curiosity in the minds of learns about the chosen language		
CObj 2	To help the learners understand the need to learn the chosen language		
CObj 3	bj 3 To introduce learners to the structure of the chosen language		
CObj 4	To understand the richness of Indian selected languages with reference to consonants and vowels		
CObj 5	5 To understand unique characteristics of the chosen language		
CObj 6	Dbj 6To understand the use of gender and tenses		
CObj 7	To understand the use of idioms and phrases		
CObj 8	To know the various dialects of the chosen language		
CObj 0	To understand the application of technology for communication by alternatively abled		
CObj 10	CObj 10 To understand the need of learning functional languageTo understand the need of learning functional language		
CObj 11	To get familiarized with the literature of the chosen language		
CObj 12	To get familiarized with the literature translated to the chosen language from other languages		
CObj 13	To learn to appreciate the other literary forms of the chosen language		

Course Outcomes		
COut 1	The learner will be curious to learn the chosen language	
COut 2	The learner will be able to understand the need to learn the chosen language	
COut 3	The learner will get familiar with the structure of the chosen language	
COut 4	To understand the richness of Indian selected languages with reference to constants and vowels	
COut 5	To understand unique characteristics of the chosen language	
COut 6	To understand the use of gender and tenses	
COut 7	To understand the use of idioms and phrases	
COut 8	To know the various dialects of the chosen language	
COut 9	To understand the application of technology for communication by alternatively abled	
COut 10	To understand the need of learning functional language	
COut 11	To get familiarized with the literature of the chosen language	
COut 12	To get familiarized with the literature translated to the chosen language from other languages	
COut 13	To learn to appreciate the other literary forms of the chosen language	

Modules at a Glance

Marathi - II		
Sr. No.	Modules	No. of Lectures
1	Select Studies in Translated Literature	10
2	Functional and Commercial Language	10
3	Forms of Literary Expressions	10
Total 30		

Sr. No.	Modules	
1	Select Studies in Translated Literature	
	Translated Literature and Cultural Exchange, Review of Translated Literature using Translated Literary work from another language to chosen language. (The choice of the texts should be made by the learner with due discussion with the faculty). Based on this module, internal evaluation shall be done.	
2	Functional and Commercial Language	
	Newspaper reading of the chosen language in the class along with faculty Watching and understanding News channel of the chosen language Translation of often used words in office circulars and government communications Simple conversations in the chosen language Banking and financial terms in the chosen language	
3	Forms of Literary Expressions	
	Appreciation of select forms of literature like Films, Theatre, Performing Arts, Fine Arts The faculty member shall discuss with the learners about the richness of other forms of Literary expressions in chosen language and learn to appreciate the creativity and present the creativity in a lighter form. Also, they are expected to appreciate the cultural dimensions behind it.	

Marathi - II Semester End Examination and Internal Evaluation – 50 Marks Semester IV

A] Semester End Examination (SEE)- 30 Marks

Maximum Marks: 30

Duration: 1 Hour

Note: 1. All questions are compulsory.

2. The learners can write answers in the chosen language or in English/ Marathi/ Hindi.

Question No.	Particulars (Nature of Questions)	Marks
Questions with sub questions	Flexibility is given to the faculty to decide the paper pattern and depending on learners ability will design the question paper. It can contain questions like identifying or changing gender, identifying or changing tenses, making rhythmic words, answer in one sentence etc.	30
	Total	30

B] Internal Evaluation - 20 Marks

The faculty will decide the means of taking internal evaluation. It can be oral quiz, dialogue exchange, role play, reading comprehension, listening comprehension etc.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 5. Ability & Value Enhancement Courses/Indian Knowledge System 5.A. Ability Enhancement Course 5.A.c Hindi - II (2 Credits) Semester IV

5. Ability & Value Enhancement Courses/Indian Knowledge System				
5.A. Ability Enhancement Course				
5.A.c Hindi - II				
	Course Objectives and Course Outcomes			
	Course Objectives			
CObj 1	To create curiosity in the minds of learns about the chosen language			
CObj 2	To help the learners understand the need to learn the chosen language			
CObj 3	To introduce learners to the structure of the chosen language			
CObj 4	To understand the richness of Indian selected languages with reference to consonants and vowels			
CObj 5	To understand unique characteristics of the chosen language			
CObj 6	To understand the use of gender and tenses			
CObj 7	To understand the use of idioms and phrases			
CObj 8	To know the various dialects of the chosen language			
CObj 9	To understand the application of technology for communication by alternatively abled			
CObj 10	To understand the need of learning functional languageTo understand the need of learning functional language			
CObj 11	To get familiarized with the literature of the chosen language			
CObj 12	To get familiarized with the literature translated to the chosen language from other languages			
CObj 13	To learn to appreciate the other literary forms of the chosen language			

