



Rayat Shikshan Sanstha's

Lead College of Karmaveer Bhaurao Patil University, Satara, Maharashtra

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Undergraduate Programme

B. Sc. II Data Science

Syllabi of the course

Choice based credit system syllabi.

(To be implemented w.e.f. from June 2024)

General Objectives of the Course: -

1. To create graduates with sound knowledge of Data Science, who can contribute towards recent advances in technology.
2. To provide advanced and in-depth knowledge of data science and specialization in one or two subjects of the new era of technology.
3. To prepare Graduates who will achieve peer-recognition, as an individual or in a team, through demonstration of good analytical, design, programming, and implementation skills.
4. To enable students, pursue a professional career in Data Science in related industry, business and research.
5. To impart industry knowledge and practical skills of current trends in IT field to the students.
6. To develop the ability among students to formulate, analyze and solve real life problems faced in Computer Science industry. To produce computer science professionals who can be directly employed or start his/her own work as
 - Data Scientist.
 - Business Analyst.
 - Data Analytics Manager.
 - Data Architect.
 - Data Administrator.
 - Business Intelligence Manager.
 - Entrepreneur in Computer Science industry.
7. To Develop designing, analyzing and critical thinking skill among students.

6. Duration:

8. The course shall be a full-time course.
9. •The course shall be for three years, consisting of six semesters.

7. Fee Structure:

- **Course Fee:** as prescribed by the Institute.

8. Eligibility for Admission:

- As per Rule (2) for graduates of this Institute.

9. Medium of instruction: English

10. OUTCOMES:

After completing this course student shall be expert in following things:

1. Avail yourself of Current trends in IT Industries and new Technologies.
2. Apply knowledge of programming platforms in Data Science and AI in real life.
3. Students should avail detailed knowledge of Data Science, Artificial Intelligence, Machine Learning, and Big Data etc.
4. Demonstrate their ability of advanced programming to design and develop innovative applications.
5. Access, evaluate, understand, and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
6. Critically evaluate, analyze, and comprehend a scientific problem. Think creatively, experiment and mic research into innovation and creatively design scientific solutions to problems.
7. Exemplify generate a solution independently, check and validate it and modify if necessary.
8. Translate project plans, use management skills, and lead a team for planning and execution of a task.
9. Can start his own business or start up.

11. SCOPE:

After Successful completion of three years Degree in Data Science, we observed that the students have the ample opportunities in diversified areas such as:

1. Data Scientist

2. Data Analytics
3. Machine learning Engineer
4. Business Intelligence Analyst
5. Data Engineer.
6. Research Scientist.
7. Data Consultant

Department of Data Science
B. Sc. II SEM -III Data Science 2024-25

Sr.no	Course Category		Name of Course
1	Major -I	BDST 311	Python for Data Science
2	Major-II	BDST 312	Advanced Database Design with SQL
3	Lab I	BDSP 313	Lab, I Based on BDST 311
4	Lab II	BDSP 314	Lab II Based on BDST 312
5	Minor-I	BDST 315	Computer Networking
6	Lab III	BDSP 316	Based on BDST 315
7	VSC	BDSTVSC I	Vocational Skill Course (Internet Data Security I)
8	SEC (Skill Enhancement Course)	BDSTSEC II	Data Processing Skills for Data Scientist
9	AEC (Ability Enhance Course)	BDSTAEC I	English I
10		BDSTAEC II	English II
11	VEC	BDSTVEC II	Environmental Awareness for Data Science

B. Sc. II SEM -IV Data Science

Sr.no	Course Category		Name of Course
1	Major -I	BDST 411	R programming
2	Major-II	BDST 412	Data Modeling in NOSQL Databases
3	Lab I	BDSP 413	Lab Based on BDST 411
4	Lab II	BDST 414	Lab Based on BDST 412
5	Minor-I	BDST 415	IOT for Data Science
6	Lab III	BDSP 416	Based on BDST 415
7	VSC	BDSTVSC II	Vocational Skill Course (Internet Data Security II)
8	SEC (Skill Enhancement Course)	BDSTSEC III	Data Visualization Skills for Data Scientist
9	AEC (Ability Enhance Course)	BDSTAEC III	English III
10		BDSTAEC 4	English IV
11	CC	BDST CC 2	Sport Event Management

B.Sc. Part II: Data Science
BDST 311: Python for Data Science

Course Objectives: - Student will able to learn ...

