Savitribai Phule Pune University
(Formerly University of Pune)

Department of Technology
Board of Studies, Electronics and Electrical Technology(EE)
Curriculum Structure for BSc in Blockchain Program

Sr. No.	Subject Code	Subject Name	Credits	Teaching Scheme (Theory)	Teaching Scheme (Lab)
Semester (I)					
1	BSCBT1	Introduction to The Fundamentals of Blockchain	4	√	
2	BSCBT2	Applied Mathematics	4	√	
3	BSCBT3	Basics of C & C++ Languages	4	√	
4	BSCBT4	Database Management System (DBMS)	2	√	
5	BSCBT5	C & C++ Programming Lab	4		√
6	BSCBT6	English Communication	4	√	
Semester (II)					
7	BSCBT7	Smart Contracts and DApps	4	√	
8	BSCBT8	Java Programming	4	√	
9	BSCBT9	Blockchain Platforms	4	√	
10	BSCBT10	Data Analytic and Visualization	2		√
11	BSCBT11	Java Programming LAB	4		√
12	BSCBT12	Networks and Implementation of Blockchain	4	√	
Semester (III)					
13	BSCBT13	Blockchain Development and Deployment	4	√	
14	BSCBT14	Data warehouse and Data Mining	4	√	
15	BSCBT15	Python Programming Language.	4	√	
16	BSCBT16	Machine Learning	2		√

#	Code	Subject	Credits		
17	BSCBT17	Blockchain Business Application Lab	2		√
18	BSCBT18	Python Programming Language.- Lab	4		√
19	BSCBT19	Seminar-1	2		√
Semester (IV)					
20	BSCBT20	Deep Dive Hyperledger	4	√	
21	BSCBT21	Deep Dive Ethereum	4	√	
22	BSCBT22	Big Data Analytics through Spark	4	√	
23	BSCBT23	Deep Dive Hyperledger - LAB	4		√
24	BSCBT24	Deep Dive Ethereum -LAB	2		√
25	BSCBT25	Regulatory And Policy Considerations of Blockchain Technology	2		√
26	BSCBT26	Seminar-2	2		√
Semester (V)					
27	BSCBT27	Blockchain Security and Risk Management	4	√	
28	BSCBT28	Introduction to Artificial Intelligence	4	√	
29	BSCBT29	Digital Marketing Strategies with Blockchain	4	√	
30	BSCBT30	Supply Chain Transparency with Blockchain	4	√	
31	BSCBT31	Cyber & Data Security	2		√
32	BSCBT32	Artificial Intelligence (use of AI in Blockchain Application) - LAB	2		√
33	BSCBT33	Min Project Work – (IoT/Machine Learning with blockchain application)	2		√
Semester (VI)					
34	BSCBT34	Decentralized HR Management	3	√	
35	BSCBT35	Decentralized Finance (DeFi) with Blockchain	3	√	
36	BSCBT36	Blockchain Project Management	4	√	
37	BSCBT37	Internship with Project Work-Major	12		√

		Total Credits	132		
		BSc Blockchain Technology degree with Honors			
Semester (VII)					
38	BSCBT38	Generative AI - I	4	√	
39	BSCBT39	Reinforcement Learning in Blockchain	4	√	
40	BSCBT40	Research Methodology	4	√	
41	BSCBT41	Generative AI -I LAB	2		√
42	BSCBT42	Reinforcement Learning- LAB	2		√
43	BSCBT43	Capstone Project-I	4		√
44	BSCBT44	Massive Open Online Courses (MOOCs)	2		√
Semester (VIII)					
45	BSCBT45	Generative AI - II	4	√	
46	BSCBT46	Ethics in AI	4	√	
47	BSCBT47	Data Visualization- MS BI	4	√	
48	BSCBT48	Generative AI – II LAB	2		√
49	BSCBT49	Data Visualization-LAB	2		√
50	BSCBT50	Capstone Project-II	4		√
51	BSCBT51	Seminar – 3	2		√
		Total Credits	**176**		

Savitribai Phule Pune University(Formerly University of Pune)

Department of Technology
STRUCTURE OF THREE YEAR FULL TIME B.SC GRADUATE PROGRAM COURSE
IN
BLOCKCHAIN TECHNOLOGY (BSCBT)

Semester	Lectures per Week	Course Credits
1st Semester	23	22
2nd Semester	23	22
3rd Semester	25	22
4th Semester	25	22
5th Semester	24	22
6th Semester	22	22
7th Semester	22	22
8th Semester	22	22
Total		Course Credits - 176

Eligibility Criteria:

- **Minimum 50% aggregate score in 10+2/Class 12th or in equivalent examination in science stream with Mathematics subject (at least 45% marks, in case of Backward class category candidate belonging to Maharashtra State only)**

OR

- **Minimum 55% aggregate score in any 3 years Engineering Diploma from any UGC approved University or equivalent.**

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In Seminar-1, Seminar-2 we will survey the fundamentals of blockchain technology by reading state of the art research papers in this area. This class will cover the basics of how to manipulate, integrate, and analyze data at scale. To receive credit, students must give in-class presentationsand complete a final project.

B.Sc. Blockchain Technology

Semester-I

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT1	Introduction to fundamentals of Blockchain	2		2	2		2	4
BSCBT2	Applied Mathematics	2		2	2		2	4
BSCBT3	Basics of C, C++ languages	2		2	2		2	4
BSCBT4	Database Management System (DBMS)	2			2			2
BSCBT5	C and C++ Programming Lab		2X2=4			4		4
BSCBT6	English Communication	2		2	2		2	4
Total		12	4	4	14	4	4	22
Total Contact Hours per Week=22					Total Credits=22			

Semester-II

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT7	Smart Contracts and DApps	2		2	2		2	4
BSCBT8	Java Programming	2		2	2		2	4
BSCBT9	Blockchain Platforms	2		2	2		2	4
BSCBT10	Data Analytics & Visualization		2X1=2			2X1=2		2
BSCBT11	Java Programming LAB		2X2=4			4		4
BSCBT12	Networks and Implementation of Blockchain	2		2	2		2	4
Total		8	6	8	8	6	8	22
Total Contact Hours per Week=22					Total Credits=22			

Semester-III

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT13	Blockchain Development andDeployment	2		2	2		2	4
BSCBT14	Data warehouse and DataMining	2		2	2		2	4
BSCBT15	Python Programming Language.	2		2	2		2	4
BSCBT16	Machine Learning		2X1=2			2		2
BSCBT17	Blockchain Business Application Lab		2X1=2			2		2
BSCBT18	Python Programming Language.- Lab		2X2=4			4		4
BSCBT19	Seminar-1			2		2		2
Total		6	8	8	6	8	8	22
Total Contact Hours per Week=22					Total Credits=22			

Semester-IV

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT20	Deep Dive Hyperledger	2		2	2		2	4
BSCBT21	Deep Dive Ethereum	2		2	2		2	4
BSCBT22	Big Data Analytics through Spark	2		2	2		2	4
BSCBT23	Deep Dive Hyperledger – LAB		2X2=4			4		4
BSCBT24	Deep Dive Ethereum –LAB		2X1=2			2		2
BSCBT25	Regulatory And Policy Considerations of Blockchain		2X1=2			2		2
BSCBT26	Seminar-2			2			2	2
Total		6	8	8	6	8	8	22
Total Contact Hours per Week=22					Total Credits=22			

Semester-V

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT27	Blockchain Security and Risk Management	2		2	2		2	4
BSCBT28	Introduction to Artificial Intelligence	2		2	2		2	4
BSCBT29	Digital Marketing Strategies with Blockchain	2		2	2		2	4
BSCBT30	Supply Chain Transparency with Blockchain	2		2	2		2	4
BSCBT31	Cyber & Data Security		2X1=2			2		2
BSCBT32	Artificial Intelligence (use of AI in Blockchain Application) -LAB		2X1=2			2		2
BSCBT33	Min Project Work – (IoT/Machine Learning with blockchain application)		2X1=2			2		2
Total		**8**	**6**	**8**	**8**	**6**	**8**	**22**
Total Contact Hours per Week=22					**Total Credits=22**			

Semester-VI

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P		L	P		Total
BSCBT34	Decentralized HR Management	3			3			3
BSCBT35	Decentralized Finance (DeFi) with Blockchain	3			3			3
BSCBT36	Blockchain Project Management	4			4			4
BSCBT37	Internship with Project Work – Major		2X6=12			6		12
Total		**10**	**12**		**12**	**10**		**22**
Total Contact Hours per Week=22					**Total Credits=22**			

