

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati.
(Empowered Autonomous)
SYLLABUS STRUCTURE of
Bachelor of Business Administration (Computer Application)
Syllabus (CBCS Pattern) under Academic Autonomy for the year 2024-2025
T.Y.BBA (CA) (2022-Pattern)

Semester –V (w.e.f.A.Y.2024-2025)

Subject Code	Subject Name	Credit
UBCA351	Android Application Programming	03
UBCA352	.Net Programming	03
UBCA353A UBCA353B	Elective: Cloud Computing Internet of Things	03
UBCA354A UBCA354B	Elective: Digital Marketing Machine Learning	03
UBCA355	Project	04
UBCA356	Computer Laboratory I [Based on UBCA351]	02
UBCA357	Computer Laboratory II [Based on UBCA352]	02
UBCA358	Computer Laboratory III [Based on UBCA353A]	02
Total		22

Semester –VI (w.e.f.A.Y.2024-2025)

Subject Code	Subject Name	Credit
UBCA361	Data Analytics using Python	03
UBCA362	NOSQL Databases	03
UBCA363A UBCA363B	Elective: Big Data Block Chain	03
UBCA364A UBCA364B	Elective: Data Mining Deep Learning	03
UBCA365	Project	04
UBCA366	Computer Laboratory I [Based on UBCA361]	02
UBCA367	Computer Laboratory II [Based on UBCA362]	02
	Certificate Course	02
Total		22

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) (w. e. from June, 2024)

Academic Year 2024-2025

Class : T.Y.BBA (C.A.) (Semester – VI)

Paper Code : UBCA361

Title of Paper: Data Analytics using Python

Credit: 3

No. of. Lectures: 48

A] Course Objective:

1. To develop relevant Programming abilities.
2. To demonstrate Proficiency with Statistical Analysis of Data.
3. To develop the ability to build and Assess Data-based Models.
4. To demonstrate Skill in Data Management.
5. To apply Data Science Concepts and Methods to solve Problems in real-world contexts and will Communicate these solutions effectively

B] Course Outcome:

By the end of course, students will be able to-

- CO1.** Demonstrate proficiency in using Python for data analytics.
- CO2.** Develop effective data visualization skills for conveying insights.
- CO3.** Effectively communicate insights through charts, graphs, and plots.
- CO4.** Apply statistical methods to analyze and interpret data.
- CO5.** Clean and preprocess data to handle missing values and outliers.
- CO6.** Apply simple machine learning algorithms for tasks like regression and classification.
- CO7.** Apply learned skills to a real-world data analytics project.

Topic/Contents

Unit 1:	Introduction to Data Science and Basics of Data	(12L)
	1.1 What is Data Science?	
	1.2 Data Science Process	
	1.3 Stages in Data Science Project	
	1.4 Basics of Data Analytics	
	1.5 Types of Analytics – Descriptive, Predictive, Prescriptive	
	1.6 Statistical Inference	
	1.7 Populations and Samples	
	1.8 Statistical Modelling	
	1.9 Probability	
	1.10 Distribution	
	1.11 Correlation	
	1.12 Regression	
Unit 2:	Introduction to Machine Learning	(12L)
	2.1 Basics of Machine Learning	
	2.2 Supervised Machine Learning K- Nearest- Neighbours, Naïve Bayes Decision Tree Support Vector Machines	
	2.3 Unsupervised Machine Learning, Cluster Analysis, Kmeans, Association Rule Mining	
	2.4 Apriori Algorithms	
	2.5 Regression Analysis, Linear Regression, Nonlinear Regression	
Unit 3:	Data Analytics with Python Programming Numpy	(12L)
	3.1 Arrays	
	3.2 Array indexing	
	3.3 Datatypes	
	3.4 Array math o Broadcasting	
	3.5 SciPy	
	3.6 Image Operations	
	3.7 Distance between Point	
	3.8 Data Analysis and Manipulation using Pandas- Importing Data Creating A Data Frame Data Frame Methods Indexing Data Frames Boolean Indexing Indexing Using Labels Multi-Indexing Merge Data Frames Sorting Data Frames Apply Function Pivot Table Crosstab Iterating over rows of a Data Frame	

Unit 4: **Data Visualization** (12L)

- 4.1 Basic Principles
- 4.2 Ideas and tools for Data Visualization Graph
- 4.3 Visualization Methods
- 4.4 Tree Visualization
- 4.5 Scikit Package
- 4.6 matplotlib Library
- 4.7 Plotting
- 4.8 Subplots Image

Reference Books:

1. Applied statistics and probability for engineers. Montgomery, Douglas C., and George C. Runger. John Wiley & Sons, 2010
2. Scaling up Machine Learning to White “Hadoop: The Definitive Guide” Third Edition, Bekkerman et al., O’reilly Media, 2012.
3. “Mining of Massive Datasets”, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.
5. Developing Analytic Talent: Becoming a Data Scientist, Vincent Granville wiley, 2014
4. The elements of statistical learning. Hastie, Trevor, et al., Vol.

Class: TYBBA (C.A) (Sem VI)

Subject: BBA (C.A)

Course: Data Analytics using Python

Course Code: UBCA361

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
CO 1	3	3	-	2	3	-	2	2	2	2	3
CO 2	3	3	2	-	3	-	2	3	1	3	3
CO 3	3	3	2	2	3	1	2	2	1	3	3
CO 4	3	3	3	2	3	-	2	3	1	3	3
CO 5	3	3	3	3	3	-	2	3	1	2	3
CO 6	3	3	-	-	3	-	2	2	2	2	3
CO 7	3	3	-	2	3	-	3	2	3	3	3

PO1. Knowledge:

All COs contribute to developing students' disciplinary knowledge in Python and other tools for data analytics. CO1 to CO4 is strongly mapped as the student will develop a deep understanding of Data Analytics concepts using Python.

PO2. Problem Analysis:

CO1 to CO7 Contribute to developing students' problem-analysis, thinking skills, and problem-solving skills. It is moderately mapped as the students apply their knowledge to understand Effective data visualization.

PO3. Design and Development:

CO4 & CO5 are strongly mapped as the students will be able to develop or design the ML Models for solving real-life problems.

PO4. Conduct investigations of complex problems:

CO5 is strongly mapped as students will be able to conduct the investigation of real word data and design and develop Machine learning Models CO1 CO3 CO4 CO7 Moderately mapped as the students will apply and manipulate the Dataframe, Series, and Data Visualization concepts.

PO5. Modern Tool Usage:

All CO's strongly mapped students will use Python Sklearn, Pandas, and OpenCV library for modern computational development.

PO7. Individual and Team Work:

CO7 is strongly mapped Working on a real-world project often involves both individual and team efforts, integrating various skills and knowledge areas.

PO8. Life-Long Learning:

CO5 is strongly mapped as it contributes to the development of students' ability to engage in life-long learning as real-life Problems by using Data Analytics skills.

PO9. Project Management:

CO7 is strongly mapped as students can create software and provide solutions using Data Analytics tools.

PO10. Communication:

CO2 CO3 CO4 CO7 are strongly mapped and necessary to communicate the results and performance of machine learning models.

PO11. Innovation, employability, and Entrepreneurial skills:

All COs are strongly related to employability skills as students can analyze problems and design ML models

**SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) (w. e. from
June, 2024)**

Academic Year 2024-2025

Class : T.Y.BBA (C.A.) (Semester - VI)

Paper Code : UBCA362

Title of Paper: NOSQL Databases

Credit: 3

No. of. Lectures: 48

A] Course Objectives:

1. Understand the importance of NoSQL Databases by exploring their role in handling large-scale, distributed, and unstructured data.
2. Learn various MongoDB commands to efficiently manage and query data within a NoSQL environment.
3. Recognize MongoDB design goals to grasp its emphasis on scalability, flexibility, and performance.
4. Design basic databases using MongoDB by applying fundamental principles and best practices in NoSQL architecture.
5. Create general-purpose databases in MongoDB that can cater to diverse application requirements and data models.
6. Explore the significance of NoSQL Databases in modern data-driven applications and cloud environments.
7. Master MongoDB commands to effectively implement and optimize NoSQL databases for real-world scenarios

B] Course Outcome:

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

- CO1.** Mastered the use of MongoDB shell and tools for efficient database management and interaction.
- CO2.** Developed skills in Schema design and Data modeling to structure and organize data effectively in MongoDB.
- CO3.** Proficient in performing CRUD operations within a MongoDB environment, ensuring robust data handling.

- CO4.** Gained expertise in optimizing query performance to enhance the efficiency of database queries and operations.
- CO5.** Acquired the ability to analyze data stored in MongoDB, enabling informed decision-making and insights.
- CO6.** Learned to leverage MongoDB tools for managing and scaling NoSQL databases in real-world applications.
- CO7.** Enhanced understanding of data management principles in NoSQL databases, focusing on performance, scalability, and flexibility.