1. Advanced Python topics specific to data science
2. Skills for writing complex programs using 'Advanced Python'.
3. Well-structured programs including machine learning libraries like, NumPy, Pandas, Matplotlib, Seaborn
4. Concept of function arguments, return values, and their importance in programming.
5. About error handling techniques when working with files, including handling file not found errors and permission errors

Credits=2	SEMESTER-III BDST 311: Python for Data Science and Machine Learning	No. of hours per unit/ credits
UNIT I	Foundations of Python for Data Science	07
	Function in pythons, arrays, Functions Arguments, Lambda Expressions, Function Annotations, Modules Organizing python projects into modules Importing own module as well as external modules, Packages, Programming using functions, modules and external packages	
UNIT II	Data Structures and Python File Operations	09
	Lists as Stacks, Queues, Comprehensions, Tuples and sequences, Sets, Dictionaries, reading config files in python, Writing log files in python, Understanding read functions, read (), readline () and readlines (), Understanding write functions, write() and writelines(), Manipulating filepointer using seek, Programming using file operations	
UNIT III	Introduction to Python Libraries	07
	Python Libraries for Data Science-Introduction to NumPy and Pandas, Basic data manipulation with Pandas, Data Visualization with Matplotlib and Seaborn, Creating basic plots and customizing visuals, Introduction to Seaborn for statistical data visualization,	
UNIT IV	Database Interaction SQL	07
	Working with Data Sources, Data Integration from various sources: CSV, Excel, SQL databases, Data preprocessing and cleaning, Database connection using python, Creating and searching tables, Reading and storing configuration information on database, Programming using databaseconnections	

Course Outcomes: - Students should be able to...

1. Demonstrate a strong understanding of Python fundamentals, including data types, variables, and control structures.
2. Use Python libraries like NumPy and Pandas for data manipulation and analysis.
3. Create effective data visualizations using Matplotlib and Seaborn.
4. Ingest, clean, and preprocess data from various sources.
5. Build, evaluate, and tune supervised machine learning models.
6. Develop data pipelines and workflows for machine learning projects.

Reference Books:

1. Patel, Rajesh. Python Programming for Beginners. Mumbai: Tech Books, 2020.
2. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media, 2019.
3. McKinney, Wes. Python for Data Analysis. O'Reilly Media, 2017.

4. Müller, Andreas C., and Sarah Guido. Introduction to Machine Learning with Python: A Guide for Data Scientists. O'Reilly Media, 2017.
5. Raschka, Sebastian, and Vahid Mirjalili. Python Machine Learning. Packt Publishing, 2017.
6. Provost, Foster, and Tom Fawcett. Data Science for Business. O'Reilly Media, 2013.

B.Sc. II- Semester-III

BCST312: Advanced Database Design with SQL

Course Objectives: - Student will able to learn ...

1. Deep understanding of advanced database concepts.
2. Master advanced SQL querying techniques.
3. Skills for data modelling and efficient database design.
4. Familiarize with various Database Management Systems (DBMS).
5. Analyse case studies and engage in problem-solving exercises.