Course Outcomes			
COut 1	The learner will be curious to learn the chosen language		
COut 2	The learner will be able to understand the need to learn the chosen language		
COut 3	The learner will get familiar with the structure of the chosen language		
COut 4	To understand the richness of Indian selected languages with reference to constants and vowels		
COut 5	To understand unique characteristics of the chosen language		
COut 6	To understand the use of gender and tenses		
COut 7	To understand the use of idioms and phrases		
COut 8	To know the various dialects of the chosen language		
COut 9	To understand the application of technology for communication by alternatively abled		
COut 10	To understand the need of learning functional language		
COut 11	To get familiarized with the literature of the chosen language		
COut 12	To get familiarized with the literature translated to the chosen language from other languages		
COut 13	To learn to appreciate the other literary forms of the chosen language		

Modules at a Glance

Hindi - II			
Sr. No.	Modules	No. of Lectures	
1	Select Studies in Translated Literature	10	
2	Functional and Commercial Language	10	
3	Forms of Literary Expressions	10	
	30		

Sr. No.	Modules		
1	Select Studies in Translated Literature		
	Translated Literature and Cultural Exchange, Review of Translated Literature using Translated Literary work from another language to chosen language. (The choice of the texts should be made by the learner with due discussion with the faculty). Based on this module, internal evaluation shall be done.		
2	Functional and Commercial Language		
	Newspaper reading of the chosen language in the class along with faculty Watching and understanding News channel of the chosen language Translation of often used words in office circulars and government communications Simple conversations in the chosen language Banking and financial terms in the chosen language		
3	Forms of Literary Expressions		
	Appreciation of select forms of literature like Films, Theatre, Performing Arts, Fine Arts The faculty member shall discuss with the learners about the richness of other forms of Literary expressions in chosen language and learn to appreciate the creativity and present the creativity in a lighter form. Also, they are expected to appreciate the cultural dimensions behind it.		

Hindi - II Semester End Examination and Internal Evaluation – 50 Marks

Semester IV

A] Semester End Examination (SEE)- 30 Marks

Maximum Marks: 30

Duration: 1 Hour

Note: 1. All questions are compulsory.

2. The learners can write answers in the chosen language or in English/ Marathi/ Hindi.

Question No.	Particulars (Nature of Questions)	Marks
Questions with sub questions	Flexibility is given to the faculty to decide the paper pattern and depending on learners ability will design the question paper. It can contain questions like identifying or changing gender, identifying or changing tenses, making rhythmic words, answer in one sentence etc.	30
	Total	30

B] Internal Evaluation - 20 Marks

The faculty will decide the means of taking internal evaluation. It can be oral quiz, dialogue exchange, role play, reading comprehension, listening comprehension etc.

Syllabus of courses of SYBSc (Data Science & Analytics) Programme (With effect from the Academic Year 2025-2026) 6. Internship/Field Project / Research Project / Community Engagement 6.A.a Foundation of Research Skills - II (2 Credits) Semester IV

6. Internship/Field Project / Research Project / Community Engagement				
6.A.a Foundation of Research Skills - II				
Course Objectives and Course Outcomes				
	Course Objectives			
CObj 1				
CObj 2				
CObj 3				
CObj 4				
CObj 5				
	Course Outcomes			
COut 1				
COut 2				
COut 3				
COut 4				
COut 5				

AC: 10/03/2025

CRITERIA FOR EVALUATING POWERPOINT PRESENTATION/ CASE STUDY/ APPLICATION BASED ACTIVITY:

MARKS:	20
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FY/SY/TY BSc: Division A/B

Semester:

Name o	f the Top	c Date	e of Preser	ntation:			
Sr No.	DallNa		Content	Team	Presentation skills		Total (20)
Sr. No	(5)	(5)	building (5)	Verbal (5)	Non Verbal (5)		
1							
2							
3							
4 Sign: 1		2. 3. 4. Faculty S	ign:			<u> </u>	
Name o	f the Top	c Da	te of Prese	entation:			
					Presentation skills		
Sr. No R	Roll No	Il No Name of the student	Content (5)	Team building (5)	Verbal (5)	Non Verbal (5)	Total (20)
1							
2							
3							
4							
Sign: 1_		34Faculty S	ign:				
Name o	of the Top	c Da	te of Prese	entation:			
			Content (5)	Team building (5)	Presentation skills		
Sr. No	Roll No Name of the student	Verbal (5)			Non Verbal (5)	Total (20)	
1							
2							
3							
4							
Sign: 1_		34Faculty S	ign:				