Topic/Contents

Unit 1:	Introduction to NOSQL	(10L)
	1.1 Definition of NOSQL 1.2 History of NOSQL and different NOSQL Products 1.3 Exploring Mongo DB java 1.4 Exploring Mongo DB Ruby/Python 1.5 Interfacing and Interacting with NOSQL	
Unit 2:	NOSQL Basics	(10L)
	2.1 Understanding the NOSQL Architecture 2.2 Performing CRUD operations 2.3 Querying NOSQL Stores 2.4 Modifying Data Stores and Managing Evolution 2.5 Indexing and Ordering 2.6 Datasets.	
Unit 3:	Advanced NOSQL	(09L)
	3.1 NOSQL in Cloud 3.2 Parallel Processing with Map Reduce 3.3 Big Data with Hive	
Unit 4:	Working with NOSQL	(09L)
	4.1 Surveying Database 4.2 Migrating from RDBMS to NOSQL 4.3 Web Frameworks and NOSQL 4.4 Using MYSQL as a NOSQL	
Unit 5:	MongoDB Index and Aggregation	(10L)
	5.1 Index Introduction, Index Concepts, Index Types, Index Properties 5.2 Index Creation and Indexing Reference 5.3 Introduction to Aggregation 5.4 Approach to Aggregation 5.5 Types of Aggregation (Pipeline, MapReduce & Single Purpose)	

5.6 Performance Tuning.

Reference Books:

1. MongoDB Basics by Peter Membrey, David Hows, Eelco Plugge.
2. MongoDB Recipes With Data Modeling and Query Building Strategies by Subhashini Chellappan, Dharanitharan Ganesan, MongoDB Simply In Depth by Ajit Singh, Sultan Ahmad.
3. MongoDB Simply In Depth by Ajit Singh, Sultan Ahmad.

Class: TYBBA (C.A) (Sem VI)

Subject: BBA (C.A)

Course: NOSQL Databases

Course Code: UBCA362

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3				3						
CO 2	3		3		3						
CO 3	3		3		3						
CO 4		3	3		3						
CO 5	3			3					3		
CO 6					3				3		
CO 7	3		3					3			

PO1. Knowledge:

CO1, CO2, CO3, CO5, and CO7 are strongly mapped as Mastering MongoDB tools requires both fundamental understanding and application of modern technologies.

PO2.Problem Analysis:

CO4 is strongly mapped as optimizing query performance involves problem analysis, designing efficient solutions, and using modern tools. Schema design is a fundamental skill in organizing data, which directly relates to creating efficient solutions and leveraging modern tools.

PO3.Design and Development:

CO2, CO3, CO4, and CO7 are strongly mapped as CRUD operations are fundamental to handling data, involving system design and the usage of modern tools.

PO4.Conduct investigations of complex problems:

CO5 is strongly mapped as data analysis involves investigating and interpreting data, applying core knowledge, and managing projects.

PO5.Modern Tool Usage:

CO1, CO2, CO3, CO4, and CO6 are strongly mapped as scaling databases for real-world applications that integrate tool proficiency, project management, and entrepreneurial thinking.

PO8.Life-Long Learning:

CO7 is strongly mapped as understanding data management principles emphasizes continuous learning and the design of scalable systems.

PO9. Project Management:

CO5 and CO6 are strongly mapped as scaling databases for real-world applications that integrate tool proficiency, project management, and entrepreneurial thinking.

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) ((w. e. from June, 2024)

Academic Year 2024-2025

Class : T.Y.BBA (C.A.)

(Semester - VI) Paper Code : UBCA363A

Title of Paper: Big Data

Credit: 3

No. of. Lectures: 48

A] Course Objectives:

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop
3. Provide HDFS Concepts and Interfacing with HDFS
4. Understand Map Reduce Jobs
5. Provide Exposure to Data Analytics with R.
6. To explore various techniques for mining data stream.
7. To gain knowledge of key big data technologies and frameworks such as Hadoop and NoSQL databases, and how they are applied in processing and analyzing large datasets.

B] Course Outcome:

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

CO1. Understand Big Data and Data analysis.

CO2. Understand the role of Hadoop in distributed storage and processing

CO3. Comprehend the principles of distributed computing and understand how distributed computing is applied in Big Data systems.

CO4. Access and Process Data on Distributed File System Manage Job Execution in Hadoop Environment.

CO5. To give the practical enhancement of visualization techniques.

CO6. Explore storage solutions for Big Data, including distributed file systems.

CO7. Learn about technologies that enable real-time data processing.

Topic/Contents

Unit 1:	Introduction to Big Data	(10L)
	1.1 Introduction to Big Data	
	1.2 Types of Digital Data	
	1.3 Big Data Analytics	
	1.4 Application of Big Data	
Unit 2:	Big Data Processing	(15L)
	2.1 Big Data Technologies	
	2.2 Google File System	
	2.3 Hadoop Eco System	
	2.4 Hadoop Architecture	
	2.5 Hadoop Storage: HDFS	
	2.6 Hadoop Shell Commands	
	2.7 HDFS Read Write Operations, Name Node, Secondary Name Node and Data Node, MapReduce Job, Task Tracker	
Unit 3:	HIVE QL	(10L)
	3.1 Data Types and File Formats	
	3.2 Databases in Hive	
	3.3 Hive QL:	
	3.3.1 Data Definition	
	3.3.2 Data Manipulation	
	3.3.3 Queries	
	3.3.4 Views	
	3.3.5 Indexes	
	3.3.6 Schema Design	
Unit 4:	Data Analysis Using R And Hadoop	(13L)
	4.1 Features of R language	
	4.2 Architecture of RHIPE	
	4.3 RHIPE function reference	
	4.4 Architecture of R Hadoop	
	4.5 R Hadoop function reference	

Reference Book:

1. Scaling up Machine Learning to White “Hadoop: The Definitive Guide” Third Edition, Bekkerman et al., O’reilly Media, 2012.
2. “Mining of Massive Datasets”, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.
3. Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
4. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
5. Prajapati, V. Big data analytics with R and Hadoop. Packt Publishing Ltd, 2013.

Class: TYBBA (C.A) (Sem VI)

Subject: BBA (C.A)

Course: Big Data

Course Code: UBCA363A

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3										
CO 2	3										
CO 3	3										
CO 4		2									
CO 5			3		3						
CO 6					3			3			
CO7									3		3

PO1. Knowledge:

CO1 CO2 CO3 are strongly mapped as they contribute to the development of students' disciplinary knowledge also Proficiency as it involves the foundational understanding of big data and data analysis concepts.

PO2. Problem Analysis:

CO4 is strongly mapped as it involves practical skills in accessing and processing data in a distributed file system and managing job execution in a Hadoop environment.

PO3. Design and Development:

CO5 is strongly mapped as the students will be able to develop effective data visualization skills and apply different techniques.

PO5. Modern Tool Usage:

CO5 CO6 is moderately mapped it involves the practical application of visualization techniques to enhance the understanding and interpretation of data using different tools.

PO8. Life-Long Learning:

CO6 is strongly mapped as it contributes to the development of students' ability to engage in life-long learning. Its goal is to produce graduates who can work with real-world data.

PO9.Project Management:

CO7 is moderately mapped as students can create models with real-world data.

PO11. Innovation, employability, and Entrepreneurial skills:

CO7 strongly relates to employability skills as students can prepare real-world applications of big data. It helps to learn about technologies that enable real-time data processing, which is crucial in team-based projects in the context of big data systems.

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) ((w. e. from June, 2024)

Academic Year 2024-2025

Class: T.Y.BBA (C.A.) (Semester - VI)

Paper Code: UBCA363B

Title of Paper: Blockchain

Credit: 3

No. of. Lectures: 48

A] Course Objectives:

1. Understand the fundamental principles of Blockchain technology.
2. Explore the architecture and components of Blockchain.
3. Gain knowledge of various consensus algorithms and smart contracts.
4. Understand the role of cryptography in securing Blockchain networks.
5. Analyze the application of Blockchain in various industries.
6. Examine the challenges and future trends in Blockchain technology.
7. Develop practical skills in implementing and deploying Blockchain solutions.

B] Course Outcome:

By the end of course, students will be able to-

- CO1:** Understand the concept of Blockchain and its importance in decentralized systems.
- CO2:** Analyze the architecture of Blockchain and the role of each component.
- CO3:** Comprehend different consensus mechanisms and their application in Blockchain.
- CO4:** Utilize cryptographic techniques to secure Blockchain transactions.
- CO5:** Design and implement smart contracts using relevant programming languages.
- CO6:** Explore real-world applications of Blockchain in finance, supply chain, healthcare, and other sectors.
- CO7:** Identify and address the challenges and future directions of Blockchain technology.