Credits =2	SEMESTER-III Course II: BCST312: Advanced Database Design with SQL	No. of hours per unit/ credits
UNIT I	Foundations of SQL and Database Design	08
	Introduction to Advanced Database Design, Understanding the importance of advanced database design, Key principles of good database design, Review of SQL Basics, Querying data with SELECT, JOIN, and WHERE, Data modification with INSERT, UPDATE, and DELETE, Introduction to normalization and denormalization, normalization vs. denormalization, Advanced SQL Data Types-Date and time data types	
UNIT II	Advanced SQL Techniques	08
	Complex Queries and Subqueries-Subquery types: scalar, table, correlated, Using EXISTS and IN, Common table expressions (CTEs),SQL Window Functions- Introduction to window functions, PARTITION BY and ORDER BY clauses, Examples of ranking, aggregation, and analytic functions,SQL Indexing and Performance-Index types: B-tree, hash, and bitmap, Query optimization and indexing strategies, Understanding execution plans,Transactions and Concurrency Control-ACID properties and transactions, Locking and isolation levels, Deadlocks and transaction management	
UNIT III	Advanced Database Design Concepts	07
	Designing schemas for complex data structures, Schema versioning and migration, Schema security and access control, Unique and check constraints, Trigger creation and usage, Cursor Creation PL Block , Real-world case studies, Designing databases for specific industry domains, Lessons from successful database design projects	
UNIT IV	Project and Advanced Database Topics	07
	Guidelines for the project, Project proposal and topic selection, Database encryption and data privacy, Access control and permissions, Auditing and compliance, Capstone Project Presentation and Evaluation, Students present and demonstrate their projects, Peer and instructor evaluations	

Course Outcomes: - Students should be able to...

1. Design and implement complex database schemas efficiently.
2. Proficiency in crafting advanced SQL queries, including subqueries and joins.
3. Skills to optimize database performance through indexing and query tuning.
4. Understanding of database security and access control mechanisms.
5. Problem-solving abilities in complex data management challenges.
6. Understanding of advanced database concepts and normalization.

References:

1. Lewis, Toby J. Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More. O'Reilly Media, 2019.
2. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. Database System Concepts. McGraw-Hill, 2019.
3. Elmasri, Ramez, and Shamkant B. Navathe. Fundamentals of Database Systems. Pearson, 2015.
4. Teorey, Toby J., Sam S. Lightstone, and Tom Nadeau. Database Modelling and Design: Logical Design. Morgan Kaufmann, 2011.
5. Garcia-Molina, Hector, Jeffrey D. Ullman, and Jennifer Widom. Database Systems: The Complete Book. Pearson, 2008.
6. Date, C. J. An Introduction to Database Systems. Addison-Wesley, 2003.
7. Ramakrishnan, Raghu, and Johannes Gehrke. Database Management Systems. McGraw-Hill, 2003.
8. Melton, Jim, and Alan R. Simon. SQL:1999 - Understanding Relational Language Components. Morgan Kaufmann, 2001.

**BDSP 313: Lab I – Based on
(BDSP 311: Python for Data Science)**

Course Objectives: - Student will able to learn ...

1. Fundamental data structures and control flow in Python.
2. Advanced Python concepts like functions, file handling, and packages.
3. Advanced Python topics specific to data science
4. Writing complex programs using ‘Advanced Python’.
5. Develop well-structured programs including machine learning libraries like NumPy,Pandas, Matplotlib, Seaborn

Credit :2 Group A-	Python for Data Science and Machine Learning	No. of hours per unit (60)
	<ol style="list-style-type: none"> 1. Implement Stack in Python 2. Implement Queue in Python 3. Execute Dictionary in Python 4. Enforce List in Python 5. Execute Set in Python 6. Implement String in Python 7. Execute Tuple in Python 8. Implement Functions in Python 9. Import NumPy Library in Python 10. Import Pandas Library in Python 11. Import Matplotlib Library in Python 12. Import Seaborn Library in Python 13. Run File Handling Basic Operations 14. Execute Read () and Write () Function 15. Use Python to read a CSV file and print the first 5 rows. 16. Use Python to read an Excel file and print the summary statistics for each column 17. Write a Python script to connect to a SQL database. 18. Use Python to query data from a SQL table and display it. 19. Use Python to clean text data in a Data Frame 20. Establish a connection to the SQL database using Python. 	

Course Outcomes: - Students should be able to...

