Shri Vaishnav Vidyapeeth Vishwavidyalaya
Shri Vaishnav Institute of Information Technology
Choice Based Credit System (CBCS) in the light of NEP-2020
B.Tech. (CSE - Big Data and Cloud Engineering – Impetus Technologies)
SEMESTER-V(2023-2027)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTCS501N	DCC	Theory of Computation	60	20	20	-	-	3	1	-	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES

The student will have ability to:

1. To introduce concepts in automata theory and theory of computation.
2. To identify different formal language classes and their relationships.
3. To design grammars and recognizers for different formal languages.

COURSE OUTCOMES

Upon completion of the subject, students will be able to:

1. Ability to relate practical problems to languages, automata, and computability.
2. Ability to demonstrate an increased level of mathematical sophistication.
3. Ability to apply mathematical and formal techniques for solving problems.

SYLLABUS

UNIT–I 10 HOURS

Introduction: Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem.

UNIT–II 8 HOURS

Regular Expression (RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden's Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

UNIT–III 9 HOURS

Context Free Grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closureproperties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

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BTCS501N	DCC	Theory of Computation	60	20	20	-	-	3	1	-	4

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UNIT–IV **7 HOURS**

Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.

UNIT–V **8 HOURS**

Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to undecidability, undecidable problems about TM, NP hard and NP complete problem, Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

TEXT BOOKS:

1. Hopcroft and Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 3rd edition, 2014
2. Peter Linz, "An Introduction to Formal Language and Automata", NarosaPub.House, 2011.
3. K.L.P Mishra & N.Chandrasekaran,"Theory of Computer Science", PHI Learning, 3rd edition, 2006

REFERENCES:

1. Martin J. C., "Introduction to Languages and Theory of Computations", TMH, 4th edition, 2010.
2. Papadimitriou, C. and Lewis, C. L., "Elements of the Theory of Computation", PHI, 1997.
3. Michael Sipser,"Introduction to Theory of Computation",Cengage Learning, 3rd edition,2013.

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Vishwavidyalaya, Indore	Vishwavidyalaya, Indore		

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BTCS502N	DCC	**Introduction to Artificial Intelligence**	**60**	**20**	**20**	**30**	**20**	**3**		**2**	**4**

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;
*Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES
The student will have ability to:
1. Know how computer system adapts, evolves and learns.
2. To gain expertise in one of fastest growing areas of Computer Science that covers topics related to human intelligence and its applications in industry, defense, healthcare, agriculture and many other areas.
3. Provides a rigorous, advanced and professional graduate-level foundation in Artificial Intelligence

COURSE OUTCOMES
Upon completion of the subject, students will be able to:
1. Build intelligent agents for search and games
2. Solve AI problems through programming with Python
3. Learning optimization and inference algorithms for model learning
4. Design and develop programs for an agent to learn and act in a structured environment.

SYLLABUS

UNIT–I **10 HOURS**

Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

UNIT–II **9 HOURS**

Search Algorithms: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

UNIT–III **8 HOURS**

Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model.

UNIT–IV **7 HOURS**

Markov Decision process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

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BTCS502N	DCC	**Introduction to Artificial Intelligence**	**60**	**20**	**20**	**30**	**20**	**3**		**2**	**4**

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UNIT–V **8 HOURS**

Reinforcement Learning: Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
3. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.
5. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010.

WEBSITES FOR REFERENCE:

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu
4. https://ai.berkeley,edu/project_overview.html (for Practicals)

LIST OF PRACTICALS:

1. Write a programme to conduct uninformed and informed search.
2. Write a programme to conduct game search.
3. Write a programme to construct a Bayesian network from given data.
4. Write a programme to infer from the Bayesian network.
5. Write a programme to run value and policy iteration in a grid world.
6. Write a programme to do reinforcement learning in a grid world.
7. Mini Project work.

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BTCS503M	DCC	Network Security & Cryptography	60	20	20	30	20	3	0	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit;
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Course Objectives:
The student will have ability:

1. To understand the different aspects of Network Security.
2. To learn about different Cryptography Encryption and Decryption Technique.

Course Outcomes:
Upon completion of the subject, students will be able to:

1. Understand Need of Security in and Type of threats.
2. Understand Security mechanism and basic and Advance Ciphers.
3. Understand Advance encryption Techniques.
4. Understand the Key exchange protocols used in Public Key Cryptography.
5. Understand the Authentication and Steganography concept.