Semester-VII

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT38	Generative AI – I	2		2	2		2	4
BSCBT39	Reinforcement Learning in Blockchain	2		2	2		2	4
BSCBT40	Research Methodology	2		2	2		2	4
BSCBT41	Generative AI -I LAB		2X1=2			2		2
BSCBT42	Reinforcement Learning- LAB		2X1=2			2		2
BSCBT43	Capstone Project-I		2X2=4			4		4
BSCBT44	Massive Open Online Courses (MOOCs)			2			2	2
Total		**6**	**8**	**8**	**6**	**8**	**6**	**22**
Total Contact Hours per Week=23					**Total Credits=22**			

Semester-VIII

Subject Code	Subjects Name	Contact Hours per Week			Credits			
		L	P	T	L	P	T	Total
BSCBT45	Generative AI – II	2		2	2		2	4
BSCBT46	Ethics in AI	2		2	2		2	4
BSCBT47	Data Visualization- MS BI	2		2	2		2	4
BSCBT48	Generative AI – II LAB		2X1=2			2		2
BSCBT49	Data Visualization-LAB		2X1=2			2		2
BSCBT50	Capstone Project-II		2X2=4			4		4
BSCBT51	Seminar – 3			2			2	2
Total		**6**	**8**	**8**	**6**	**8**	**6**	**22**
Total Contact Hours per Week=22					**Total Credits=22**			

Introduction to Blockchain Technology: Why blockchain matters more than you think,What is Blockchain?,How does a Blockchain work,The origins of blockchain, Blockchain Applications.

Basic Cryptography: Blockchain came from Bitcoin, Why is Blockchain a Distributed, P2P Network?, Blockchain Vs Cryptocurrency, Types of Blockchain.

Cryptocurrency and Bitcoin: What Are Different Blockchain Technologies?,Benefits of using Blockchain Technology,The Origin of BlockchainCompleted, Blockchain came from Bitcoin.

Basic Understanding of Blockchain: Why blockchain matters more than you think What is Blockchain and what is it going to change The Origin of Blockchain, A deeper dive into understanding Blockchain Overview of Blockchain.

Basics of Blockchain: Blockchain Technology, The Evolution of Blockchain Technology, Blockchain Technology – Basics, Introduction to the Decentralized Web Introduction to Distributed Ledgers, Merkle Tree and Hashing, Blocks, Wallets, and Addresses, Public and Private Key.

Consensus Algorithms: Cryptography and Cryptographic Algorithms, Transaction Execution and Distribution, Components of Blockchain Ecosystem, Blockchain Architecture.

References:
1. The Basics of Bitcoins and Blockchains by Anthony Lewis, Two Rivers Distribution
2. Blockchain Explained: A Pragmatic Approach by Srihari Kapu,
3. Blockchain Technology by Chandramouli Subramanian , University Press India

BSCBT2: Applied Mathematics

Calculus: Introduction to Limits ,Continuity and Differentiability, Rules of Differentiation, Applications of Derivatives, Indefinite and Definite Integrals, Applications of Integrals, Fundamental Theorem of Calculus.

Linear Algebra: Matrices and Matrix Operations, Determinants and Properties, Vector Spaces and Subspaces, Linear Independence and Basis, Eigenvalues and Eigenvectors, Diagonalization.

Ordinary Differential Equations (ODEs): Introduction to ODEs,First-Order ODEs ,Second-Order Linear ODEs, Higher-Order ODEs, Systems of ODEs, Boundary Value Problems, Laplace Transforms and ODEs.

Probability and Statistics: Probability Concepts and Definitions, Random Variables and Probability Distributions, Probability Density Functions (PDFs),Expectation and Variance, Discrete and Continuous Probability Distributions, Hypothesis Testing, Regression Analysis.

Complex Analysis: Complex Numbers and Operations, Analytic Functions and Cauchy-Riemann

Equations, Complex Integration and Cauchy's Theorem, Taylor and Laurent Series, Residue Theorem and Contour Integration, Conformal Mapping.

Numerical Methods: Root Finding Methods, Numerical Integration Techniques, Numerical Solutions of ODEs Interpolation and Approximation.

References:

1. Gilbert Strang, Linear Algebra and its Applications. Thomson /Brooks Cole (Available in a Greek Translation).
2. Thomas M. Apostol, Calculus, Wiley, 2nd Edition, 1991 ISBN 960-07-0067-2.
3. Michael Spivak. Calculus, publish or Perish, 2008, ISBN 978-0914098911.
4. Ross L. Finney, Maurice D.Weir . and Frank R. Giordano. Thomas's Calculus, Pearson 12th Edition 2009.
5. David C. Lay, Linear Algebra and Its Applications, 4th Editoin.
6. Yourself saad, Iterative Methods for spare Linear Systems.
7. C.L. Liu, D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition, Tata McGraw Hill, 1985.
8. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition, McGraw Hill 2006
9. T.H.Coremen, C.E.Leiserson, R. L. Rivest, Introduction to algorithms, 3rd edition Prentice Hall on India,
10. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms, John wiley Publication, 1988
11. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
12. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers, 2008
13. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., PrenticeHall of India Pvt. Ltd., New Delhi, 2004.
14. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
15. A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984.
16. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.

BSCBT3: Basics of C, C++ languages

Introduction to C and C++ Programming: Introduction to Programming, History and Evolution of C and C++,Getting Started with a C/C++ Program,Structure of a C/C++ Program, Data Types, Variables, and Constants, Input and Output in C and C++.

Control Structures and Functions: Conditional Statements (if, else if, switch), Loops (for, while, do-while), Functions and Function
Prototypes, Passing Arguments to Functions, Recursion, Scope and Lifetime of Variables, Inline Functions.

Data Types and Operators: Basic Data Types (int, float, double, char, etc.), Operators (arithmetic, relational, logical, bitwise, etc.), Type Casting and Type Conversion, Enumerated Types, Storage Classes (auto, extern, static, register).

Arrays and Pointers: Introduction to Arrays, Single-Dimensional Arrays, Multidimensional Arrays, Introduction to Pointers, Pointers and Arrays, Pointers and Functions, Dynamic Memory Allocation (malloc, calloc, realloc, free).

C and C++ Standard Libraries: Standard Input/Output Library (stdio.h), Standard Template Library (C++ only), String Handling Functions (string.h), Math Functions (math.h), File Input/Output (stdio.h), Exception Handling (C++ only).

Object-Oriented Programming (C++): Classes and Objects, Constructors and Destructors, Inheritance and Polymorphism, Operator, Overloading, Templates, Standard Template Library (STL).

BSCBT4: Database Management System (DBMS)

Introduction to Database: Introduction to Database Management Systems, Importance of Data Management, Evolution of DBMS,Types of DBMS (Relational, NoSQL, Object-Oriented, etc.), Data Models (Relational,Entity-Relationship, Hierarchical, Network, Object-Oriented).

Relational Database Management System (RDBMS): Relational Data Model, Tables, Rows, and Columns, Keys (Primary, Foreign, Candidate, Super), Entity-Relationship Diagrams (ERD), Normalization (1NF, 2NF, 3NF, BCNF), Structured Query Language (SQL), SQL Data Types, SQL Query Basics (SELECT, FROM, WHERE, etc.)SQL Joins (INNER JOIN, LEFT JOIN, RIGHT JOIN), SQL Aggregation (GROUP BY, HAVING), SQL Subqueries.

Database Design: Conceptual, Logical, and Physical Database Design, Schema and Instance, Data Integrity and Constraints, Indexing and Query Optimization, Denormalization, Data Warehousing and Data Mining (optional).

Transaction Management and Concurrency Control: ACID Properties (Atomicity, Consistency, Isolation, Durability), Transaction Processing, Concurrency Control Techniques, Deadlocks and Deadlock Prevention.

Database Security and Authorization: Data Security and Privacy, User Authentication and Authorization, Role-Based Access Control, Security Threats and Countermeasures.

NoSQL Databases (Optional): Introduction to NoSQL Databases, Types of NoSQL, Databases (Document, Key-Value, Column-Family, Graph), Comparing SQL and NoSQL Databases, Use Cases for NoSQL Databases.

BSCBT5: C & C++ Programming Lab

Advanced Topics (Optional): Memory Management and Smart Pointers (C++), Multi-threading (C++), File Handling and Streams (C++), Exception Handling (C++), Preprocessor Directives, Debugging and Testing Techniques.