1. Demonstrate a strong understanding of Python fundamentals, including data types, variables, and control structures.
2. Use Python libraries like NumPy and Pandas for data manipulation and analysis.
3. Create effective data visualizations using Matplotlib and Seaborn.
4. Ingest, clean, and preprocess data from various sources.
5. Build, evaluate, and tune supervised machine learning models.
6. Develop data pipelines and workflows for machine learning projects.

References:

1. Eric Matthes, Python Crash Course, 3rd Edition, No Starch Press,US,2023 .
2. David Beazley, Python Essential Reference,Addison-Wesley,2021.
3. Lee Vaughan, Impractical Python, No Starch Press,2018.
4. Anthony Molinaro, SQL Cookbook, O'Reilly, 2006
5. Peter Gulutzan , Mary O'Brien SQL Performance Tuning,Addison-Wesley,2002
6. Peter Robson , Stephane Faroult,The Art of SQL,O'Reilly Media,2006

BDSP 314: Lab I – Based on BDSP:312 Advanced Database Design with SQL)

Course Objectives: - Student will able to learn ...

1. Advanced database concepts.
2. Advanced SQL querying techniques.
3. Data modeling and efficient database design.
4. Various Database Management Systems (DBMS).
5. To Analyze case studies and engage in problem-solving exercises.

Group B-	Advanced Database Design with SQL	No. of hours per unit (60)
	<ol style="list-style-type: none">1. Perform Basic SQL Query's2. Implement Select Clause in SQL3. Execute Join in SQL4. Implement Where Clause in SQL5. Perform Data Modification using INSERT (), UPDATE & DELETE()6. Execute Date and Time Data Type in SQL7. Implement Sub-Query's in SQL8. Run EXISTS and IN Functions.9. Perform Aggregate Function10. Implement Window Functions11. Run PARTITION BY and ORDER BY clauses12. Implement Indexing in SQL13. Perform B-tree in SQL14. Run hash in SQL15. Execute bitmap in SQL	

	16. Implement Unique and check constraints in SQL 17. Perform Trigger creation and usage in SQL 18. Write a Case Study on Designing databases for specific industry domains 19. Write a Case Study on Lessons from successful database design projects 20. Write a Case Study on of Database encryption and data privacy	
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Course Outcomes: - Students should be able to...

1. Ability to design and implement complex database schemas efficiently.
2. Proficiency in crafting advanced SQL queries, including subqueries and joins.
3. Optimize database performance through indexing and query tuning.
4. Understanding of database security and access control mechanisms.
5. Problem-solving in complex data management challenges.
6. In-depth understanding of advanced database concepts and normalization.

Reference Books:

1. Lewis, Toby J. Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More. O'Reilly Media, 2019.
2. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. Database System Concepts. McGraw-Hill, 2019.
3. Elmasri, Ramez, and Shamkant B. Navathe. Fundamentals of Database Systems. Pearson, 2015.
4. Teorey, Toby J., Sam S. Lightstone, and Tom Nadeau. Database Modeling and Design: Logical Design. Morgan Kaufmann, 2011.
5. Garcia-Molina, Hector, Jeffrey D. Ullman, and Jennifer Widom. Database Systems: The Complete Book. Pearson, 2008.
6. Date, C. J. An Introduction to Database Systems. Addison-Wesley, 2003.
7. Ramakrishnan, Raghu, and Johannes Gehrke. Database Management Systems. McGraw-Hill, 2003.
8. Melton, Jim, and Alan R. Simon. SQL:1999 - Understanding Relational Language Components. Morgan Kaufmann, 2001.

Departmental Minor

Theory: Course I: BCST315: Computer Networking

Course Objectives: Student should be able to learn ...

1. Fundamental networking concepts, protocols, and standards.
2. Various layers of the OSI model and TCP/IP suite.
3. Addressing schemes and transmission methods at the physical and data link layers.
4. Routing protocols and logical addressing at the network layer.
5. Exploring application layer protocols and their functionalities.
6. Importance of network security and its protocols.