Syllabus:

UNIT I Introduction to Network Security: 8HRS
Computer Security Concept, Need for Security, Security in Networks: Threats in networks, Network SecurityControls – The OSI Security Architecture, Fundamental Security Design Principle, Security Attacks, Security Services, Security mechanism,
Attack Surface and Attack trees, A Model of Network Security
Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honey pots. Proxy Servers and Anonymizers, Firewall, Types of firewall, Password Cracking Techniques.

UNIT II Cryptography: Concepts & Techniques: 9HRS
Introduction, Plaintext & Cipher text, Creaser Cipher, Substitution Techniques, Substitution Boxes (S-Boxes), Permutation Cipher, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size, Cryptographic Attacks.

UNIT III Symmetric Key Algorithm: 8HRS
Introduction of Block Ciphers, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, Double DES Triple DES, AES, IDEA(International Data Encryption Algorithm) algorithm.

UNIT IV Asymmetric Key Algorithm: 10HRS
Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Random Oracle Model, Diffie-Hellman Key Exchange, Digital

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BTCS503M	**DCC**	**Network Security & Cryptography**	**60**	**20**	**20**	**30**	**20**	3	0	2	4

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Signature, Basic concepts of Message Digest and Hash Function. Man in Middle Attack, DoS and DDoS Attacks.

UNIT V Internet Security Protocols: 9HRS

User Authentication Basic Concepts, SSL Architecture, SSL protocol Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication. Steganography it's importance. Basics of mail security, Pretty Good Privacy, S/MIME, ISAKMP.

Text Books:

1. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
2. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
3. Cryptography & Network Security: Atul Kahate, TMH

References:

1. Cryptography And Network Security Principles And Practice Fourth Edition, William Stallings, Pearson Education
2. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall PTR
3. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall
4. Cryptography: Theory and Practice by Douglas R. Stinson, CRC press.
5. Building Internet Firewalls, Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly.
6. http://nptel.ac.in/

List of Practical:

1. Write a Program to implement Ceaser Cipher
2. Write a Program to implement Substitution Cipher with equation c=3x+12
3. Write a Program to implement polyalphabetic Cipher
4. Write a Program to implement Rail fence technique
5. Write a Program to implement Simple Columner Transposition technique
6. Write a Program to implement Advanced Columner Transposition technique

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BTCS503M	**DCC**	**Network Security & Cryptography**	**60**	**20**	**20**	**30**	**20**	3	0	2	4

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7. Write a Program to implement Rotation Cipher
8. Create a Virtual Private Network.
9. Write a Program to implement Simple RSA Algorithm with small numbers.
10. Write a Program to implement Simple Diffie- Hellman Key Exchange Algorithms with small numbers.

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BTCSIT505N	DSC	Big Data Analytics	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Objectives:
The objectives of this course are to make the students to:
1. Introduce students to Big Data Analysis using HADOOP.
2. Introduce to Hadoop Eco System, HDFS, commands, management and map reduce.
3. Understating Spark basics and its commands
4. Spark SQL, data frames and operations

Course Outcomes:
At the end of the course, students shall be able to:
1. Install Hadoop, configure HDFS, Hbase Installation run commands
2. Develop an understanding of the complete open-source Hadoop ecosystem and its near-term future direction.
3. Understand the functions and features of HDP.
4. Understand the MapReduce model v1 and review java code.
5. Appreciate the influence of big data for business decisions and approach

SYLLABUS

UNIT–I **10 HRS**

HADOOP: Why Hadoop or Hadoop as a solution. Custom Input and Output Formats: The Writable Interface, WritableComparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, BytesWritable, NullWritable, ObjectWritable and GenericWritable, Writable collections, Implementing a Custom Writable: Implementing a RawComparator for speed, Custom comparators. Storage Formats, Partitioner, Combiner. YARN architecture. HDFS Federation, Centralized cache management, Anatomy of read/ write in HDFS and also working of Mapreduce. Phases of Mapreduce (Map,shuffing,sorting,reduce,partitioning), Compare Hadoop vs traditional systems, Limitations and Solutions of existing Data Analytics Architecture.