Topic/Contents		
Unit 1:	Introduction to Blockchain Technology	(06L)
	1.1 Introduction to Blockchain	
	1.2 History and Evolution of Blockchain	
	1.3 Characteristics of Blockchain	
	1.4 Types of Blockchain: Public, Private, Consortium	
	1.5 Applications of Blockchain Technology	
Unit 2:	Blockchain Architecture	(12L)
	2.1 Blockchain Components: Blocks, Chains, Nodes, and Networks	
	2.2 Cryptography in Blockchain: Hash Functions, Digital Signatures	
	2.3 Distributed Consensus Mechanisms: Proof of Work, Proof of Stake, Delegated Proof of Stake, Practical Byzantine Fault Tolerance	
	2.4 Blockchain Platforms: Bitcoin, Ethereum, Hyperledger	
Unit 3:	Introduction to Bitcoin	(10L)
	3.1 Currency	
	3.2 Double Spending	
	3.3 Cryptocurrency	
	3.4 P2P Payment Gateway	
	3.5 Wallet	
	3.6 Mining	
Unit 4:	Cryptography and Security in Blockchain	(12L)
	4.1 Fundamentals of Cryptography: Symmetric and Asymmetric Encryption	
	4.2 Public Key Infrastructure (PKI) and Blockchain	
	4.3 Cryptographic Hash Functions: SHA-256, Merkle Trees	
	4.4 Securing Blockchain Networks: Attack Vectors and Mitigation Strategies	
Unit 5:	Applications and Future Trends of Blockchain	(08L)
	5.1 Blockchain in Finance: Cryptocurrencies, Digital Assets, DeFi	
	5.2 Blockchain in Supply Chain Management	
	5.3 Blockchain in Healthcare and Identity Management	
	5.4 Challenges in Blockchain Adoption: Scalability, Interoperability, Regulatory Issues	

Reference Books:

1. **"Mastering Blockchain"** by Imran Bashir, Packt Publishing, 2017.
2. **"Blockchain Basics: A Non-Technical Introduction in 25 Steps"** by Daniel Drescher, Apress, 2017.
3. **"Blockchain: Blueprint for a New Economy"** by Melanie Swan, O'Reilly Media, 2015.
4. **"Solidity Programming Essentials"** by Ritesh Modi, Packt Publishing, 2018.
5. **"Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World"** by Don Tapscott and Alex Tapscott, Penguin, 2016.
6. **"Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions"** by Joseph J. Bambara, Paul R. Allen, McGraw-Hill Education, 2018.

Class: TYBBA (C.A) (Sem VI)

Subject: BBA (C.A)

Course: Blockchain

Course Code: UBCA363B

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3										
CO 2	3										
CO 3		2		3							
CO 4	3							2			
CO 5		3									
CO 6	3				3						
CO7									3		

PO1. Knowledge:

CO1 CO2 CO4 CO6 are strongly mapped as they contribute to developing students' disciplinary knowledge and involve the foundational understanding of blockchain technology, which is fundamental to the discipline.

PO2. Problem Analysis:

CO3 CO5 is moderately mapped as the Students will be able to explore and understand emerging technologies relevant to blockchain development.

PO4. Conduct investigations of complex problems:

CO3 is strongly mapped as students will be able to investigate real-world data as it involves the application of knowledge to assess and choose consensus mechanisms in blockchain networks.

PO5. Modern Tool Usage:

CO6 is moderately mapped it involves communication skills and the ability to convey complex technical concepts to diverse audiences, which is essential for collaboration in the field.

PO8. Life-Long Learning:

CO4 is strongly mapped as it contributes to developing students' ability to engage in life-long learning. Its goal is to produce graduates who can work with real-world data.

PO9. Project Management:

CO7 is moderately mapped as students can create models with real-world data.

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) ((w. e. from June, 2024)

Academic Year 2024-2025

Class: T.Y.BBA (C.A.) (Semester - VI)

Paper Code: UBCA364A

Title of Paper: Data Mining

Credit: 3

No. of. Lectures: 48

A] Course Objectives:

1. Understand the fundamentals of data mining and its significance in various domains.
2. Provide an overview of data pre-processing techniques and methods.
3. Explore various data mining techniques including classification, clustering, and association.
4. Introduce advanced topics such as text mining, web mining, and social network analysis.
5. Provide hands-on experience with data mining tools and software.
6. Develop an understanding of evaluating and interpreting data mining results.
7. Gain knowledge of ethical considerations in data mining and data privacy issues.

B] Course Outcome:

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

- CO1:** Understand the basic concepts and techniques of data mining.
- CO2:** Apply data preprocessing techniques to clean and prepare data for analysis.
- CO3:** Utilize classification and prediction techniques to identify patterns in data.
- CO4:** Implement clustering techniques to discover natural groupings in data.
- CO5:** Analyze data using association rule mining and understand its applications.
- CO6:** Apply advanced data mining techniques such as text mining and web mining.
- CO7:** Evaluate data mining models and interpret results effect.

Topic/Contents		
Unit 1:	Introduction to Data Mining	(04L)
	1.1 Overview of Data Mining	
	1.2 Data Mining vs. Database Management Systems	
	1.3 Data Mining Functionalities	
	1.4 Applications of Data Mining	
	1.5 Challenges	
Unit 2:	Data Preprocessing	(08L)
	2.1 Data Cleaning, Data Integration, Data Transformation	
	2.2 Data Reduction Techniques	
	2.3 Discretization and Concept Hierarchy Generation	
	2.4 Data Pre-processing for Mining	
Unit 3:	Classification	(12L)
	3.1 Introduction to Classification	
	3.2 Decision Tree	
	3.3 Bayesian Classification	
	3.4 Rule-Based Classification	
	3.5 Nearest Neighbour Classifiers	
	3.6 Neural Networks for Classification	
	3.7 Model Evaluation and Selection	
Unit 4:	Clustering Techniques	(10L)
	4.1 Introduction to Clustering	
	4.2 Partitioning Methods: K-means, K-medoids	
	4.3 Hierarchical Methods: Agglomerative, Divisive	
	4.4 Density-Based Methods: DBSCAN, OPTICS	
	4.5 Evaluation of Clustering Methods	
Unit 5:	Association Rule Mining	(08L)
	5.1 Introduction to Association Rules	
	5.2 Apriori Algorithm	
	5.3 Frequent Pattern Growth (FP-Growth)	
	5.4 Mining Multilevel and Multidimensional Association Rules	
	5.5 Applications of Association Rule Mining	

Reference Books:

1. "Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei, 3rd Edition, Morgan Kaufmann, 2011.
2. "Introduction to Data Mining" by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, 1st Edition, Pearson Education, 2005.
3. "Principles of Data Mining" by David Hand, Heikki Mannila, and Padhraic Smyth, MIT Press, 2001.
4. "The Elements of Statistical Learning: Data Mining, Inference, and Prediction" by Trevor Hastie, Robert Tibshirani, and Jerome Friedman, 2nd Edition, Springer, 2009.
5. "Data Mining Techniques" by Arun K. Pujari, University Press, 2nd Edition, 2010.

Class: TYBBA (C.A) (Sem VI)**Subject:** BBA (C.A)**Course:** Data Mining**Course Code:** UBCA364A**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3										
CO 2										2	
CO 3	3				2						
CO 4			3								
CO 5			3	3							
CO 6		3									
CO 7		3	3					3			3

PO1. Knowledge:

CO1 CO3 is strongly mapped as it involves foundational knowledge of data mining concepts, which is fundamental to the discipline.

PO2. Problem Analysis:

CO6 CO7 is moderately mapped as analyzing a problem and identifying computing requirements appropriate to its solution.

PO3. Design and Development:

CO4 CO5 CO7 is strongly mapped as it involves designing, training, and evaluating models, which is an experimental and analytical process. CO7 applies data mining techniques in a practical context to solve real-world problems, often requiring collaboration within a team.

PO4. Conduct investigations of complex problems:

CO5 is strongly mapped as students will be able to conduct the investigation of real-world data and design and develop models using regression classification.

PO5. Modern Tool Usage:

CO3 is moderately mapped as it involves the practical skills of preparing and cleaning data, which is essential for successful data mining.

PO8. Life-Long Learning:

CO7 is strongly mapped as it contributes to the development of students' ability to engage in life-long learning. Its goal is to produce graduates who can work with real-world data.

PO10. Communication:

CO2 is moderately mapped as it involves understanding the role and significance of data mining in addressing complex problems related to large datasets.

PO11. Innovation, employability, and Entrepreneurial skills:

CO7 strongly relates to employability skills as students can prepare real-world applications of data analytics, aligning with the program's focus on practical, industry-relevant skills.