Credits=2	SEMESTER-III Course I: BCST315: Computer Networking	No. of hours perunit/credits
UNIT I	Introduction to networks	08

	Introduction to networks, internet, protocols and standards, Introduction to OSI model with layers, TCP/IP suite with layers, Comparison between TCP/Ip and OSI, Addressing	
UNIT II	Physical Layer and Data link layer	08
	Physical Layer: digital transmission, multiplexing, transmission media, circuit switched networks, Datagram networks, virtual circuit networks, switch and Telephone network. Data link layer: Introduction, Block coding, cyclic codes, checksum, framing, flow and error control, Noiseless channels, noisy channels, HDLC, point to point protocols	
UNIT III	Network Layer	07
	Network Layer: Logical addressing, internetworking, tunneling, address mapping, ICMP, IGMP, forwarding, uni-cast routing protocols, multicast routing protocols	
UNIT IV	Application Layer	07
	Application Layer – Domain name space, DNS in internet, electronic mail, FTP, WWW, HTTP, SNMP, multi-media, network security	

Course Outcomes: Students will be able to...

1. Understand the basic concepts of data communication including the key aspects of Networking and their interrelationship
2. To know various protocols and the basic structure of IP Address and concept of sub netting with numerical
3. Explore various protocols like TCP
4. Understand various Network Layer And Application Layer

References:

Mike Younkers, Model-Driven DevOps: Increasing agility and security in your physical network through DevOps, 1st Edition, Pearson Education, 21 November 2023

Kurose, Computer Networking, 8e, Pearson Education, 31 May 2022

Practical-I
Lab Course III: BDSP:316 based on (BDST315)

Course Objectives: Student should be able to ...

1. Identify how each device contributes to network communication.
2. Covers Recognize the differences between these devices and their applications
3. Configure and simulate OSPF behavior in a virtual setting.
4. Configure and demonstrate the implementation of static routing in a virtual environment.

Credits=2	SEMESTER-I Course I: BCST315: Computer Networking	No. of hours per unit (60)
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Credit :2 Group A	1) Implement of Routers 2) Exhibit of Modem 3) Demonstration of NIC 4) Demonstration of Hubs 5) Manifestation of Switches and its type 6) Demonstration of Cables and its type 7) Expiration of Virtual IPv4 Addressing 8) Demonstration of Sub netting. 9) Use of various Commands and utilities. 10) Demonstration of Virtual Static Routing. 11) Demonstration of point-to-point protocols 12) Demonstration of Virtual Simple Open Shortest Path First (OSPF). 13) Demonstration Of Virtual Dynamic Host Configuration Protocol i. (DHCP). 14) Demonstration of Virtual Configuring DNS Server and client. 15) Case Study Internet Control Message Protocol (ICMP) 16) Case Study Internet Gropu Management Protocol (IGMP) 17) Case Study on Domain Name System (DNS) 18) Demonstration of File Transfer Protocol (FTP) 19) Case Study on network security 20) Case Study on High Level Data Link Control (HDLC)	
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Course Outcomes: Students will be able to...

1. Understand the purpose and functionality of routers, modems, NICs, and hubs.
2. To Know various types of cables and their uses in networking.
3. Understand how static routing controls network traffic.
4. To get Knowledge OSPF's role in dynamic routing and its advantages.
5. Understand the automatic IP address assignment process.

References:

1. Mike Younkens, Model-Driven DevOps: Increasing agility and security in your physical network through DevOps, 1st Edition, Pearson Education, 21 November 2023
2. Kurose , Computer Networking, 8e, Pearson Education, 31 May 2022
3. Tanenbaum, Computer Networks, 6e, Pearson Education, 1 April 2022
4. Computer Networks: A Top-Down Approach, McGraw Hill, 12 June 2023
5. Ed Tittel, COMPUTER NETWORKING, McGraw Hill Education, 20 December 2006
6. Kurose James F. , COMPUTER NETWORKING: A TOP-DOWN APPROACH, 6TH EDN, Pearson Education, 30 June 2017

**Semester II – Vocational Skill Course
(Internet Data Security I)**

BDSTVSC 1

Course Objectives- Students should be able to learn ...