UNIT–II **8HRS**

Spark Basics: What is Apache Spark? What are RDDs ? In addition, refer to following link to white paper mentioned below. What are the advantages and limitations of Apache Spark when compared with MapReduce? RDD Operations - Transformations, Actions and Lazy Evaluation in RDD, Accumulators and Broadcast Variables, What is SparkConf? What is SparkContext?

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BTCSIT505N	DSC	**Big Data Analytics**	60	20	20	30	20	3	0	2	4

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what is SparkSession?, How shuffling happens in Spark?, Installation of SPARK in local mode, Stand Alone Mode , on YARN cluster. How Spark works in cluster mode - concepts of Driver, Master, Slave and how it works. Spark UI - Launch Spark UI, debug a Job, Look at stderr and stdout logs. Monitor jobs, tasks, stages, memory utilization, DAG etc. Run SPARK using spark-shell and spark-submitter.

UNIT–III **9HRS**

Spark Commands: Follow the programming guide to spark(http://spark.apache.org/docs/latest/programming-guide.html), Follow the written examples of spark (https://spark.apache.org/examples.html , https://github.com/apache/spark/tree/master/examples/src/main/scala/org/apache/spark/examples), Follow Apache Spark API by example EBook (https://unify.impetus.co.in/BigData/_layouts/15/WopiFrame.aspx?sourcedoc=/BigData/Shared%20Documents/E-Books/SparkAPIMaster.pdf&action=default)

UNIT–IV **7HRS**

Spark Streaming: What is Spark Streaming? What is StreamingContext & JavaStreamingContext?, What are DStreams? Transformations on Dstreams. Windows operations, join, output, caching, persistence on DStream, Checkpointing in Spark, Integration with Kafka or any MQ for streaming, Follow the programming guide to Spark Streaming (https://spark.apache.org/docs/latest/streaming-programming-guide.html)

UNIT–V **8HRS**

Spark SQL and DataFrames & Spark Structued Streaming: What is Spark SQL ? What is SQLContext, HiveContext ?Differences between SQLContext and HiveContext? When to use which context, Follow the programming guide to Spark SQL (https://spark.apache.org/docs/latest/sql-programming-guide.html), What are DataFrames? DataFrames Concept & Operations, Create DataFrames from HDFS, RDD, Hive Table, Join, Aggregate, Filters, Group By, Order By, Persist, Window functions, Stastical, Math functions etc. in DataFrame, Integrate Hive metastore with Spark (both new and existing metastore), Limitations of using Hive in Spark, Basic Concepts (Unbounded Table, Triggers), Output Modes, Late data Arrival/Fault Tolerance Pricipals, Data Frames & Streaming Datasets, Eventtime windowing & watermarking, Stream-Stream Joins, Sinks, Stateful Operations, Deduplications.

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BTCSIT505N	DSC	**Big Data Analytics**	60	20	20	30	20	3	0	2	4

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Text Books:

1. Tom White," Hadoop: The Definitive Guide Paperback – 2015" Shroff Publishers & Distributers Private Limited - Mumbai; Fourth edition (2015).
2. V. K. Jain (Author)," Big Data and Hadoop" Khanna Publishers; 1 edition (1 June 2015)
3. Jason Bell (Author) "Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" Wiley (2014)
4. Big Data Analytics & Hadoop by IBM ICE Publications

References:

1. SPARK WHITE PAPER: http://www.cs.berkeley.edu/~matei/papers/2010/hotcloud_spark.pdf
2. RDDs WHITE PAPER: https://www.cs.berkeley.edu/~matei/papers/2012/nsdi_spark.pdf
3. SPARK STREAMING WHITE PAPER: http://www.eecs.berkeley.edu/Pubs/TechRpts/2012/EECS-2012-259.pdf
4. https://spark.apache.org/docs/latest/ml-guide.html
5. https://spark.apache.org/docs/1.1.0/mllib-guide.html
6. https://acadgild.com/blog/machine-learning-using-spark/
7. http://spark.apache.org/docs/latest/ml-guide.html
8. http://spark.apache.org/docs/latest/ml-advanced.html
9. https://www.mapr.com/blog/apache-spark-machine-learning-tutorial

SUGGESTED LIST OF EXPERIMENTS:

1. List all the movies and the number of ratings
2. List all the users and the number of ratings they have done for a movie
3. List all the Movie IDs which have been rated (Movie Id with at least one user rating it)
4. List all the Users who have rated the movies (Users who have rated at least one movie)
5. List of all the User with the max ,min ,average ratings they have given against any movie
6. List all the Movies with the max ,min, average ratings given by any user.