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) ((w. e. from June, 2024)

Academic Year 2024-2025

Class: T.Y.BBA (C.A.) (Semester - VI)

Paper Code: UBCA364B

Title of Paper: Deep Learning

Credit: 3

No. of. Lectures: 48

A] Course Objectives:

1. Understand Fundamentals of Deep Learning:
2. Understand the differences between traditional machine learning and deep learning.
3. Understand the fundamental building blocks of neural networks, including neurons, layers, and activation functions
4. Understand and apply appropriate evaluation metrics for different types of deep learning tasks.
5. Apply Deep Learning to Real-world Problems:
6. To enable students to apply deep learning techniques to solve practical problems in fields such as computer vision, natural language processing, and reinforcement learning design and deployment of deep learning models for machine learning problems

B] Course Outcome:

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

- CO1.** Demonstrate a clear understanding of the foundational principles and concepts of deep learning.
- CO2.** Articulate the role of deep learning in the broader field of artificial intelligence.
- CO3.** Demonstrate proficiency in training neural networks using backpropagation and gradient descent.
- CO4.** Apply convolutional neural networks for tasks such as image classification and object detection.
- CO5.** Apply deep learning techniques to natural language processing tasks.
- CO6.** Understand the impact of hyper parameter choices on model training and generalization.
- CO7.** Explore emerging technologies and their potential impact on deep learning research and applications

Topic/Contents

Unit 1: Introduction to Deep Learning	(08L)
1.1 Why Deep Learning?	
1.2 Deep Learning Models	
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1.2.4 Recurrent Nets	
Unit 2: The Neural Network	(12L)
2.1 Building Intelligent Machines	
2.2 The Limits of Traditional Computer Programs	
2.3 The Mechanics of Machine Learning	
2.4 The Neuron	
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3.6 Test Sets	
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Unit 4: Convolution Neural Networks	(14L)
4.1 Convolutional Neural Networks	
4.2 Neurons in Human Vision	
4.3 The Shortcomings of Feature Selection	
4.4 Vanilla Deep Neural Networks	
4.5 Filters and Feature Maps	
4.6 Full Description of the Convolutional Layer	
4.7 Max Pooling	
4.8 Full Architectural Description of Convolution Networks	
4.9 Closing the Loop on MNIST with Convolutional Networks,	
4.10 Image Pre-processing Pipelines Enable More Robust Models	

Reference Book:

1. Ethem Alpaydm, Introduction to Machine Learning, PHI, Third Edition,
2. Nikhil Buduma, Fundamentals of Deep Learning, O'Reilly, First Edition,
3. Shai shalev-Shwartz and Shai Ben-David, Understanding Machine Learning(From Theory to Algorithms), Cambridge University Press, First Edition, ISBN No. 9781-107-51282-5.
4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw-Hill, ISBN No. 0-07-115467-1.
5. Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07115467-1. 4. Ian Goodfellow and Yoshua Bengio, Deep Learning (Adaptive Computation and machine Learning Series), Massachusetts London, England, ISBN No. 9780262035613.

Class: TYBBA (C.A) (Sem VI)**Subject:** BBA (C.A)**Course:** Deep Learning**Course Code:** UBCA364B**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3										
CO 2	3										
CO 3	3	3	3		3						
CO 4	3	3	3		3						3
CO 5	3	3	3		3						3
CO 6	3				3			3			3
CO7	3				3			3			3

PO1. Knowledge:

All CO's are strongly mapped as Understanding foundational principles aligns directly with the application of core knowledge in computer science and AI. Articulating the role of deep learning in AI reinforces core knowledge across AI and computer science. Proficiency in backpropagation and gradient descent applies knowledge of machine learning models. Applying CNNs reflects knowledge of advanced deep learning techniques.

PO2. Problem Analysis:

CO3, CO4 and CO5 are strongly mapped as CO3 Implementing and optimizing neural networks supports problem analysis.CO4 CNNs solve complex problems in image classification and object detection. CO5 Solving complex NLP problems like sentiment analysis and language modeling requires strong problem analysis.

PO3. Design and Development:

CO3, CO4 and CO5 are strongly mapped as CO3 helps to Designing neural network models meets the design and development requirements for complex problems.CO4 is a Designing CNN models aligns with development for real-world image analysis tasks.CO5 helps to

Designing models for NLP tasks meets development needs for human-computer interaction, chatbots, etc.

PO5. Modern Tool Usage:

CO3, CO4, CO5, CO6 and CO7 are strongly mapped as Training models requires using modern tools like TensorFlow or PyTorch. Using CO4 modern tools for CNNs is essential for handling image-related problems.

In CO5 Using advanced tools for NLP tasks is critical for developing modern AI solutions. CO6 helps to use Modern tools allow students to fine-tune hyperparameters efficiently.CO7 is used to understanding and applying emerging tools reflects modern tool usage.

PO8. Life-Long Learning:

CO6 As deep learning models evolve, hyperparameter tuning remains a critical skill for ongoing learning.CO7 staying updated on emerging trends promotes lifelong learning.

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) ((w. e. from June, 2024)

Academic Year 2024-2025

Class : T.Y.BBA (C.A.) (Semester - VI)

Paper Code : UBCA365

Title of Paper: Project

Credit: 4

No. of. Lectures: 48

A] Course Objectives:

1. To apply Theoretical Knowledge to Practical Problems.
2. To develop Problem-Solving and Analytical Skills.
3. To design and Develop Functional Software Applications.
4. To enhance Technical and Programming Skills.
5. To foster Teamwork and Collaboration.
6. To develop Project Management Skills.
7. To improve Communication and Presentation Skills.

B] Course Outcomes:

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

CO1. Students will be able to apply the theoretical concepts including programming, databases, software engineering, and web technologies, to develop functional software solutions.

CO2. Students will demonstrate the ability to analyze complex problems, define requirements, and design appropriate software solutions that address specific needs or challenges.

CO3. Students will develop a complete software application or system, implementing key features such as user interfaces, back-end processes, data management, and security measures using appropriate technologies and tools.

CO4. Students will gain hands-on experience and enhance their skills in relevant programming languages (e.g., Java, Python, and C++), frameworks, libraries, and tools necessary for the successful completion of their projects.

CO5. Students will effectively work in teams, demonstrating the ability to collaborate, communicate, and manage team dynamics while contributing to project goals and meeting deadlines.

CO6. Students will apply project management techniques, including project planning, scheduling, task allocation, risk management, and quality control, to ensure the successful execution of their projects.

CO7. Students will produce clear and comprehensive project documentation, including technical reports, system design specifications, user manuals, and project presentations.

CO8. Students will enhance their critical thinking and decision-making skills by evaluating different approaches, troubleshooting issues, and selecting optimal solutions throughout the project lifecycle.

Evaluation:

External Evaluation	Marks
Project Report	30
Power Point Presentation	10
Viva	20
Project Logic	20
Project Demonstrations	20
Total	100

Class: TYBBA (C.A) (Sem VI)**Subject:** BBA (C.A)**Course:** Project**Course Code:** UBCA365**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3				3				3		
CO2		3	3	3							
CO3			3		3				3		
CO4	3				3			3			
CO5							3			3	
CO6							3		3		
CO7										3	
CO8		3				3		3			

PO1. Knowledge:

CO1 involves the application of theoretical concepts in programming, databases, and software engineering, which aligns with knowledge application. CO4 is strongly mapped as it gaining hands-on experience in relevant programming languages and tools relates to knowledge application.

PO2. Problem Analysis:

CO2 strongly mapped as it focuses on problem analysis, requirement definition, and designing solutions. This aligns with problem analysis. CO8 is strongly mapped as critical thinking and decision-making align with problem analysis.

PO3. Design and Development:

CO2 strongly mapped as it focuses on design appropriate software solutions that address specific needs or challenges. CO3 is strongly mapped as developing a complete software application.

PO4. Conduct investigations of complex problems:

CO2 strongly mapped as it focuses on investigating complex problems

PO5. Modern Tool Usage:

CO1 is strongly mapped as to develop functional software solutions. CO3 and CO4 are strongly mapped as it uses different software tools to develop the software's and hands-on experience and enhance their skills in relevant programming languages.

PO7. Individual and Team Work:

CO5 is strongly mapped as Teamwork and collaboration directly align with individual and team work. CO6 is strongly mapped as working in teams also relates to team work.

PO8. Life-Long Learning:

CO4 and CO8 is strongly mapped as student gain hands-on experience and enhance their skills in relevant programming languages (e.g., Java, Python, and C++), frameworks, libraries, and tools which help for lifelong learning to keep up with advancements. It is a lifelong learning to improve troubleshooting skills

PO9. Project Management:

CO1 is strongly mapped as it also requires understanding of project management principles. CO3 is essential for successfully completing the project. CO6 is strongly mapped as Students will apply project management techniques,

PO10. Communication:

CO5 is strongly mapped as students communicate, and manage team dynamics while contributing to project goals and meeting deadlines. CO7 is Producing clear project documentation aligns with communication, which emphasizes the importance of effective technical writing and presentations

.SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) ((w. e. from June, 2024)**Academic Year 2024-2025****Class : T.Y.BBA (C.A.) (Semester - VI)****Paper Code: UBCA366****Title of Paper: Computer Laboratory I (based on UBCA361)****Credit: 2****No. of. Lectures: 48****A] Course Objective:**

1. Gain practical experience with Python libraries such as NumPy and Pandas for efficient data handling and analysis. Make Proficiency with Statistical Analysis of Data.
2. Learn and apply statistical methods to analyze and interpret data, including measures of central tendency, variability, and distribution. Understand Numpy and Pandas Library.
3. Understand the fundamentals of machine learning, including supervised and unsupervised learning techniques. Understand Visualization methods.
4. Apply advanced features of NumPy and Pandas to solve complex data problems and perform sophisticated data analyses.
5. Learn to use various data visualization methods and tools to represent data insights effectively, including charts, graphs, and interactive visualizations.
6. Understand and apply tree-based visualization techniques, such as decision trees and hierarchical clustering, to real-life problems.
7. Interpret tree visualizations to gain insights into model decisions and data structure, and use these insights to enhance model performance and decision-making.