Project Work (Practical Application): Real-world problem-solving using C and C++, Developing a small project or application.

Introduction to English Communication: Importance of Effective Communication, The Role of Communication in Science andTechnology, Types of Communication (Verbal and Non-verbal), Barriers to EffectiveCommunication, Overcoming Communication Challenges.

Speaking and Presentation Skills: Developing Confidence in Speaking, Public Speaking and Presentation Techniques, VoiceModulation and Articulation, Non-verbal Communication (Body Language, Gestures),Effective Use of Visual Aids (Slides, Charts, Graphs),Handling Questions and Feedback.

Listening and Comprehension: Active Listening Skills, Note-taking Techniques, Understanding Different Accents, Listeningto Technical and Scientific Discourse, Summarizing and Paraphrasing Information.

Reading and Comprehension: Developing Reading Habits, Reading Strategies for Technical Texts, Skimming and Scanning, Critical Reading and Analyzing Scientific Articles, Vocabulary Building through
Reading.

Writing Skills: Principles of Effective Writing, Scientific and Technical Writing Style, Structuring Essays and Reports, Writing Research Papers and Lab Reports, Proofreading and Editing, Writing
for Different Audiences (Academic, Professional, General).

Professional and Academic Communication:
Email Etiquette in Academic and Professional Settings, Writing Cover Letters and Resumes,Communicating in Group Projects, Peer Review and Feedback, Ethical Considerations in Communication (Plagiarism, Citations).

BSCBT7 : Smart Contracts and Decentralized Applications (DApps)

Smart Contracts: Introduction to smart contracts, Introduction to smart contracts platforms, Smart contract structure, Development, Deployment & Testing of smart contracts, Use cases & case studies.

Solidity Programming Language: Basics of solidity, Variables & Data types, Control structures, Functions & modifiers, Events & logging, Storage & memory management, Error handling.

Developing Smart Contracts: Setting up Developing Environment, Creating first smart contract, Solidity fundamentals, Smart contract interactions.

Decentralized Applications (DApps): Introduction to Decentralized Applications(DApps), Blockchain platforms for DApp development, Development Environment set up, Front End development for DApps, Structure of DApp, DApp development.

Use Cases of Smart Contracts and DApps: Use cases of Smart Contracts & DApps.

Legal Considerations: Security Challenges & Measures, Smart contract platforms, Smart Contract Implementation Ricardian Contracts & Smart Contracts Practice.

References

1. Andreas M. Antonopoulos and Gavin Wood, "Mastering Ethereum: Building Smart Contracts andDApps", O'Reilly Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly
2. Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment Paperback – 6 December 2019 by David Hoover, O' Really
3. Smart Contracts and Comparative Law: A Western Perspective by Andrea Stazi, Springer Publications

BSCBT8: Java Programming

Introduction to Java: History and Evolution of Java, Advantages of Java, Java Development Environment (JDK, JRE, IDEs), Writing and Running a Simple Java Program, Basic Structure of a Java Program.

Variables and Data Types: Variables and Constants, Primitive Data Types (int, float, double, char, boolean), Declarations and Initialization, Type Casting and Conversion, String Data Type, Java Naming Conventions.

Operators and Expressions: Arithmetic Operators, Relational Operators, Logical

Operators, Assignment Operators, Increment and Decrement Operators, Operator Precedence, Expressions and Statements.

Control Flow: Conditional Statements (if, else if, else), Switch Statement, Loops (while, do-while, for), Break and Continue Statements, Nesting of Control Structures.

Functions and Methods: Defining Functions (Methods), Method Signature and Return Types, Method Parameters and Arguments, Method Overloading, Scope and Lifetime of Variables, Calling Methods, Recursion.

Arrays and Collections: Declaring and Initializing Arrays, Accessing Array Elements, Multidimensional Arrays, Introduction to Collections (ArrayList, HashMap, etc.), Iterating Over Collections.

<center>BSCBT9: Blockchain Platforms</center>

Introduction to Blockchain Platforms: What are Blockchain Platforms?, Types of Blockchain Platforms, Key Features and Characteristics, Blockchain as a Service (BaaS), Use Cases and Adoption Trends.

Ethereum and Smart Contract Platforms: Introduction to Ethereum, Ether (ETH) and Gas, Ethereum Virtual Machine (EVM), Developing Smart Contracts on Ethereum, Ethereum 2.0 and Proof of Stake.

Hyperledger Fabric: Overview of Hyperledger Project, Key Features of Hyperledger Fabric, Permissioned Blockchain Networks, Chaincode (Smart Contracts) in Fabric, Use Cases and Business Applications.

Corda and R3 Platforms : Introduction to Corda, Corda's Approach to Privacy, Smart Contracts in Corda, Corda Enterprise Solutions, Use Cases in Financial Services.

Binance Smart Chain (BSC) and Other Public Chains: Binance Smart Chain (BSC),Tron (TRX) and EOSIO, Interoperability and Cross-Chain Communication, Delegated Proof of Stake (DPoS), Public vs. Private Blockchains.

Tezos and Self-Amending Blockchains: Introduction to Tezos, On-Chain Governance in Tezos, Baking and Staking on Tezos, Self-Amending Protocol Upgrades, Use Cases and Innovations, Hyperledger Fabric Explained, Hyperledger vs. Permission-less Blockchains, Ethereum VS Hyperledger Fabric, What is the difference between a cryptocurrency coin and a token.

References

1. Matt Zand, Xun (Brian) Wu, and Mark Anthon, "Hands-on Smart Contract Development with Hyperledger Fabric V2: Building

2. Enterprise Blockchain Applications", O'ReillyMastering Ethereum: Building Smart Contracts and DAppsby Andreas M. Antonopoulos and Dr. Gavin Wood, O' Reilley

BSCBT10: Data Analytics and Visualization

Introduction to Data Analytics and Visualization with Power BI: Overview of Data Analytics and Visualization, Introduction to Power BI, Installation and Setup of Power BI Desktop, Tour of Power BI Interface, Data Sources and Data Loading.

Data Preparation and Transformation in Power BI: Data Cleaning and Data Transformation, Data Modeling with Power Query Editor, Data Integration from Multiple Sources, Handling Missing Data, Data Types and Formatting.

Creating Basic Visualizations: Introduction to Visualizations in Power BI, Creating Tables and Matrix Visuals, Building Bar and Column Charts, Line and Area Charts, Pie and Donut Charts, Cards and KPIs.

Advanced Visualizations in Power BI: Scatter Plots and Bubble Charts, Waterfall and Funnel Charts, Gauges and Cards with States, Treemaps and Sunburst Charts, Maps and Geographic Visualization, Drillthrough and Drilldown.

Data Interactivity and Filtering: Filtering Data Using Slicers, Cross-filtering and Drillthrough, Creating Hierarchies, Measures and Calculated Columns, Time Intelligence Functions.

Dashboard Design and Layout: Principles of Effective Dashboard Design, Designing Dashboards in Power BI, Arranging and Formatting Visuals , Themes and Styles, Mobile-Friendly Design.

BSCBT11: Java Programming LAB:

Introduction to Java Programming: Setting up the Java Development Environment (JDK, IDE), Writing and Running Your First Java Program, Basic Input and Output (Scanner class), Variables, Data Types, and Constants, Operators and Expressions, Control Structures (if else, switch), Practice Exercises and Simple Programs.

Object-Oriented Programming (OOP) in Java: Classes and Objects, Constructors and Methods, Inheritance and Polymorphism, Encapsulation and Data Hiding, Method Overriding, Creating and Using Objects, Practice Exercises and Mini Projects.

Data Structures and Algorithms in Java: Arrays and Array List, Iterating through Collections, Searching and Sorting Algorithms (e.g., linear search, binary search), Linked Lists (Singly and Doubly Linked Lists), Stacks and Queues, Recursion and Recursive Algorithms, Practice Implementations and Problem Solving.

File Handling, Exception Handling, and GUI (Optional): Reading and Writing Files, Exception Handling (try-catch, throw, throws), Custom Exception Classes, Introduction to GUI Programming (Swing), Building Simple Java GUI Applications, Event Handling in GUI Applications, Practice Projects and Final Lab Projects

BSCBT12: Networks and Implementation of Blockchain

Networks and Implementation of Blockchain:
Types of Blockchain Networks, The 4 Types of Blockchain Networks, Network Applications, Network Challenges, Blockchain Network Security, How Can Blockchain Help in Cyber Security?, Conceptualizing Blockchains - Characteristics and Applications, How Blockchain is set to change transactions, information flow and business processes, Which Networks to use.