1. General overview of Internet Data Security.
2. Standard models for the layered approach to communication
3. Machines in a network and the protocols of the various layers.

- The ability to merge, transform, and reshape datasets efficiently for analysis purposes

Credits=2	SEMESTER-III	No. of hours per unit/ credits
UNIT I	Introduction to Internet Data Security	08
	Introduction, Need of Data Security, principle of Security, Types of data security, Security services- accesses control, Data security capabilities, Overview of cyber security threats and challenges, Importance of data security in the context of data science.	
UNIT II	Network Security	08
	Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security, IP Security, VPN, Firewalls Security, OSI and TCP model	
UNIT III	Web Security	08
	Introduction to Web Security, Authentication and Authorization, Web Security Protocols, Common web vulnerabilities (SQL injection, XSS, CSRF), Web application security best practices, Security measures for APIs	
UNIT IV	Emerging Trends in Internet Data Security	08
	Risk Management and Compliance, Risk assessment methodologies, Compliance standards and frameworks (ISO, NIST, etc.), Incident response and disaster recovery planning, AI/ML in cyber security, Blockchain and its implications for security, IoT security challenges and solutions.	

Course Outcomes- Students will be able to...

- Gain foundational knowledge of internet data security.
- Understand the OSI and TCP/IP reference models and their relevance to security.
- Develop skills in routing mechanisms.
- Acquire an understanding of risk management, compliance, and incident response in the context of cyber security.

References:

- Mike Younkers, Model-Driven DevOps: Increasing agility and security in your physical network through DevOps, 1st Edition, Pearson Education, 21 November 2023
- Kurose, Computer Networking, 8e, Pearson Education, 31 May 2022
- Tanenbaum, Computer Networks, 6e, Pearson Education, 1 April 2022
- Computer Networks: A Top-Down Approach, McGraw Hill, 12 June 2023
- Ed Tittel, COMPUTER NETWORKING, McGraw Hill Education, 20 December 2006
- Kurose James F., COMPUTER NETWORKING: A TOP-DOWN APPROACH, 6TH EDN, Pearson Education, 30 June 2017

BDSTSEC 2 - Data Processing Skills for Data Scientist

Course Objectives Students should be able to learn ...

- Data processing within the context of data science.
- Proficiency in various data cleaning techniques, including handling missing values, outliers, and duplicates.
- Data pipelines for processing and analysing datasets.

4. Ethical principles underlying data processing and their significance in society.
5. Visualizing data distributions and patterns to uncover insights and potential relationships.

Credits=2	SEMESTER-III Name of Course: Data Processing Skills for Data Scientist	No. of hours per unit/ credits
Unit I	Introduction to Data Processing	8
	Introduction, Overview of data processing in the context of data science, Importance of data processing for analysis and modeling, Data Collection ,Methods for data collection (web scraping, APIs, databases),Data acquisition techniques and tools	
Unit II	Data Cleaning and Preprocessing	8
	Data cleaning techniques (handling missing values, outliers, duplicates),Types of data cleaning Standardization and normalization of data, Exploratory data analysis (EDA) for identifying data issues	
Unit III	Data Pipelines and Workflow Management	8
	Designing data pipelines for processing and analysis, Workflow management tools (Airflow, Luigi), Big Data Processing, Introduction to big data technologies (Hadoop, Spark), Processing large-scale datasets efficiently	
Unit IV	Ethical Considerations in Data Processing	6
	Introduction to Ethics in Data Processing , Overview of ethical principles, their importance in data processing, and their impact on society ,Privacy concerns and data anonymization , Ethical handling of data in processing stages	

Course Outcomes: - Student will be able to ...