B] Course Outcomes:**By the end of the course, students will be able to:**

- CO1.** Identify and display unique values in a specified column, and determine the total count of these unique values.
- CO2.** Utilize the `groupby` function to segment data based on categorical features and perform operations on these groups.
- CO3.** Effectively communicate insights through charts, graphs, and plots.

- CO4.**Demonstrate the ability to generate random data within a specified range, apply a linear regression model, and evaluate its performance on given test data.
- CO5.**Implement a simple linear regression model using Scikit-Learn to predict values based on a specified linear equation.
- CO6.**Perform element-wise addition of two one-dimensional arrays using NumPy, and understand the concept of array broadcasting in this context.
- CO7.**Utilize NumPy to create and manipulate one-dimensional arrays, including operations such as displaying elements and computing the sum of all elements.

Assignment No-1

Topic: Array, Dictionary, Set

- 1) Write a Python Code to Create a Dictionary & perform the following operation-
 - a) Updating Dictionary Element
 - b) Delete Dictionary Element
 - c) Check Presence of key in Dictionary or Not
 - d) Print all keys & Values
- 2) Write a Python Code to accept the number of student data in a dictionary like Name of Student, Roll Number, and Marks and perform following operations
 - a) Display all student information
 - b) By Entering Mark find the Name of Student
- 3) Write a Python code to create a Simple array of one dimension to perform following array operations-
 - a) Display all individual element in array
 - b) Make Sum of all Elements in Array
- 4) Write a Python code to create Two Simple one dimensional array and make addition of both array elements into third array.
- 5) Write a Python code to find Minimum and Maximum value in an Array.
- 6) Write a Python code to create an ndarray to perform the following operations
 - i) To find Dimensions of Array
 - ii) Display Data Type of Element

- iii) Find Shape and Size of Array
 - iv) Delete Array Elements
- 7) Write a Python Code to create TWO ndarray and concatenate that both array.
 - 8) Write a Python Code to perform addition of all elements of ndarray.
 - 9) Write a python program to find minimum and maximum value in ndarray.
 - 10) Write a Python program to perform array broadcasting in two ndarray.

Assignment No-2

Topic: Series, DataFrame

- 1) Write a Python Code to create a Series by-
 - i) From Array
 - ii) From Dictionary
 - iii) From Scalar
- 2) Write a Python Code to create a DataFrame and perform the following column operations (Use Following DataSet)

	name	age	city	Maths	science
0	sachin	18	pune	85	87
1	kartik	22	solapur	87	90
2	piyush	21	kolhapur	88	91
3	Mahesh	20	Banglore	85	90

- i) Column Selection in DataFrame
- ii) Addition of Two Column Values
- iii) Deletion of Column

- 3) Write a Python code to Create DataFrame to perform following Row Operations (Use Following DataSet)

	name	age	city	Maths	science
0	sachin	18	pune	85	87
1	kartik	22	solapur	87	90
2	piyush	21	kolhapur	88	91
3	Mahesh	20	Banglore	85	90
n	Smith	18	pune	85	92

- i) Selection of row
 - ii) Insertion of new row
 - iii) Deletion of any row
- 4) Write a python code to perform various indexing operation (Use Following DataSet)
 - i) Label Based Indexing(.loc)

	name	age	city	Maths	science
a	sachin	18	pune	85	87
b	kartik	22	solapur	87	90
c	piyush	21	kolhapur	88	91
d	Mahesh	20	Banglore	85	90

ii) Integer Based Indexing (.iloc)

	name	age	city	Maths	science
0	sachin	18	pune	85	87
1	kartik	22	solapur	87	90
2	piyush	21	kolhapur	88	91
3	Mahesh	20	Banglore	85	90

5) Write a Python Code to perform Following Boolean Indexing Operations (Use Following DataSet)

	name	age	degree	Score
True	Aparna	18	BCA	85
False	Pankaj	22	MBA	87
True	piyush	21	BBA	88
False	Geeta	20	BTECH	85

- i) Accessing Dataframe by .loc()
- ii) Apply Boolean Mask to Dataframe

6) Write a Python code to create a DataFrame to perform the following operations

	name	age	degree	Score
True	Aparna	18	BCA	85
False	Pankaj	22	MBA	87
True	piyush	21	BBA	88
False	Geeta	20	BTECH	85

- i) Masking Data Based on Column Value
- ii) Masking Data Based on Index Value

7) Write a Python code to create Two DataFrame & Merge that DataFrame by Unique Key Combination in both list (i.e. by on='key')

	name	age	degree
0	Aparna	18	BCA
1	Pankaj	22	MBA
2	piyush	21	BCA
3	Geeta	20	BTECH

	name	city	score
0	Aparna	Pune	85
1	Pankaj	Solapur	87
2	piyush	Kolhapur	88
3	Geeta	Nashik	85

8) Write a Python code to Create a Two DataFrame & Merge that DataFrame by how in an arguments by following ways-

	name	age	degree
0	Aparna	18	BCA
1	Pranav	22	MBA
2	piyush	21	BCA
3	Geeta	20	BTECH

	name	city	score
0	Aparna	Pune	85
1	Pankaj	Solapur	87
2	piyush	Kolhapur	88
3	Pranita	Nashik	85

- i) Left Outer Join
- ii) Right Outer Join
- iii) Outer Join
- iv) Inner Join

9) Write a Python code to create a Two DataFrame and perform following operations

	name	age	degree
a	Aparna	18	BCA
b	Pranav	22	MBA
c	piyush	21	BCA
d	Geeta	20	BTECH

	city	score
a	Pune	85
b	Solapur	87
c	Kolhapur	88
d	Nashik	85

- i) Joining of DataFrame
- ii) Concatenate DataFrame by Both Vertical & Horizontal Ways

10) write a Python Code to Create a DataFrame to perform –

	name	age	city	science	maths	phy
0	Aparna	18	Pune	85	90	87
1	Pranav	22	Solapur	87	92	85
2	piyush	21	Kolhapur	88	87	90
3	Geeta	20	Nashik	85	93	82

- i) Sorting DataFrame by column in Ascending Order
- ii) Sorting DataFrame by column in Descending Order
- iii) Sorting DataFrame by Multiple Columns

Topic: Visualizations

- 1) Create an Array in the range 1 to 20 with values 1.25 apart. Another array contains the log values of the elements in first array.
- Simply plot the two arrays first vs second in a line chart
 - Change the x-axis label as “Random Values” & Y-axis as “Logarithmic values”
 - create a third array that shows the cos values of first array and plot that with first array. The Cos line should be plotted with a dashdotted line.

2) T.C.College celebrated volunteering week where each section of class TY dedicated a day for collecting amount for charity being supported by the college. Section A volunteered on Monday, B on Tuesday, C on Wednesday and so on. There are six section in class TY. Amount collected by sections A to F are 8000, 12000, 9800, 11200, 15500, 7300.

- Create a bar chart showing collection of amount.
- Plot the collected amount vs days using a bar chart.
- Plot the collected amount vs Sections using bar chart.

3) Write to create a pie for sequence con=[23.4,17.8,25,34,40] for zones = ['East', 'West', 'North', 'South', 'Central'].

- Show North Zone's Value Exploded
- Show % Contribution for each zone
- The Pie Chart should be Circular

4) Create a multiline line charts on common plot where three data ranges are plotted on same chart. The data ranges to be plotted is –

Data= [[5.0, 25.0, 45.0, 20.0],[8.0,13.0,29.0,27.0],[9.0,29.0,27.0,39.0]]

5) Create a Scatter Plot Chart having two array as follows.

[5,7,8,7,2,17,2,9,4,11,12,9,6] [99,86,87,88,111,86,103,87,94,78,77,85,86]

- Show simple scatter plot.
- Set your own color of the Markers.

6) Write a Python Code to create Tree by using Bigtree library of python the output display should be in following form

```
a [age=90]
├── b [age=65]
└── c [age=60]
```

7) Write a Python Code to create Tree by using Bigtree library of python the output display should be in following form

```
Language
├── Python
│   ├── Pandas
│   └── Django
```

└─ java

Assignment Number-04

- 1) Write a Python code to perform the following operations use following [dataset](#)
 - i) Check empty or missing data in all dataset
 - ii) Check empty or missing data in column 'Postcode'
 - iii) Display total count of missing data in each column
 - iv) Drop rows that are having missing values

- 2) Write a Python code to perform the following operations use following [dataset](#)
 - i) Display unique value in column 'Price'
 - ii) Display total number (Count) unique value
 - iii) Display duplicate rows in dataset
 - iv) Display total count of all duplicates

- 3) Write a Python code to perform the following operations use following [dataset](#)
 - i) Find the total marks of column Maths
 - ii) Find the Mean & standard deviation of marks in column Science
 - iii) Find minimum marks in Physics & Maximum marks in Maths
 - iv) Find minimum marks all Subjects

- 4) Write a Python code to perform the following operations use following [dataset](#)
 - i) Use groupby function to create a group of "Course"
 - ii) Display first row Group "Course"
 - iii) Display all rows in a Group "Course"
 - iv) Create a group "Maths" & display its mean

Assignment no-5

Topic: Building Models

- 1) Write a Sklearn Library code to create a simple Linear Regression Algorithm that creates random number in the range (0,10000) and test the data [10,20,30] against the expression $=a+(2*b)+(3*c)$.
- 2) Create a Linear Regression Model to show relation for house price prediction by using following dataset and predict the output.