References:

1. Blockchain Economics: Implications Of Distributed Ledgers - Markets, Communications Networks, And Algorithmic Reality by Frank Witte and Paolo Tasca, Standard Press
2. Blockchain Consortiums - A Comprehensive Handbook: Analyzing the Business Model of the future by Varun Singhi, Notion Press

BSCBT13: Blockchain Development and Deployment

Blockchain Development Tools: Ethereum Development Tools, Solidity Tools, Hyperledger Fabric Tools, Web3.js and Ethers.js, Corda Development Tools, NEO Development Tools, Binance Smart Chain (BSC) Tools, Solano.

Blockchain Implementation & Use cases: Why Implement Blockchain? , Benefits and Challenges of Blockchain Adoption , Considerations Before Implementation, Implementation Approaches: Public vs. Private Blockchains, Success Factors in Blockchain Implementation.

Finance & Banking Industry Introduction: The Evolution of Finance and Banking ,The Role of Technology in the Industry, Emergence of Blockchain Technology, Why Blockchain Matters in Finance and Banking, Traditional Banking Vs. Blockchain Banking: Traditional Banking Systems, Limitations and Challenges, Advantages of Blockchain Banking ,Opportunities for Innovation.

Case Study: Remittance with crypto-currencies, Case Study: Ripple Supply Chain & Logistics Introduction, Case Study: Tracking & Authenticity.

Case Study: Genuinety Health Care & Medicals Introduction, Case Study: Electronic Health Record System, Case Study: Biomedicines Research Governance & Public Services Introduction.

Case Study: Voting on Blockchain, Case Study: Public Benefit Distribution System
Case Study: Document Management & Storage.

References:

Blockchain For Business With Hyperledger Fabric: A Complete Guide To Enterprise Blockchain Implementation Using Hyperledger Fabric by Nakul Shah, BpB Publications

Blockchain Systems and Communication Networks: From Concepts to Implementation by Mubashir Husain Rehmani, Springer

BSCBT14: Data Warehouse and Mining

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Introduction to Data Warehousing and Data Mining: Overview of Data Warehousing, Motivation for Data Warehousing, Data Mining: Concepts and Importance, Data Warehouse Architecture, Data Warehouse Components.

Data Warehouse Design and ETL Process: Requirements Gathering for Data Warehousing, Dimensional Modeling (Star and Snowflake Schema), Fact Tables and Dimension Tables, Data Extraction, Transformation, and Loading (ETL), ETL Tools and Best Practices.

Data Warehouse Implementation: Data Warehouse Storage and Indexing, Data Warehouse Security Processing, Data Warehouse Maintenance and Optimization, Data Warehouse Security and Access Control, Case Studies in Data Warehousing.

Data Preprocessing for Data Mining: Data Cleaning and Integration, Data Reduction and Transformation, Handling Missing Data, Data Discretization and Binning.

Data Mining Algorithms - Part 1: Classification and Prediction, Decision Trees (CART, ID3, C4.5), Naive Bayes Classification, Rule-Based Classification, Evaluation Metrics (Accuracy, Precision, Recall).

Data Mining Algorithms - Part 2: Clustering, K-Means Clustering, Hierarchical Clustering, Association Rule Mining (Apriori Algorithm), Anomaly Detection.

Introduction to Python Programming: Introduction to Python, Setting Up the Python Development Environment, Writing and Running Your First Python Program, Understanding Python Syntax and Indentation, Using Variables and Data Types.

Control Structures and Functions: Conditional Statements (if, elif, else), Loops (while, for), Loop Control Statements (break, continue), Functions: Defining and Calling, Function Parameters and Return Values.

Data Structures: Lists: Creation, Indexing, and Slicing,Modifying Lists (Appending, Inserting, Removing), Tuples: Creation and Use, Dictionaries: Creation and Key-Value Pairs, Sets: Creation and Set Operations.

File Handling and Modules: Reading and Writing Text Files, Using Context Managers (with statement) , Introduction to Python Modules, Importing and Using Modules, Creating Your Own Modules.

Advanced Python Concepts: List Comprehensions, Exception Handling (try, except, finally), Object-Oriented Programming (Classes and Objects), Inheritance and Polymorphism, Working with Dates and Times (datetime module).

Final Project and Additional Topics: Independent Python Programming Project, Problem Statement and Design, Implementation and Testing, Presentation and Documentation Optional Topics (e.g., Virtual Environments, Basic Data Visualization).

Introduction to Machine Learning: What is Machine Learning?, Types of Machine Learning (Supervised, Unsupervised, Reinforcement Learning), Applications of Machine Learning, Machine Learning Workflow, Python and Libraries for Machine Learning (NumPy, Pandas, Scikit-Learn).

Supervised Learning: Introduction to Supervised Learning, Linear Regression, Logistic Regression, Model Evaluation and Metrics (e.g., MSE, MAE, Accuracy, Precision, Recall, F1-score),Overfitting and Underfitting.

Unsupervised Learning: Introduction to Unsupervised Learning, Clustering Algorithms (K-Means, Hierarchical Clustering), Dimensionality Reduction (Principal Component Analysis), Anomaly Detection, Use Cases and Applications.

Neural Networks and Deep Learning: Introduction to Neural Networks, Feedforward Neural Networks, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Deep Learning Frameworks (TensorFlow, Keras, PyTorch).

Model Selection and Evaluation: Cross-Validation, Hyperparameter Tuning, Model Deployment and Serving, Ethics and Bias in Machine Learning, Interpretability and Explainability.

Advanced Topics and Final Project: Transfer Learning, Generative Adversarial Networks (GANs), Natural Language Processing (NLP) and Text Mining, Reinforcement Learning (Introduction), Final Machine Learning Project.

BSCBT17: Blockchain Business Application Lab

Blockchain Business Application: Use cases on a variety of blockchain applications including supply chain, healthcare, consumer, and social impact, Learn how companies can use new technologies such as blockchain to enter new markets or turn around a flagging business, Overview of the developing blockchain ecosystem from service providers to initial coin offerings, Insights for entrepreneurs and investors on the market and how it's evolving, Identifying new opportunities in the blockchain ecosystem, Regulatory and Policy Considerations of Blockchain Technology, Latest regulatory and policy developments and governance of blockchain in major economies, Privacy and Risks in Using Blockchain Technology, Risks associated with adopting new technologies such as blockchain, including hacking, Privacy considerations around the blockchain, Future of Blockchain Technology, Trends to keep your eye on, Ways to apply these emerging technologies to your organization through a final, Blockchain Use Cases across industries,(Automobile,Manufacturing,Renewable Energy, Supply Chain,Utilities,Agriculture,Logistics,Hospitality,Construction,Civil Engineering).

References:
1. Enterprise Blockchain: A Definitive Handbook by Navveen Balani and Rajeev Hathi
2. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology by Vitalik Buterin and William Mougayar, Wiley
3. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World by Don Tapscott and Alex Tapscott, Penguin Publishers

Lab 1: Setting Up the Python Environment
Installing Python, Using Python IDEs (Integrated Development Environments), Writing and running a simple Python program

Lab 2: Basic Python Syntax
Variables and data types, Arithmetic operations, Input and output

Lab 3: Conditional Statements and Control Flow
If statements, If-else statements, Nested if statements, Conditional expressions (ternary operator)

Lab 4: Loops and Iteration
For loops, While loops, Loop control statements (break, continue), Nested loops

Lab 5: Functions
Defining and calling functions, Function parameters and return values, Scope and lifetime of variables

Lab 6: Lists and Tuples
Creating and manipulating lists, Accessing elements in lists, List comprehension, Working with tuples

Lab 7: Dictionaries and Sets
Creating and using dictionaries, Dictionary methods, creating and using sets, set operations (Union, intersection, difference)

Lab 8: File Handling
Reading and writing text files, Using context managers (with statement), Exception handling in file operations

Lab 9: List Comprehensions and Generators
List comprehensions for data transformation, Generator expressions, Working with iterators and generators

Lab 10: Object-Oriented Programming (OOP)
Defining classes and objects, Constructors and methods, Inheritance and polymorphism

Lab 11: Modules and Packages
Creating and using modules, Importing modules and functions, Organizing code into

Packages

Lab 12: Working with External Data
Retrieving data from APIs (e.g., RESTful APIs), Parsing JSON and XML data, Web scraping using libraries like Beautiful Soup