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BTIT507N	SEC	**Programming with Python**	0	0	0	60	40	0	0	4	2

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COURSE OBJECTIVES

1. To develop proficiency in creating based applications using the Python Programming Language.
2. To be able to understand the various data structures available in Python programming language and apply them in solving computational problems.
3. To be able to do testing and debugging of code written in Python.
4. To be able to draw various kinds of plots using PyLab.
5. To be able to use generators for generating series like fibonacci.

COURSE OUTCOMES

Upon completion of this course, the student will be able apply technical knowledge and perform specific technical skills, including:

1. Ability to create robust applications using the Python programming language.
2. Ability to test and debug applications written using the Python programming language.
3. Ability to create applications for solving computational problems using the Python Programming Language.

SYLLABUS

UNIT–I 10 HOURS

Introduction to Python: The basic elements of Python, Branching programs, Strings and Input, Iteration. Functions, Scoping and Abstraction: Functions and Scoping, Specifications, Recursion, Global variables, Modules, Files.

UNIT–II 9 HOURS

Testing and Debugging: Testing, Debugging. Structured Types, Mutability and Higher order Functions: Tuples, Lists and Mutability, Functions as Objects, Strings, Tuples and Lists, Dictionaries.

UNIT–III 8 HOURS

Exceptions and assertions: Handling exceptions, Exceptions as a control flow mechanism, Assertions. Classes and Object oriented Programming: Abstract Data Types and Classes, Inheritance, Encapsulation and information hiding.

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BTIT507N	SEC	**Programming with Python**	0	0	0	60	40	0	0	4	2

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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UNIT–IV **10 HOURS**

Numpy and Pandas: Python list vs NumPy arrays, Creating a NumPy Array, Basic ndarray, Shape of NumPy array, Size of NumPy array,Random numbers in ndarray, The Shape and Reshaping of NumPy Array, Dimensions of NumPy array, Reshaping a NumPy array, Flattening a NumPy array, Transpose of a NumPy array, Indexing and Slicing of NumPy Array.

Pandas Series, Pandas DataFrames, Common Operations in Pandas, How to Deal With Missing Data in Pandas, How To Merge DataFrames in Pandas, How To Join DataFrames in Pandas, How to Concatenate DataFrames in Pandas. Data Input and Output in Pandas, How to Save Pandas DataFrames. Data visualization

UNIT–V **8 HOURS**

Matplotlib: Matplotlib Introduction, Line Chart, Scatter Plot , Bar Graph, Histogram, Subplots , Pie Chart , Pyplot, Matplotlib with Pandas and Numpy. Specify Color, Markings and Lline Styles, Adjust Thickness, Label Tilte, and Legend

TEXT BOOKS:

1. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India
2. Allen Downey, Jeffrey Elkner and Chris Meyers "How to think like a Computer Scientist, Learning with Python", Green Tea Press.
3. Mark Lutz "Learning Python" O'Reilly Media; 5 edition.
4. David Beazley "Python Cookbook, Third edition" O'Reilly Media

REFERENCES:

1. Python Essential Reference, 4th Edition Addison-Wesley Professional.
2. Mark Lutz "Programming Python: Powerful Object-Oriented Programming "David Beazley "Python Cookbook" Third edition, O'Reilly Media

LIST OF EXPERIMENTS:

1. Write a Python Program to Print Hello world!
2. Write a program to demonstrate different number data types in Python.
3. Write a program to perform different Arithmetic Operations on numbers in Python.
4. Write a Program to Swap Two Variables.