POSTED_YEAR	UNDER_CONSTRICTION	RERA	BHK_NO.	BHK_OR_RK	SQUARE_FT	READY_TO_MOVE	RESALE	ADDRESS	LONGITUDE	LATITUDE	TARGET_PRICE_IN_LACS
Owner	0	0	2	BHK	1300.236	1	1	Ksfc Layout, Bangalore	12.96991	77.59796	55
Dealer	0	0	2	BHK	1275	1	1	Vishweshwara Nagar,	12.27454	76.64461	51

								Mysore			
Owner	0	0	2	BHK	933.15 97	1	1	Jigani, Bangalore	12.7 780 3	77.6321 9	43
Owner	0	1	2	BHK	929.92 11	1	1	Sector-1 Vaishali, Ghaziabad	28.6 423	77.3445	62.5
Dealer	1	0	2	BHK	999.00 92	0	1	New Town, Kolkata	22.5 922	88.4849 1	60.5
Owner	0	0	3	BHK	1250	1	1	South Chittoor, Kochi	10.0 332 8	76.2825 7	42
Dealer	0	0	3	BHK	1495.0 54	1	1	Sodala, Jaipur	26.9 163 5	75.7956	66.5
Owner	0	1	3	BHK	1181.0 13	1	1	Kharar, Mohali	30.7 4	76.65	52
Dealer	0	1	2	BHK	1040	1	1	Bileshi vale, Bangalore	13.0 542	77.674	41.6
Owner	0	0	2	BHK	1300.2 36	1	1	Ksfc Layout, Bangalore	12.9 699 1	77.5979 6	36

3) Create a Decision Tree Classifier model on following dataset and show decision tree.

Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
6	148	72	35	0	33.6	0.627	50	1
1	85	66	29	0	26.6	0.351	31	0
8	183	64	0	0	23.3	0.672	32	1
1	89	66	23	94	28.1	0.167	21	0
0	137	40	35	168	43.1	2.288	33	1
5	116	74	0	0	25.6	0.201	30	0
3	78	50	32	88	31	0.248	26	1
10	115	0	0	0	35.3	0.134	29	0
2	197	70	45	543	30.5	0.158	53	1
8	125	96	0	0	0	0.232	54	1
4	110	92	0	0	37.6	0.191	30	0
10	168	74	0	0	38	0.537	34	1

10	139	80	0	0	27.1	1.441	57	0
1	189	60	23	846	30.1	0.398	59	1
5	166	72	19	175	25.8	0.587	51	1
7	100	0	0	0	30	0.484	32	1
0	118	84	47	230	45.8	0.551	31	1
7	107	74	0	0	29.6	0.254	31	1
1	103	30	38	83	43.3	0.183	33	0
1	115	70	30	96	34.6	0.529	32	1
3	126	88	41	235	39.3	0.704	27	0
8	99	84	0	0	35.4	0.388	50	0
7	196	90	0	0	39.8	0.451	41	1
9	119	80	35	0	29	0.263	29	1
11	143	94	33	146	36.6	0.254	51	1
10	125	70	26	115	31.1	0.205	41	1
7	147	76	0	0	39.4	0.257	43	1
1	97	66	15	140	23.2	0.487	22	0
13	145	82	19	110	22.2	0.245	57	0

4) Create K-Means clustering model following dataset.

Index	CustomerID	Genre	Age	Annual Income (k\$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40
5	6	Female	22	17	76
6	7	Female	35	18	6
7	8	Female	23	18	94
8	9	Male	64	19	3
9	10	Female	30	19	72
10	11	Male	67	19	14
11	12	Female	35	19	99
12	13	Female	58	20	15
13	14	Female	24	20	77
14	15	Male	37	20	13
15	16	Male	22	20	79

Class: TYBBA (C.A) (Sem VI)**Subject:** BBA (C.A)**Course:** Computer Laboratory based on (UBCA361)**Course Code:** UBCA366**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2		3								
CO 2	3										
CO 3	3										
CO 4	2	2	3		2						
CO 5		2		2	2			3			
CO 6			3								
CO7					2			3	2		3

PO1. Knowledge:

CO2, CO3 strongly mapped as students will get disciplinary knowledge, Proficiency in Python is a fundamental skill for data analysts. It provides a strong foundation in programming. CO1 and CO4 moderately mapped as student apply their knowledge to build applications.

PO2. Problem Analysis:

CO4, CO5 Moderately mapped as the Students will able to Apply various python library for solving real life problems.

PO3. Design and Development:

CO1, CO4, CO6 Strongly mapped as the students will be able to develop effective data visualization skills to Build Machine Learning Models.

PO4. Conduct investigations of complex problems:

CO5 moderately mapped as student will be able to conduct the investigation of real word data and design and develop models using regression classification.

PO5. Modern Tool Usage:

CO2, CO5, CO7 moderately mapped student will create different models of ML using algorithms as Modern tool.

PO8. Life-Long Learning:

CO5, CO7 strongly mapped as it contributes to the development of students' ability to engage in life-long learning as students can build models based on real-world data.

PO9. Project Management:

CO7 moderately mapped as student can create models with real word data using different Models of ML.

PO10. Communication:

CO2 moderately mapped as it aligns with the program's focus on developing both analytical and communication skills in term of ML.

PO11. Innovation, employability, and Entrepreneurial skills:

CO7 strongly relate to employability skills as students are able to prepare real-world applications of data analytics, aligning with the program's focus on practical, industry-relevant skills.

SYLLABUS (CBCS) FOR T.Y.BBA (C.A.) (w. e. from June, 2021)**Academic Year 2021-2022****Class : T.Y.BBA (C.A.) (Semester - VI)****Paper Code : UBCA367****Title of Paper: Computer Laboratory II based on (UBCA362)****Credit: 2****No. of. Lectures: 48****A] Course Objectives:**

1. To understand what a MongoDB database is?
2. Learn to work with data stored in BSON or JSON format.
3. Learn to create and manipulate documents in MongoDB.
4. Master the use of Create, Read, Update and Delete (CURD) operations.
5. Learn to create an Aggregation Pipeline.
6. To learn MongoDB configuration and backup method, monitoring, and operational strategies.
7. To learn how to handle data storage, data modeling, ingestion, query, sharding, and data replication with MongoDB, along with installing, updating, and maintaining the MongoDB environment.

B] Course Outcome:**By the end of the course, students will be able to:**

- CO1.** Define and explain the fundamental concepts of NoSQL databases, including their development and key characteristics.
- CO2.** Perform Create, Read, Update, and Delete (CRUD) operations on NoSQL databases, demonstrating proficiency in handling data.
- CO3.** Analyze and implement strategies for horizontal scalability and optimize performance in a NoSQL database environment.
- CO4.** Analyze and apply NoSQL databases to real-world use cases, identifying scenarios where NoSQL is more suitable than traditional relational databases.
- CO5.** Demonstrate competency in designing NoSQL database management systems.
- CO6.** Apply NoSQL development tools on different types of NoSQL Databases.
- CO7.** Compare and contrast RDBMS with different NoSQL databases.

Q.1. MongoDB:

A) Create a 'films' collection of documents with the following fields:

```
{
title : "Jurassic Park", director :
"Steven Spielberg",release_year :
1993, language:"English",
film_type : [ "Action", "Adventure "],
actors : ["Sam Neill", "Laura Dern", "Jeff Goldblum"]
}
```

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'films' collection in proper format.

B) Solve the Following Queries:

- 1) Give all English films released before year 2000.
- 2) Display title and release year of 'Action' films that starts with the letter 'K'.
- 3) Display the latest five 'Hindi' films released in easy-to-read format.
- 4) Count the number of films in which 'Akshay Kumar' has not acted.
- 5) Update release year of a film 'Jungle Book' to 2016.

Q.2. MongoDB:

A) Create a 'Competition' collection of documents with the following fields:

```
{Competition_Name: "....", Competition_Type: "....",
Competition_Year:...,students:["....","....","...." ]}
```

In this, Competition_type can be 'Sport' or 'Academic'.

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'Competition' collection in proper format.

B) Solve the Following Queries:

- 1) Display all 'Sport' competition details which were held between years 2018 to 2019.
- 2) Display number of students participated in 'Running' competition which was conducted in year 2019.
- 3) Update Competition_name of 'Programming Competition' to 'Online ProgrammingCompetition' for year 2020.
- 4) Add one more name of student 'Prasad More' in 'Project Competition' of year2021.
- 5) Sort Competition collection in descending order of Competition_Year.