Lab 13: Data Analysis and Visualization
Using libraries like NumPy and Pandas for data analysis, Data visualization with libraries like Matplotlib and Seaborn

BSCBT20: Deep Dive Hyperledger

Deep Dive Hyperledger: What is Hyperledger?,Advantages & Disadvantages of Hyperledger, Introduction to Hyperledger Fabric, Hyperledger Fabric Model,Hyperledger Fabric Components, Hyperledger Fabric Architecture,Hyperledger Fabric Transaction Flow, Hyperledger Fabric Endorsement Flow, Hyperledger Fabric Endorsement Policies, Hyperledger Fabric Data Distribution Protocol, Hyperledger Fabric Chaincode, Structure of Chaincode, Hyperledger Fabric Certificate Authority, Hyperledger Fabric Membership Service Provider, Hyperledger Fabric Network Details,Repository Folder Structure,Create Cryptomaterials for all network Participant, Create Channel Artifacts (Genesis Block, Channel.tx file etc), Docker-Compose file Walk-through (All Services), Run All Services in Network, Create Channel and Join all Peers, Chaincode (Smart Contract) Walk-through, Downloading Smart Contract Dependency, Package & Install Chaincode, Approve Chaincode from Both Organisation, Commit Chaincode Definition on Endorsing Peer, Invoke and Query Transaction, Start Network With Single Script, Flow Diagram, Create Cryptomaterials For New Organisation, Docker-Compose file Walk-through (All Org3 Services), Create New Organisation Definition File, Configuration Update Flow, Fetch Configuration Block & Add New Organisation Definition File, Compute Update using Configtxlator Tool using Original & Modified Block, Sign & Send Updated Configuration Block to Orderer, Run Org3 Services, Join Channel & Verify Data, Introduction: Add New Organisation in Existing consortium, Add New Organisation in system Channel (Consortium) Flow,Try To Create Channel when Org is not Part Of Consortium, System Channel Update – Consortium Info Update, Create Channel and Join all Peers- After Updating Consortium with New Org, Deploy Chaincode, Invoke Transaction and Verify data in State DB, Add New Orderer in Existing Fabric Network – Flow Diagram, Create All Certificates using Certificate Authority for whole Fabric Network, Create Cryptomaterials.

References:
1. Hyperledger Fabric In-Depth: Learn, Build And Deploy Blockchain Applications Using HyperledgerFabric: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric (English Edition)by Ashwani Kumar, BPB Publications
2. Mastering Hyperledger Fabric: Master The Art of Hyperledger Fabric on docker, docker swarm and Kubernetes, 1st Edition by Narendranath Reddy Thota, BPB Publications

3. Blockchain For Business With Hyperledger Fabric: A Complete Guide To Enterprise BlockchainImplementation Using Hyperledger Fabric by Nakul Shah, BPB Publications

BSCBT21: Deep Dive Ethereum

Deep Dive Ethereum: Ethereum Overview,Ethereum Clients,ERC-20 verview,Ethereum Test Networks,Integrated Development Environment,Local Test Nodes with RPC Interface,Command Line Based Development Tools,Code Analysers,Browsers, DAO Overview,Use Cases,Cross-Border Payments, Supply Chain, Identity,Trade Finance,Smart Power Grids.

References:
1. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos and Dr. GavinWood, SPD Publications
2. Ethereum Projects for Beginners: Build blockchain-based cryptocurrencies, smart contracts, and DAppsby Kenny Vaneetvelde, Packxx

BSCBT22: Big Data Analytics through Spark

Introduction to Spark Apache Spark Ecosystem: Setting up the Spark Python Environment, Execution of a PySpark Program, Resilient Distributed Datasets, Spark Architecture, Spark Project Workflow.

Spark Programming with Python Loading and Storing Data: Transformations, Actions, Key-Value Resilient Distributed Datasets, Local Variables, Broadcast Variables, Accumulators, Partitioning, Persistence.

Spark SQL Overview of Spark SQL: Spark Session, Data Frames, Schema of a Data Frame, Operations supported by Data Frames, Filter, Join, GroupBy, Agg operations, Nesting the Operations, Temporary Tables, Viewing and Querying Temporary Tables.

Spark Streaming Use Cases for Realtime Analytics: Transferring, Summarizing, Analysing Real time data, Data Sources supported by Spark Streaming, Flat files, TCP/IP, Flume, Kafka, Kinesis, Streaming Context, DStreams, Dstream RDDs, Dstream Processing.

Machine Learning with Spark Linear Regression: Decision Tree Classification, Principal Component Analysis,Random Forest Classification,Text Pre-processing with TF-IDF,Naïve Bayes Classification, KMeans Clustering, Recommendation Engines.

References:
1. Tomasz Drabos, "Learning PySpark", PACKT, 2017.
2. Padma Priya Chitturi, "Apache Spark for Data Science", PACKT, 2017.

3. Holden Karau, " Learning Spark". PACKT, 2016.
4. Sandy Riza, "Advanced Analytics with Spark", O' Reilly, 2016.
5. Romeo Kienzler, "Mastering Apache Spark", PACKT, 2017.

BSCBT23: Deep Dive Hyperledger -LAB

Introduction to Hyperledger and Blockchain

Lab 1: Hyperledger Basics
Introduction to Hyperledger and its projects
Installing Hyperledger Fabric and Composer

Lab 2: Smart Contracts with Hyperledger Fabric
Writing and deploying smart contracts (chaincode)
Interacting with Fabric networks

Advanced Hyperledger Fabric Development

Lab 3: Chaincode in Depth
Advanced chaincode development
Error handling and best practices

Lab 4: Developing Hyperledger Applications
Building applications on top of Hyperledger Fabric
Integrating with external systems

Hyperledger Composer for Rapid Development

Lab 5: Introduction to Hyperledger Composer
Overview of Composer
Building business networks with Composer

Lab 6: Modeling Business Networks
Designing and defining business models with Composer
Testing and simulating business networks

Real-World Use Cases and Final Projects

Lab 7: Supply Chain Management with Hyperledger
Implementing supply chain solutions with Fabric

Lab 8: Hyperledger in Healthcare
Applying Hyperledger to healthcare data management

Lab 9: Identity Management and Access Control

Developing identity management solutions with Composer

Lab 10: Final Hyperledger Project

BSCBT24: Deep Dive Ethereum-LAB

Ethereum Fundamentals and Smart Contracts

Lab 1: Setting up Ethereum Dev Environment
Tools: Ganache, Truffle, Remix

Lab 2: Ethereum Basics
Ethereum Wallet, Ether transactions

Lab 3: Smart Contracts
Solidity basics, writing and deploying contracts

Advanced Smart Contract Development

Lab 4: Solidity in Depth
Advanced Solidity concepts

Lab 5: Complex Smart Contracts
Building tokens, integrating Oracles

Lab 6: Testing and Debugging
Truffle for testing and best practices

Decentralized Applications (DApps)

Lab 7: Introduction to DApps
Basic DApp structure and frontend

Lab 8: Interacting with Smart Contracts
Building UI for contract interaction

Lab 9: Web3.js and Ethereum Integration
Using Web3.js for Ethereum integration

Real-World Use Cases and Final Projects

Lab 10: Ethereum in Supply Chain
Building supply chain smart contracts

Lab 11: Ethereum in Finance (DeFi)
Creating a basic DeFi application

Lab 12: Identity Management
Developing an identity verification DApp

Lab 13: Final Ethereum Project

BSCBT25: Regulatory and Policy Considerations of Blockchain

Regulatory and Policy Considerations of Blockchain Technology: Latest regulatory and policy developments and governance of blockchain in major economies, Smart contracts and why they're increasing in popularity for a variety of applications, What is a smart contract?, Smart contracts and why they're increasing in popularity for a variety of applications, Contract Dimensions, Legal Considerations, Security Challenges & Measures, Smart contract platforms, Smart Contract Implementation Ricardian Contracts & Smart Contracts Practice: Deploy a Smart Contract.

References:
1.Blockchain, Law and Governance by Benedetta Cappiello and Gherardo Carullo, Springer
2. Legal Tech, Smart Contracts and Blockchain (Perspectives in Law, Business and Innovation) by Marcelo Corrales, Springer

BSCBT27: Blockchain Security and Risk Management

Blockchain Security and Risk Management: Risks associated with adopting new technologies such as blockchain, including hacking, Privacy considerations around the blockchain Blockchain and Cryptocurrency Regulation, Blockchain Regulation, Advantages and Challenges to Overcome when Integrating Blockchain Technology, Second-level Transport System, Routes to Blockchain Integration, privacy considerations around the Blockchain. Regulation, Advantages and Challenges to Overcome when Integrating Blockchain Technology, Second-level Transport System, Routes to Blockchain Integration, privacy considerations around the Blockchain.