1. Demonstrate the ability to effectively clean and preprocess datasets by handling missing values, outliers, and duplicates, and performing standardization and normalization.
2. Employ various data collection methods such as web scraping, APIs, and database querying to acquire relevant datasets for analysis.
3. Design, develop, and implement data pipelines for processing and analyzing datasets, utilizing workflow management tools such as Airflow and Luigi for automation.
4. Gain proficiency in integrating big data processing technologies like Hadoop and Spark to efficiently handle and analyze large-scale datasets.

References: -

1. Venkatesh Pappakrishnan, Essential SQL Skills for Data Scientists and Data Engineers: Hands-on Approach, 31 July 2022
2. Donovan Brook, Data Scientist: Data Analysis in Action - Take Your Skills to the Next Level with Practical Machine Learning Applications,9 July 2023
3. Knowledge Graphs and Big Data Processing: 12072,Lecture Notes in Computer Science, Valentina Janev, 16 July 2020
4. Data-Driven Process Discovery and Analysis: First International Symposium, SIMPDA 2011, Campione

5. Svilen Gospodinov, Concurrent Data Processing in Elixir: Fast, Resilient Applications with OTP, GenStage, Flow, and Broadway, The Pragmatic Programmers, 31 August 2021

BDSTVEC II: Environmental Awareness for Data Science

Course Objectives: - Student will be able to learn...

1. The Environmental Issues
2. Role of Computer in creation of environmental issues
3. The Environmental Laws
4. The Sustainable development goals
5. The Computational Sustainability

Credits=2	SEMESTER-I BDSTVEC II: Environmental Awareness for Data Science	No. of hours per unit/ credits
UNIT I	Environmental issues	10
	Pollution (Air, water, and Land), Fresh-water overuse, Natural disasters, Fuel and Energy shortage due to overuse, Increase in wasteland, Biodiversity loss, Global warming, and climate change (Causes and intensity of the problem), role of Data Science in creation of environmental issues.	
UNIT II	Environmental Laws and ethics	12
	Environmental Protection Act, Wildlife Protection Act, Forest Conservation Act, Prevention and Control of Pollution Act (Air, Water, Land), from unsustainable to sustainable development, Responsibilities of an Environmentally aware citizen.	
UNIT III	Sustainable Development Goals	12
	Implementation, History, Structure of goals, targets and indicators, Goals with their targets and indicators, Challenges in sustainable development, Role of Data Science in Environmental Awareness	
UNIT IV	Role of Data Science in meeting the sustainable development goals	11
	Data-driven Decision-Making, Predictive Analytics for Resource Allocation, Monitoring and Evaluation, Optimizing Resource Efficiency, Climate Change Mitigation and Adaptation, Healthcare and Disease Prevention	

Course Outcomes: - Student should be able to ...

1. Understand Environmental issues
2. Understand how Environmental Laws and Ethics work are
3. Challenges in sustainable development of goals in Environmental Awareness of Computer Science
4. Balancing environmental and socioeconomic needs.

References: –

1. Gerardus Blokdyk, Environmental Awareness A Complete Guide ,5STARCooks, 4 July 2019
2. Wayne R. Ott, Environmental Statistics and Data Analysis, CRC Press Inc, 20 December 1994
3. Prof. Vyacheslav Kharchenko, Green IT Engineering: Social, Business and Industrial Applications, Springer, 11 October 2018
4. R. Rajagopalan, Environmental Studies from Crisis to Cure, Chaukhamba Auriyantaliya, 1 January 2017
5. Anna Satsiou, Collective Online Platforms for Financial and Environmental Awareness: First International Workshop on the
6. Internet for Financial Collective Awareness ... 10078 (Lecture Notes in Computer Science), Springer International Publishing AG, 1 December 2016
7. Siddhartha Bhattacharyya, Intelligent Environmental Data Monitoring for Pollution Management (Intelligent Data-Centric Systems), 23 October 2020

Semester-IV**Major
BDST 411****R Programming****Course Objectives: -** Student will be able to learn...