Q.3. MongoDB:

- A) Create a 'Hospital' collection of documents with the following fields:

```
{
  hospital_name:"Bir
  la Hospital",city:
  "Chinchwad",

  specialties:["Pediatric", "Orthopedic"],
  doctors:[{doctor_name:"Dr. Kadam", visit_day:"Monday"},
  {doctor_name:"Dr.Mane",visit_day:"Tuesday"}],
  services:["laboratory", "surgical", "diagnostic", "ambulance"],rating:5
}
```

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'Hospital' collection in proper format.

- B) Solve the Following Queries:

- 1) Display details of hospital where Dr. More is visiting.
- 2) Display all hospital names along with their specialties from 'Pune' city.
- 3) Count the number of hospitals which are providing 'ambulance' service.
- 4) Display details of hospital whose 'rating' is specified.

Q.4. Delete those documents whose hospital name starts with letter 'P'. MongoDB:

- A) Create a 'Book' collection of documents with the following fields:

```
{
  Book_Title:"....", Publisher_name:"....", Authors:[".....", "..... "],
  Language:"....",Publication_year:.....,ISBN:....., price:.....
}
```

- 1) Insert at least 10 documents in a collection, use bulk insert.
 - 2) Display all documents of 'Book' collection in proper format.
- B) Solve the Following Queries:
- 1) Display two books of 'BPB' publication.
 - 2) Display Book_title and Authors of books published between years 2019 to 2021.
 - 3) Count number of books having three authors.
 - 4) Update the ISBN number of book titled "Definitive Guide to MongoDB" to "1-4302-3051-7".
 - 5) Add one more author "Alex Buckley" to book titled "The Java Languages Specification".

Q.5. MongoDB:

A) Create an 'Institute' collection of documents with the following fields:

```
{ Name:"....", City:"....",No_of_faculties:.....,Est_Year:.....,
Courses:[{Course_Name:"....",Dur_in_month:.....,Fees:.....},...]}
}
```

- 1) Insert at least 10 documents in a collection.
 - 2) Display all documents of 'Institute' collection in proper format.
- B) Solve the Following Queries:
- 1) Give all institute names whose establishment year is before 2010.
 - 2) Display Institute details having Course 'Java'.
 - 3) Update No_of_faculties of 'Disha' Institute to 10.
 - 4) Display the
 - 5) latest three Institutes established in easy-to-read format.
 - 6) Count the number of Institutes in 'Pune' city, established after 2019.

Q.6. MongoDB:

A) Create a 'Doctor' collection of documents with the following fields:

```
{
  Doctor_name:"Dr. Patil", Contact_No:9876543210,City: "Pune",
  Qualification:"MBBS",
  specialization:["ENT", "General Surgery"],
  hospitals:[{hospital_name:"NiramayHospital",
  visit_day:"Monday"},
  {hospital_name:"Birla Hospital", visit_day:"Tuesday"}]
}
```

- 1) Insert at least 10 documents in a collection, use bulk insert.
 - 2) Display all documents of 'Doctor' collection in proper format.
- B) Solve the Following Queries:
- 1) Count number of doctors having qualification 'MBBS'.
 - 2) Display qualification and specialization of all doctors from 'Mumbai' city.
 - 3) Display details of two doctors having specialization in 'ENT'.
 - 4) Change qualification of "Dr. Patil" to MD.
 - 5) Delete all Doctor Documents not having city 'Pimpri'.

Q.7. MongoDB:

A. Create a 'Result' collection of documents with the following fields:

```
{
  student_id:1,
  student_name:"Mr.
  Anuj Joshi",
  class:"TYBBA_CA",
  test_marks:[{subject:"Java",marks:78},{subject:"Python",marks:80}], grade: 'A'
}
```

A) Insert at least 10 documents in a collection.

B) Display all documents of 'Result' collection in proper format.

B) Solve the Following Queries:

- 1) Display details of students whose 'grade' is given.
- 2) Display documents where the subject is 'Java' and marks are greater than or equal to 70.
- 3) Display student details whose name ends with "ne".
- 4) Give name and class of student who has given 4 subject tests.
- 5) Insert a field percentage in student document whose name is "Ms. Priya Rane"

Q.8. MongoDB:

A) Create an 'Album' collection of documents with the following fields:

```
{title:"...",artist: ["...", "..."],released_year: .....,
  tracks:[{track_id: ....., track_title:"...",seconds: .... },.....],genre: "..."}
```

- 1) Insert at least 10 documents in a collection, use bulk insert.
- 2) Display all documents of 'Album' collection in proper format.

B) Solve the Following Queries:

- 1) Count number of albums released between years 2010 to 2020.
- 2) Display two documents which have genre 'Rock'.
- 3) Give title and artist of an album which has 3 tracks.
- 4) Display albums that do not have genre either 'Rock' or 'hip-hop'.
- 5) Update the seconds of the track to 6.38 whose track id is 2 and album title is "What's Going On".

Q.9. MongoDB:

A) Create a 'Contributor' collection of documents with the following fields:

```
{ Contributor_name:
  "Rohit Sawant",
  Branch:"CSE",
  Join_year:2019, Language:["C++", "Java"],
  Articles:[{Language:"C++",tArticles:20,pArticles:30},{Language:"Java",tAr
  ticl es:50,pArticles:30}],Personal_Info: {age:24, Sem_Marks:[70, 80, 77,
  81]}
}
```

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'Contributor' collection in proper format.

B) Solve the Following Queriesz:

- 1) Append two languages named "Python" and "C" to contributor "Rohit Sawant".
- 2) Delete the first matched document having Branch "CSE" or Join_Year less than 2020.
- 3) Display the latest five Contributors joined in easy-to-read format.
- 4) Display documents having "CSE" branch. (Use cursor)
- 5) Give the name and branch of contributor whose age is greater than or equal to 20.

Q.10. MongoDB:

A) Create a 'Person' collection of documents with the following fields:

```
{pname: "....", contact_no: ....., city: "....", profession: ["....","...."],
  cars:[{model: "....", year: .....,price: .... }, .... ]}
```

- 1) Insert at least 10 documents in a collection, use bulk insert.
- 2) Display all documents of 'Person' collection in proper format.

B) Solve the Following Queries:

- 1) Display the name and contact number of person having 3 cars.
- 2) Display different cities from which persons belong.
- 3) Create an index using the 'pname' field and name it as 'Person Name Index'.
- 4) Delete the first person document whose city is 'Chinchwad'.
- 5) Update Person document whose name is "Mrs. Mahajan" while updating add only those professions which are not already exists in her profession field.

Q.11. MongoDB:

A) Create a 'Company' collection of documents with the following fields:

```
{ company_id:1,company_name:"Apple",
  contact_details:{ address: "Cupertino, CA 95014", phone: "1-408-
  996-1010"},products:[{code:"A-123", name:"iPhone 7", price:
  29,900},{code: "A-456", name: "IPadPro", price: 37,900}], rating:5
}
```

- 1) Insert at least 10 documents in a collection.
 - 2) Display all documents of 'Company' collection in proper format.
-
- 1) Solve the Following Queries: Count Number of mobile companies whose name ends with letter 'o'.
 - 2) Sort the company collection in descending order of their id.
 - 3) Give address and phone number of 'Samsung' company.
 - 4) Update the price of the 'iPhone 7' to 32,900.
 - 5) Display details of company whose 'rating' is specified.

Q.12. MongoDB:

A) Create a 'Customer' collection of documents with the f

```
{ Cust_id: 1,
  Cust_name: "Mr. Joshi",
  address:{ city: "Pune", street: "S. B. Road"},orders: [
  { id:101,
  orderItems:[
  { productId: 8, price: 560,
  productName: "keyboard"
  },.....],
  },.....]
}
```

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'Customer' collection in proper format.

B) Solve the Following Queries:

- 1) Display customer details that have placed two orders.
- 2) Replace the document having id 3 with a new document.
- 3) Increment the price of 'keyboard' by Rs. 100.

- 4) Add one more product in an order having order id 101, which is placed by "Mr.Joshi".
- 5) Display all the documents having customer id greater than or equal to 4.

Q.13. MongoDB:

A) Create a 'Company' collection of documents with the following fields:

```
{
  company_id:1,company_name:"Apple",
  contact_details:{ address: "Cupertino, CA 95014", phone: "1-408-996-1010"},products:[{code:"A-123", name:"iPhone 7", price: 29,900},{code: "A-456", name: "iPadPro", price: 37,900}],rating:5
}
```

- 1) Insert at least 10 documents in a collection.
- B) Display all documents of 'Company' collection in proper format.Solve the Following Queries:
 - 1) Count number of mobile companies whose name ends with letter 'o'.
 - 2) Sort the company collection in descending order of their id.
 - 3) Give address and phone number of 'Samsung' company.
 - 4) pdate the price of the 'iPhone 7' to 32,900.
 - 5) Display details of company whose 'rating' is specified.

Q.14. MongoDB:

A) Create a 'Customer' collection of documents with the following fields:

```
{ Cust_id: 1,
  Cust_name: "Mr. Joshi",
  address:{city: "Pune", street: "S. B. Road"},orders: [
  { id:101,
  orderItems:[
  { productId: 8, price: 560,
  productName: "keyboard"
  },.....],
  },.....]
}
```

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'Customer' collection in proper format.