References:

1. Blockchain Technology: Concepts and Applications by Kumar Saurabh and Ashutosh Saxena, Wiley Blockchain Technology by Chandramouli Subramanian, Universities Press (India) Pvt. Ltd.

BSCBT28: Introduction to Artificial Intelligence

Introduction:
Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behavior and environment.

Problem Solving: Problem Characteristics, Production Systems, Control Strategies

Searching Techniques : Breadth First Search, Depth First Search, Hill climbing and its Variations, Heuristics Search Techniques: Best First Search, A* algorithm, Constraint Satisfaction Problem, Means-End Analysis, Introduction to Game Playing, Min-Max and Alpha-Beta pruning algorithms.

Knowledge Representation: Introduction to First Order Predicate Logic, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, Frames, and Scripts, Production Rules, Conceptual Graphs. Courseming in Logic (PROLOG)

Dealing with Uncertainty and Inconsistencies: Truth Maintenance System, Default Reasoning, Probabilistic Reasoning, Bayesian Probabilistic Inference, Possible World Representations.

Understanding Natural Languages: Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

References:

1. DAN.W. Patterson, Introduction to A.I and Expert Systems – PHI, 2007.
2. Russell &Norvig, Artificial Intelligence-A Modern Approach, LPE, Pearson Prentice Hall, 2nd edition, 2005.
3. Rich & Knight, Artificial Intelligence – Tata McGraw Hill, 2nd edition, 1991.
4. W.F. Clocksin and Mellish, Courseming in PROLOG, Narosa Publishing, House, 3rd edition,
5. Ivan Bratko, Prolog Courseming for Artificial Intelligence, Addison-Wesley, Pearson 3rd ed

BSCBT29: Digital Marketing Strategies with Blockchain

Digital Marketing Strategies with Blockchain: Functional Overview of Digital Marketing, Digital Marketing Overview, Search Engine Optimization, Social Media Marketing, Content Marketing, Online Advertising, Email Marketing, Web Analytics, How Digital Marketing will benefit from Blockchain, Eliminating Digital Marketing Middleman, Building Trust & Transparency, Customers having full control of their information, Benefits of Branding, Provide Security, Use of Smart Contracts, Limitations of the current Digital Marketing Model Introduction, Eliminating Online Ad Fraud, The link between Advertiser and Ad Publisher.

References:
1. Blockchain Technology and Applications for Digital Marketing by Rohit Bansal, Pacha Malyadri, IGI Global
2. Fundamentals of Digital Marketing by Puneet Bhatia, Pearson

BSCBT30 : Supply Chain Transparency with Blockchain

Supply Chain Transparency with Blockchain: What is Supply chain?, Introduction to Supply Chain Management?, How Supply Chain Management works?, Traditional Supply Chain Management, Supply Chain Management & Blockchain Integration Overview,

Supply Chain Management Traditional Architecture, Supply Chain Management Blockchain Architecture, Blockchain Deployment Stages, Use case – Food Industry, Use case – Pharmaceuticals, Use case – Automobile Industry, Real World Case Study (IBM/Walmart and VeChain)

References:

1. Blockchain and the Supply Chain: Concepts, Strategies and Practical Applications by Nick Vyas, Kogan Page Publishing
2. Supply Chain Revolution: How Blockchain Technology Is Transforming the Global Flow of Assets by Don Tapscott, Barlow Publishing

BSCBT31: Cyber& Data Security

Introduction to Cybersecurity: Understanding Cybersecurity and Its Importance,Key Terminology in Cybersecurity,Historical Overview of Cyber Threats,Legal and Ethical Aspects of Cybersecurity,Cybersecurity Standards and Best Practices.

Information Security Fundamentals: Confidentiality, Integrity, and Availability (CIA Triad),Threats and Attacks (e.g., Malware, Phishing, DoS),Vulnerabilities and Common Weaknesses,Risk Assessment and Management,Security Policies and Procedures.

Network Security: Network Security Concepts,Firewalls and Intrusion Detection Systems (IDS),Virtual Private Networks (VPNs),Network Segmentation and Access Control,Wireless Network Security.

Cryptography and Data Protection: Fundamentals of Cryptography,Symmetric and Asymmetric Encryption,Cryptographic Protocols (e.g., SSL/TLS),Public Key Infrastructure (PKI),Data Encryption at Rest and in Transit.

Secure Software Development and Application Security: Secure Coding Principles,Common Software Vulnerabilities (e.g., OWASP Top Ten),Secure Development Life Cycle (SDLC),Security Testing and Code Review,API Security and Web Application Firewalls (WAF).

Incident Response and Ethical Hacking: Incident Response Planning and Handling,Digital Forensics and Evidence Collection,Penetration Testing and Ethical Hacking,Security Awareness and Training,Emerging Trends in Cybersecurity.

<u>**Additional Topic:**</u> Blockchain and Cloud Computing, Blockchain Cloud Computing, Blockchain and Cyber Security.

BSCBT32: Artificial Intelligence(Use of AI in Blockchain Application LAB)

Introduction to Blockchain and AI Integration
Lab 1: Setting up the Development Environment
Lab 2: Understanding Blockchain Basics
Lab 3: AI Integration in Blockchain (Smart Contracts)

Enhancing Security with AI in Blockchain
Lab 4: Securing Blockchain Transactions with AI
Lab 5: Implementing AI-Based Identity Verification
Lab 6: Anomaly Detection and Intrusion Prevention

Data Analysis and AI in Blockchain
Lab 7: Extracting Insights from Blockchain Data
Lab 8: Implementing Predictive Analytics
Lab 9: Natural Language Processing for Blockchain Data

AI-Driven Blockchain Applications
Lab 10: Developing AI-Powered DApps (Decentralized Applications)
Lab 11: AI for Supply Chain Management on Blockchain
Lab 12: Final Project

Additional Topic: Blockchain with Artificial Intelligence, Blockchain and IoT.

BSCBT33: Mini Project Work

Mini Project Work: Blockchain-Based Supply chain tracking, Decentralized Identity verification, Blockchain-based certificate verification, Tokenization of assets, Blockchain-based voting system, Blockchain-based medical records, Blockchain-based IPR system, Blockchain-based charity donation format, Blockchain-based supply chain finance, Blockchain-based digital asset marketplace, Blockchain-based document notarization, Blockchain-based food supply traceability, Blockchain-based cross border payments.

BSCBT34: Decentralized HR Management

Decentralized HR Management: What is Human Resource?,What is Human Resource Management?, Scope & Objectives of Human Resource Management, Functions of Human Resource Management, Advantages & Disadvantages of Human Resource, Importance of Human Resource, Human Resource SWOT Analysis, Human Resource Management Process, Problem Statements, Market's Current Scenario, Fake Market, Implementation, Trust of Security, Blockchain's Impact on Human Resource, Transparent Work & Education Histories, International Payroll, Enforcing Compliance via Smart Contracts, Transparent Audits, Automating Taxation Process, Paying Independent Contractors.

References:

1. Fundamentals of Human Resource Management by Raymond A. Noe, McGraw Hill

BSCBT35: Decentralized Finance (DeFi) with Blockchain

Decentralized Finance (DeFi) with Blockchain: Finance in the Economic world, Overview of Financial Management, Challenges in Financial system, How Blockchain change current Face of Financing, Blockchain in Financial System, Vendor Perspective about Blockchain in Financial Services, Advantages of blockchain in Financial Services, Cross Border Payments, Syndicate Lending, Digital Identity Verification, Trade Finance

References:

1. Digital Finance: Security Tokens and Unlocking the Real Potential of Blockchain by Baxter Hines, Wiley

BSCBT36: Blockchain Project Management

Explain what Project Management is, Explain the steps in The Project Life Cycle and the value purpose of each one, Explain how a project gets started, Perform the steps required to determine the Critical Path for a project, Explain Project Management in the context of business, Define the components of the Success Triangle, Explain the terms (common) used inProject Management, Determine strategies for involving and engaging Stakeholder Determine the true cost and effort that a project takes for it to be successful, Determine what approach to use for calculating a budget, Apply a strategy / process to ensure you have the skills require to be successful, Determine what work needs to be done to be successful, Identify and plan for Impacts to your project (Risk Management), Utilize templates to assist you in documenting a project, Explain the purpose and value of including Lessons Learned in your project, Take an active role in the management of Project, Fetch Configuration Block & Add New Organisation Definition File, Compute Update using Configtxlator Tool using Original & Modified Block, Sign & Send Updated Configuration Block to Orderer, Run Org3 Services, Join Channel & Verify Data, Introduction: Add New Organisation in Existing consortium, Add New Organisation in system Channel (Consortium) Flow, Try To Create Channel when Org is not Part Of Consortium, System Channel Update – Consortium Info Update, Create Channel and Join all Peers- After Updating Consortium with New Org, Deploy Chaincode, Invoke Transaction and Verify data in State DB, Add New Orderer in Existing Fabric Network – Flow Diagram, Create All Certificates using Certificate Authority for whole Fabric Network, Create Cryptomaterials.