Chairperson	Chairperson	Controller of Examination	Joint Registrar
Board of Studies	Faculty of Studies	Shri Vaishnav Vidyapeeth	Shri Vaishnav Vidyapeeth
Shri Vaishnav Vidyapeeth	Shri Vaishnav Vidyapeeth	Vishwavidyalaya, Indore	Vishwavidyalaya, Indore
Vishwavidyalaya, Indore	Vishwavidyalaya, Indore		

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Shri Vaishnav Institute of Information Technology
Choice Based Credit System (CBCS) in the light of NEP-2020
B.Tech. (CSE - Big Data and Cloud Engineering – Impetus Technologies)
SEMESTER-V(2023-2027)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTIT507N	SEC	**Programming with Python**	0	0	0	60	40	0	0	4	2

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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5. Write a Program to Convert Celsius to Fahrenheit.
6. Write a Program to Find the Largest Among Three Numbers.
7. Write a Program to Check Prime Number.
8. Write a Program to Find the Factorial of a Number.
9. Write a Program to Print the Fibonacci sequence.
10. Write a program to create, append, and remove lists in python.
11. Write a program to demonstrate working with tuples in python.
12. Write a program to demonstrate working with set in python.
13. Write a program to demonstrate working with dictionaries in python.
14. Write a program to find reverse of given number using function.
15. Write a python Program to call data member and function using classes and objects
16. Write a program to read 3 subject marks and display pass or failed using class and object.
17. Write a program in Python to handle user defined exception for given problem
18. Write a program using a Numpy module to create an array and check the following:
    a. Type of array b. Axes of array c. Shape of array c. Type of elements in array
19. Write a python program to concatenate the dataframes with two different objects
20. Write a Python program to Demonstrate how to Draw a Scatter Plot, Bar Graph and Pie Chart using Matplotlib.

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BTIT508M	SEC	**No SQL and MongDB**	0	0	0	30	20	0	0	2	1

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Course Objectives

1. Understand NoSQL
2. Analyze the MongoDB Architecture
3. Understand the working of Atlas Search

Course Outcomes

1. Understanding NoSQL Database Concepts
2. Demonstrate Proficiency in MongoDB Operations
3. Investigate Advanced MongoDB Features
4. Design Database and Data Modelling Skills
5. Apply NoSQL development tools on Real-World Scenarios

Unit 1 **10HRS**

NoSQL Database: Types of NoSQL Database, Brief History of NoSQL Databases, NoSQL Database Features, Relational database vs NoSQL database example, Differences between RDBMS and NoSQL databases, NoSQL use cases, NoSQL Database Misconceptions

Unit 2 **9HRS**

Introduction to MongoDB: MongoDB Atlas, MongoDB and Document Object Model, CRUD Operation, MongoDB Aggregation, Using $match and $group Stages in a MongoDB Aggregation Pipeline, Using $sort and $limit Stages in a MongoDB Aggregation Pipeline, Using $project, $count, and $set Stages in a MongoDB Aggregation Pipeline, Using $out Stage in a MongoDB Aggregation Pipeline

Unit 3 **8HRS**

MongoDB Indexes: Using MongoDB Indexes in Collections, Creating a Single Field Index in MongoDB, Creating a Multikey Index in MongoDB, Working with Compound Indexes in MongoDB, Deleting MongoDB Indexes

Unit 4 **10 HRS**

Atlas Search: Using Relevance-Based Search and Search Indexes, creating a Search Index with Dynamic Field Mapping, Creating a Search Index with Static Field Mapping, Using $search and Compound Operators, Grouping Search Results by Using Facets

Unit 5 **8 HRS**

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MongoDB Data Modelling: Types of data relationships, modelling, embedding data in documents, referencing data in documents, scaling data model, Using Atlas Tools for Schema Help, MongoDB transactions

List of Mini Projects

- **Build a Mini-Application**: Create a sample application (e.g., a task manager, blog platform, or e-commerce site) using MongoDB as the database backend. Implement all CRUD functionalities and data modeling techniques learned in class.
- **Performance Benchmarking**: Conduct performance tests comparing the execution time of queries on indexed versus non-indexed collections to understand the importance of indexing in MongoDB

Books

1. MongoDB University, https://learn.mongodb.com/
2. Marko Aleksendric, Arek Borucki, Leandro Domingues. Mastering MongoDB 7.0 - Fourth Edition: Achieve data excellence by unlocking the full potential of MongoDB, 4th Edition. MongoDB Press
3. Rachelle Palmer, Ben Perlmutter, Ashwin Gangadhar, Nicholas Larew, Sigfrido Narváez , Thomas Rueckstiess, Henry Weller, Richmond Alake, Shubham Ranjan. Building AI Intensive Python Applications: Create intelligent apps with LLMs and vector databases. 1st Edition. MongoDB Press