B) Solve the Following Queries:

- 1) Display customer details that have placed two orders.
- 2) Replace the document having id 3 with a new document.
- 3) Increment the price of 'keyboard' by Rs. 100.
- 4) Add one more product in an order having order id 101, which is placed by "Mr.Joshi".
- 5) Display all the documents having customer id greater than or equal to 4.

Q.15 MongoDB:

C) Create a 'Projects' collection of documents with the following fields:

```
{  proj_id: ....,
  proj_name: "....",
  proj_manager:
  "....",start_date:
  ...., dur_in_month:
  ....,
  emps_work_in_proj
  : ["....","...."]
}
```

- 1) Insert at least 10 documents in a collection.
- 2) Display all documents of 'Projects' collection in proper format.

D) Solve the Following Queries:

- 1) Display id and name of all those projects having duration greater than or equal to sixmonths.
- 2) Count number of projects managed by "Mr. Sumit Jadhav".
- 3) Increment the duration of all projects by one month.
- 4) Add one more employee "Mr. Mahesh Kulkarni" to the "College Automation" project.
- 5) Display details of projects in which 4 employees are working.

A) Write a java program to calculate sum of digits of a given number using recursion.

B) Write a java program to accept n employee names from user. Sort them in ascending order and Display them.(Use array of object and Static keyword)

Q.15. MongoDB:

A) Create two documents named user1 and user2 as follows:

- 1) user1 = {FName: "Test", LName: "User", Age:30, Gender: "M", Country: "India"} user2 = {Name: "Test User", Age:45, Gender: "F", Country: "India"}

add both these documents (user1 and user2) to the users collection in the subsequent order.

2) Verify your created collection and database by using proper Mongo DB command

B) Solve the Following Queries:

- 1) Display all documents in the users collection.
- 2) Updates the country to UK for all female users and check whether the country has been updated for all the female employees or not.
- 3) Add new field company to all the documents.
- 4) Delete the documents where Gender = 'M'.
- 5) Add 5 more similar documents in a collection and find all female users who belong to either India or US.

Q.16. MongoDB:

A) Solve the following:

1) Create document named scientist with following fields:

```
{First Name, Last Name:           , Contribution:           , Awarded:           ,
  date_of_birt, Year :           , Country:           }
collect
```

The document keeps information about the scientist who has contributed in various fields like Artificial intelligence, Data Science etc. The scientist may have contributed in more than one field and may have received more than one awards for his contribution in various fields.

2) Insert at least 10 documents in a collection.

B) Solve the Following Queries:

- 1) List names of all scientists whose last name starts with N.
- 2) List all scientists who were born after 1/1/1960.
- 3) List scientists that received an award in year 2000.
- 4) List all scientists who have received "Turing Machine Award"
- 5) List all scientist who has made contributed in 4 fields

Q.17. MongoDB:

A) Solve the following :

1) Create documents Inventory with following fields:

```
{Item Name:           , status:           , Tags:           , qty:           }
```

- 2) Insert at least 10 documents in a collection with suitable values.
Verify created documents.
- B) Solve the Following Queries:
- 1) List all items from the inventory where the status equals "D" and qty is greater than 30.
 - 2) List all items which have 3 tags. List all items having status equal to "A" or having quantity less than 30 and height of the product should be greater than 10.
 - 3) Delete the documents where status = 'C'
 - 4) Find all documents that keep item "Planner" and having in stock quantity less than 20.

Q.18. MongoDB:

A) Solve the following:

- 1) Create documents containing transaction information as:

```
{Transaction_id: Customer Name:, Payment_mode:, Amount: Date:
  }
```

in which the payment was done – Cash, Credit Card or Debit Card in a collection.

Verify your created collection and documents by using proper command.

- 2) Insert at least 10 documents in a collection.

B) Solve the Following Queries:

- 1) Find all transactions which were made by the user "Vikas".
- 2) Find all the transactions which were made using debit card.
- 3) Find transaction id and total amount of purchase made using a credit card.
- 4) Find the total payment for each payment type.
- 5) List all transactions made by customers on particular date.

Q.19. MongoDB:

A) Solve the following:

- 1) Create Programmer collection with documents containing fields {Programmer_name: _____, Join_year: _____, Languages: [_____, _____, _____], Programmer_details: {age: _____, "Address": [_____, _____]}};
- 2) Insert at least 10 documents in a collection with suitable values. Verify your created collection and database by using proper command.

B) Solve the Following Queries:

- 1) Append a single value, i.e., “C” to an array field, i.e., Language field in the document whose Programmer_name is “Neha”.
- 2) Remove the **first** element of the Language field in the document whose programmer_name is “Rahul”.
- 3) Removing the **last** element of the Language field in the document whose Programmer_name is “Rahul”.
- 4) Adds “PHP” in the Language field for the programmer Radha.
- 5) Delete the first document containing programmer name ‘Radha’.

Q.20. MongoDB:

A) Solve the following:

- 1) Create documents with following data in a collection:

```
{ _id:      ,vidio_title:  ,description:  , YouTuber
  Name:,    url:,tags: ['mongodb', 'database', 'NoSQL'],
  likes: 100 }
```

- 2) Insert at least 7 documents in a collection with suitable values. Verify your created collection and database by using proper command.

B) Solve the Following Queries:

- 1) Display a list stating how many videos are uploaded by each youtuber.
- 2) Gets the maximum likes of the corresponding values from all documents in the collection for each youtuber.
- 3) Calculates the average likes of all given values from all documents in the collection for each youtuber.
- 4) Find total likes received to each youtuber.
- 5) Calculate total likes received to youtuber except “Mongo DB” video.

Q.21. MongoDB:

A) Solve the following:

- 1) Create a collection to embed the 3 branch document inside the Bank document like (“Bank_name”: , “Contact”: , “Address”: , “branch”: , “city”:)

that maintains all the related data in a single document. Branch should contain fields like branch_id, branch_name & branch_address.

- 2) Insert at least 8 documents in a collection with suitable values. Verify

your created collection and database by using proper command.

B) Solve the Following Queries:

- 1) Display all branches in individual city.
- 2) Updates the Address of branch in city Pune.
- 3) Add new branch in a city Baramati.
- 4) Delete the one branch in city Pune.
- 5) Count total branches in individual city.

Q.22. MongoDB:

A) Solve the following:

- 1) Create a collection "**Customer**" which contains documents with the same structure like this one:

```
{ "_id" :      , "firstname" :      , "lastname" :      , "email" :
  "password" :      , "last_login" :      , "address" : { "country":
    , "street" :      ,      , "zip" :      , } }
```

- 2) Insert at least 8 documents in a collection with suitable values. Verify your created collection and database by using proper command.

B) Solve the Following Queries:

- 1) Replace a single existing document entirely with other data.
- 2) Replace the document for current firstname field that you have taken in your document.
- 3) Insert some other similar documents in it.
- 4) Find the first document which firstname field is equal "Rahul" and updates (sets) the lastname field to "Patil".
- 5) Update multiple fields of a document.

Q.23. MongoDB:

A) Solve the following:

- 1) Create a collection **employee** in your database with the following type of documents:

```
{"_id": 1, "emp_name": { name: , surname:      }, "age": , "city": , "salary": }
```

- 2) Insert at least 8 documents in a collection with suitable values. Verify your created collection and database by using proper command.

B) Solve the Following Queries:

- 1) Define a single field index on the **age** field and also drop created index.
- 2) Define a multiple field index on the age field for descending and city field for ascending order.
- 3) Write mongo DB queries that will use the index both for retrieving the documents and for sorting.
- 4) Retrieve all the indexes in the collection.
- 5) Find total salary spend on employee.

Class: TYBBA (C.A) (Sem VI)**Subject:** BBA (C.A)**Course:** Computer Laboratory based on (UBCA362)**Course Code:** UBCA367**Weightage:** 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

Course Outcomes	Programme Outcomes (POs)										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	3										
CO 2			3								
CO 3		2	3		3			3			
CO 4			3								
CO 5	2								3		
CO 6		3	3					3			3
CO7	3										

PO1. Knowledge:

CO1 CO7 strongly mapped as it contributes to the development of students' disciplinary knowledge concepts of NoSQL databases, Co5 moderately mapped as students will able to Demonstrate NoSQL database management systems.

PO2. Problem Analysis:

CO6 strongly mapped as the Students will able to Apply NoSQL development tools on different types of NoSQL Databases. CO3 moderately mapped as students will able Analyse and implement strategies for horizontal scalability and optimize performance in a NoSQL database environment.

PO3. Design and Development:

CO2, CO3, CO4 CO6 Strongly mapped as the students will be able to perform operations on NoSQL databases, demonstrating proficiency in handling data.

PO5. Modern Tool Usage:

CO3 strongly mapped student will create databases using different tools to work with the application.

PO8. Life-Long Learning:

CO3 CO6 strongly mapped as it contributes to the development of students' ability to engage in life-long learning to create software project with database management.

PO9. Project Management:

CO5 strongly mapped as student can design applications or software's with database management.

PO11. Innovation, employability, and Entrepreneurial skills:

CO6 strongly relate to employability skills as students are able to prepare real-world applications with database