References:
1. Integrating Blockchain Technology in Project Life Cycle for efficient Project Management by LuxmiKanth Navaneethan, Springer
2. Project Management Essentials 4th Edition: by Kalpesh Ashar, Vibrant Publishers

BSCBT38: GENERATIVE AI-I

Introduction to Generative AI and ChatGPT: Understanding Generative AI: Concepts and applications.Evolution of Language Models: From rule-based systems to large language models, Introduction to ChatGPT: Features, capabilities, and use cases, Navigating Ethical Considerations: AI-generated content and responsible usage.

Prompt Engineering and Basic Techniques: Basics of Prompt Engineering: Crafting effective prompts for desired outputs, Generating Text with ChatGPT: Single-sentence completions and short responses, Fine-tuning Concepts: Overview of fine-tuning and transfer learning, Workshop: Creating basic prompts for specific tasks.

Advanced Prompting Strategies: Chain-of-Thought Prompting: Generating coherent multi-turn responses, Zero- and Few-shot Learning: Leveraging model's general knowledge and adapting to specific tasks, Prompt Injunctions: Controlling model behavior through instructions, Prompt Parameter Tuning: Adjusting parameters to influence output style,Workshop: Applying advanced techniques to real-world scenarios.

Multimodal Generative AI: Introduction to Multimodal Models: Combining text and images for richer outputs, Stable Diffusion and Mid Journey Models: Generating images and text together, Use Cases in Creative Industries: Design, photography, and multimedia content generation, Workshop: Creating prompts for multimodal outputs.

Applications in Code Generation and Data Science: Code Generation with LLMs: Writing code snippets for various programming tasks, Data Science Applications: Using LLMs for data preprocessing, analysis, and modeling, Introduction to Copilot: Collaborative coding with AI assistance, Workshop: Generating code and conducting data tasks with AI.

Building AI-powered Applications: Product Development Fundamentals: Design thinking, user experience, and iteration, Integrating AI in Applications: Incorporating ChatGPT or similar models, Web Application Development with Flask: Creating a GPT-powered web app. Final Projects: Students develop their own AI-enabled applications.

BSCBT39: REINFORCEMENT LEARNING IN BLOCKCHAIN

Introduction to Blockchain Technology: What is Blockchain Technology, How does blockchain works, Key terminology.

Introduction to Reinforcement Learning: Definition and components of RL (agent, environment, actions, rewards), Markov decision process(MDPs), RL algorithms(eg- Q-learning, Deep Q Networks).

Use cases & Challenges in Blockchain: Blockchain use cases(eg- cryptocurrency,supply chain,voting systems), Challenges in blockchain(eg-scalability,security,energy consumption).

RL for Blockchain Consensus Mechanisms: Overview of consensus algorithms(eg- Proof of work, Proof of stake), Using RL for optimizing block validation and consensus processes, Case studies of RL based consensus mechanisms.

RL for Blockchain Security: Threats and vulnerabilities in blockchain, Using RL for intrusion detection and prevention, Case studies on RL enhanced blockchain security.

Smart Contracts and RL: What are smart contracts, Automating contract execution with RL, Examples of RL-powered smart contracts.

RL for Blockchain Optimization: Optimizing transaction validation, Resource allocation in blockchain networks, Dynamic fee adjustment using RL.

RL and Privacy in Blockchain: Privacy challenges in blockchain, Using RL for privacy-preserving transactions, Case studies on RL-based privacy solutions.

Practical RL Implementation in Blockchain: Setting up RL environments for blockchain simulations, Coding RL agents for blockchain tasks, Testing and evaluating RL models in blockchain context.

Future Trends and Research Directions: Current research topics and challenges, The potential impact RL advancement on blockchain industry, Encourage students to explore further research in this domain.

Final Project: RL-Powered Blockchain Application.

BSCBT40: RESEARCH METHODOLOGY

Introduction to Research and its Importance: Understanding Research: Definition and scope, Importance of Research: Role in advancing knowledge and solving problems, Criticism in Research: Understanding its significance and impact,Peer Reviews: Role of peer reviews in ensuring research quality.

Types of Research and Research Designs: Descriptive vs. Analytical Research: Distinguishing between different research approaches, Applied vs. Fundamental Research: Exploring practical vs. theoretical research goals, Quantitative vs. Qualitative Research: Understanding data collection and analysis methods, Bayesian vs. Frequentist Approach: Contrasting two statistical paradigms.

Research Process and Literature Review: Research Question: Formulating clear and focused research questions, Hypothesis and Aims: Establishing hypotheses and research objectives, Formulating a Problem: Identifying and defining research problems, Literature Review: Evaluating existing literature and identifying gaps.

Research Project Management and Planning: Project Cycle: Understanding the different stages in a research project, Project Requirements on Data: Gathering and preparing necessary data, Identifying Milestones: Setting project milestones for tracking progress, Project Timelines: Using tools like Gantt Charts to plan project schedules.

Report Writing and Presentation: Art of Writing Papers: Strategies for effective scientific writing, Parts of a Paper: Understanding the structure of a research paper, Tools for Writing Papers: Exploring software and tools for paper writing, Publishing Papers: Submission to journals and presenting at seminars.

Scientific Ethics and Citation: Citation Methods and Rules: Proper citation practices and avoiding plagiarism, Honor Code: Upholding academic integrity and ethical research behavior, Research Claims: Ensuring validity and reliability of research claims, This structured course covers various aspects of research methodology, from understanding different research types to project management, report writing, and ethical considerations, It equips learners with the knowledge and skills required to conduct research effectively and ethically in diverse fields.

BSCBT41: GENERATIVE AI -I LAB

1. Craft a Python program that generates creative stories using a language model based on user-defined prompts.

2. Develop a script that illustrates the historical evolution of language models, creating a timeline visualization using a Python plotting library.

3. Build a chatbot application that engages in ethical content generation while interacting with users in a responsible manner.

4. Design a Python function to craft effective prompts for language models, enhancing the relevance of generated outputs.

5. Create a script that provides concise answers to user questions using ChatGPT for a specific topic or domain.

6. Develop a notebook demonstrating fine-tuning of a language model using a small dataset, comparing its performance with the original model.

7. Construct a chat application simulating coherent multi-turn conversations with the AI, maintaining context with ChatGPT.

8. Implement a Python program that uses zero-shot learning to generate responses to various user queries on a range of topics.

9. Create an interactive tool for prompt parameter tuning, allowing users to adjust parameters like temperature and max tokens to influence output style.

10. Build a Python application that generates marketing content for a photography business, combining textual descriptions and sample images using multimodal AI models.

BSCBT42: Reinforcement Learning- LAB

1. Develop a Python program that applies dynamic programming to solve a grid navigation problem, showcasing the agent's optimal path.

2. Implement the Q Learning algorithm in Python to create an AI agent capable of playing Tic-Tac-Toe and learn optimal strategies.

3. Craft a command-line-based Tic-Tac-Toe game where players can compete against an AI agent trained using Q Learning.

4. Create a Python function to calculate state and action value functions in a reinforcement learning context and visualize the results.

5. Build a Python script that illustrates the evolution of language models, discussing key examples like AlphaGo and Boston Dynamics' robots.

6. Enhance the Q Learning Tic-Tac-Toe agent by implementing fine-tuning strategies and comparing its performance against baseline agents.

7. Develop a user interface where users can play against the trained Tic-Tac-Toe agent, observing its learning progress over multiple games.

8. Write a Python program that computes evaluation metrics to measure the agent's success in learning optimal Tic-Tac-Toe strategies.

9. Create a visualization tool that showcases the Q Learning Tic-Tac-Toe agent's performance improvement over training episodes.

10. Design a Python script that introduces Monte Carlo methods and explains their role in episodic prediction and control.

BSCBT44 : Massive Open Online Courses (MOOCs)

1. Introduction to Machine Learning: https://nptel.ac.in/courses/106/106/106106139/

2. Machine Learning: https://nptel.ac.in/courses/106/106/106106202/

3. Machine Learning for Science and Engineering applications:

    https://nptel.ac.in/courses/106/106/106106198/

4. Introduction to Machine Learning: https://nptel.ac.in/courses/106/105/106105152/

5. Deep Learning (Part-I): https://nptel.ac.in/courses/106/106/106106184/

6. Deep Learning: https://onlinecourses.nptel.ac.in/noc19_cs54/preview

7. Naive Bayes from Scratch: https://courses.analyticsvidhya.com/courses/naive-bayes

8. Getting Started with Neural Networks: https://courses.analyticsvidhya.com/courses/getting-started- with-neural-networks

9. Machine Learning – Offered by Stanford Online - https://www.coursera.org/learn/machine- learning

10. Microsoft Exam DA-100: Analyzing Data with Microsoft Power BI

11. Microsoft Exam PL-300: Microsoft Power BI Data Analyst.

12. Microsoft Exam: Microsoft Certified: Azure Data Scientist Associate

13. University of Nicosia MOOCs:The University of Nicosia offers MOOCs and a Master's program in Digital Currency, covering blockchain and cryptocurrencies.

14. Blockchain Training Alliance:Offers certifications and training programs for blockchain professionals.

BSCBT45: Generative AI – II

Introduction to Embedding Large Documents with LLMS: Explore the fundamentals of embeddings and their significance in the context of large documents. Begin the journey of building custom LLMs by understanding how to integrate databases with GenAI models.

Storing and Indexing Embeddings of Large Documents with Vectorstores: Dive deeper into embedding techniques and leverage vectorstores like Pinecone to store and index extensive documents and datasets. Enhance ChatGPT's contextual understanding, minimize hallucinations, and improve accuracy on data-specific tasks.

LangChain and its Applications: Recognize the limitations of standalone LLMs and discover the potential of LangChain. Learn how LangChain can overcome these limitations by integrating GenAI models with specific data pools, opening up new application avenues.

LangChain Agents, Tools, and Vectorstores for Storage and Retrieval: Delve into the components that constitute LangChain, such as Models, Prompts, Indexes, Chains, Memory, and Agents. Gain insight into how these components collectively contribute to building robust GenAI models.

Connecting Components and Leveraging Tools in LangChain: Understand the intricacies of connecting various components within LangChain through chains. Explore the toolkit offered by LangChain, utilizing inbuilt tools to maximize the potential of your GenAI models.

Scaling and Deploying Generative AI Apps Using Azure OpenAI Services, Future Developments: Learn to deploy your generative AI models using Azure OpenAI services. Gain insights into the considerations involved in scaling generative AI models effectively. Conclude the course by exploring the future landscape of AI, including risk mitigation, reinforcement learning from human feedback (RLHF) as a product, and the trajectory of multimodal learning.

BSCBT46: Ethics in AI

Introduction to Ethics in AI: Overview of the course, AI industry growth, Ethics and society, Applications of AI in different industry sectors, Historical context and milestones in AI ethics.

AI and Data manipulation: Understanding data manipulation in AI, Sources of AI manipulation, Case studies of AI manipulation.

Mitigating AI manipulation: Concept of mitigating AI manipulation, Methods for detecting AI manipulation, Fairness in Machine Learning algorithms.

Privacy and Data Ethics: The need for transparency in AI systems, Techniques for explaining AI decisions, Privacy concerns in building AI, Data collection, consent, and anonymization, GDPR and other privacy regulations.

Privacy and Data Ethics: Legal and ethical aspects of AI accountability, Responsibility in AI development and deployment, Case studies of AI failures and their consequences.

Autonomous Systems and Ethics: The use of AI in autonomous machines, Ethical issues in autonomous machines (vehicles and drones), Ethical AI implementation in building autonomous machines.

AI in Big Data: Big data challenges, Ethical concerns in big data, Ethical AI in Big data.

AI in Healthcare: As is healthcare system, AI driven healthcare, Ethical challenges in AI-driven healthcare, Patient data privacy and consent, AI and medical decision-making, Ethical AI implementation in Healthcare.

AI in Judicial system: As is Judicial system in India, AI driven Judicial system, Predictive algorithm system, Ethical challenges in AI-driven judicial system, AI and judicial decision-making, Ethical AI implementation in Judicial system.

AI and the workforce: The impact of AI on employment, Reskilling workforce, Ethical consideration in HR AI systems.

Global Perspective on AI Ethics: Global approaches to Ethics in AI, Global institutions addressing AI ethics, National variations in AI ethics.

AI Ethics in Practice: Real-world case studies, Ethical guidelines from organizations, Guest speakers

AI and Society: Social impact on growing AI industry, Need of Ethical AI, Ethical consideration in AI policy and regulations.

BSCBT47: Data Visualization- MS BI

Introduction to MSBI Analytics: Tableau Introduction: Understanding MSBI role in data visualization and analysis, Data Connection: Connecting data sources to Tableau for analysis, Calculated Fields and Hierarchy: Creating calculated fields and hierarchical structures in MSBI. Parameters, Sets, Groups: Exploring parameters, sets, and groups for dynamic visualization control.

Advanced Visualization Techniques in MSBI: Various Visualization Techniques: Exploring different visualization types and their applications, Map-based Visualization: Creating geographical visualizations using MSBI mapping features, Reference Lines and Totals: Adding reference lines and calculating totals and subtotals, Advanced Formatting: Utilizing advanced formatting options to enhance visual appeal.

Data Manipulation and Analysis in MSBI: Combining Fields: Using combined fields to merge and analyze data from different sources, Filters and Sorting: Applying filters and sorting options to analyze specific subsets of data, Table Calculations: Performing calculations on the data within Tableau, Creating Dashboards: Building interactive dashboards to visualize and analyze data.

Advanced Techniques and Integration: Action Filters: Using action filters to create interactive connections between visualizations, Creating Stories: Constructing data-driven stories by weaving together visualizations, Clustering and Time Series Analysis: Applying clustering and time series analysis techniques using MSBI.

Integrating R, Phython and Advanced Analytics: R Integration with Tableau: Integrating R code to enhance data analysis capabilities, Creating Statistical Models: Building statistical models with dynamic inputs using R and MSBI, Visualizing R Output: Displaying R-generated output within MSBI visualizations.

Real-time Case Studies: Case Study 1: Real-time project involving Twitter Data Analytics, Case Study 2: Real-time project focused on Google Finance data analysis,Case Study 3: Real-time project using IMDB Website data for analysis.
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BSCBT48 GENERATIVE AI-II LAB

1. Develop a Python program that simulates a grid navigation problem using dynamic programming. Implement a visualization to showcase the agent's optimal path.

2. Build a Python-based Tic-Tac-Toe game where players can compete against an AI agent trained using the Q Learning algorithm. Test the AI's performance against human players.

3. Create a Python script that calculates state and action value functions for a simple reinforcement learning scenario. Visualize these functions to understand their impact on decision-making.

4. Craft a presentation explaining the evolution of language models, using examples like AlphaGo and Boston Dynamics' robots to illustrate their impact on the AI field.

5. Enhance the Q Learning Tic-Tac-Toe agent by incorporating fine-tuning strategies. Compare the agent's performance with and without these strategies through experimentation.

6. Develop a user-friendly interface for playing Tic-Tac-Toe against a Q Learning agent. Track the agent's learning progress over a series of games.

7. Implement a Python program that calculates evaluation metrics to quantify the success of the Q Learning Tic-Tac-Toe agent's training. Analyze the results to draw insights.

8. Create a visualization tool using Python libraries to depict the Q Learning Tic-Tac-Toe agent's performance improvement over training episodes.

9. Build a neural network in a deep learning framework to predict Q values for reinforcement learning tasks. Train and evaluate this network on a simple RL problem.

10. Implement a policy gradient method, such as REINFORCE, using a neural network for a simple RL environment. Visualize the agent's learning progress and policy changes.

BSCBT49: Data Visualization LAB:

Introduction to Power BI, Data preparation, Data modeling, Advanced Data visualization, Power BI and Excel Integration, Data Refresh and Scheduling, Power BI service collaboration, Power BI Mobile App, Power BI administration.