1. The objective of this module to make students exercise the fundamentals of statistical analysis in R environment.
2. Analysis data for the purpose of exploration using Descriptive and Inferential Statistics.
3. Probability and Sampling Distributions and learn the creative application of Linear Regression in multivariate context for predictive purpose.
4. Create visualizations using packages such as ggplot2 to effectively communicate insights from data.

Credits (Total Credits)	SEMESTER – BDST 411: R Programming	No. of hours per unit/credits
Unit - I	Introduction to R programming	08
	R Introduction- Overview of R Programming, Downloading and installing, Help Function in R. Viewing documentation, General issues in R, What is R? Installing R and RStudio, RStudio Overview, Working in the Console, Arithmetic Operators, Logical Operations, Using Functions, Getting Help in R and Quitting RStudio	
Unit – II	Data structures, variables, and data types	
	Creating Variables, Numeric, Character and Logical Data Vectors, Data Frames, List, Factors, Sorting Numeric, Character, and Factor Vectors, Special Values, Importing data, Reading from csv files, Re-directing R Output	08
Unit – III	Matrix Operation and Data Visualization	

	Matrix Operations, Adding and Deleting Rows and Columns – Higher Dimensional Arrays, Creating bar chart, dot plot , Creating histogram and box plot, Plotting Pie chart, Ogive curve, Ogive Curve with base graphics, Plotting and colouring in R.	08
Unit - IV	Functions and Programming in R- Flow control: For loop, If condition, While loop,	06

Course Outcomes: Student will be able to...

1. Install, Code and Use R Programming Language in R Studio IDE to perform basic tasks on Vectors, Matrices and Data frames.
2. Describe key terminologies, concepts and techniques employed in Statistical Analysis.
3. Define, Calculate, Implement Probability and Probability Distributions to solve a wide variety of problems.
4. Conduct and interpret a variety of Hypothesis Tests to aid Decision Making.

References:

1. Mark Gardner,—Beginning– The Statistical Programming Language ,Wiley,2013.
2. RobertKnell,—IntroductoryR:ABeginner_sGuidetoDataVisualisation,StatisticalA analysis and programming in R , Amazon Digital South Asia Services Inc, 2013. Richard Cotton (2013). Learning R,O_Reilly Media.
3. Garret Golemund (2014). Hands-onProgrammingwithR.O_ReillyMedia,Inc.
4. Andrie de Vries , R Programming for Dummies, 2ed, Wiley,1 January 2016
5. Kent D. Lee ,Foundations of Programming Languages (Undergraduate Topics in Computer Science),Springer International Publishing AG,20 December 2017
6. Garrett Golemund , Hands on Programming With R: Write Your Own Functions and Simulations, Shroff/O'Reilly, 1 January 2014
7. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, 11 October 2011

Major BCST 412 : Data Modelling in NOSQL Databases

Course Objectives: - Student will be able to learn ...

1. NoSQL database systems, including key differences from traditional relational databases.
2. Various types of NoSQL databases, such as document-based, key-value, column-family, and graph databases.
3. Fundamental data modeling principles applicable to NoSQL databases, such as denormalization, schema flexibility, and eventual consistency.
4. NoSQL data models differ from relational database models and the benefits they offer for specific use cases.
5. Data modeling techniques for key-value store databases such as Redis and Amazon Dynamo DB.

Credits=2	SEMESTER-IV Major BCST 412 Data Modelling in NOSQL Databases	No. of hours per unit/ credits
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UNIT I	Introduction to NoSQL Databases	08
	Understanding the need for NoSQL databases. - Contrasting NoSQL databases with traditional relational databases Types of NoSQL Databases - Document-based databases (e.g., MongoDB, Couchbase). - Key-value stores (e.g., Redis, DynamoDB). - Column-family stores (e.g., Cassandra, HBase). - Graph databases (e.g., Neo4j, Amazon Neptune)	
UNIT II	Data Modeling Techniques	08
	Document modeling in document-based databases., Key design considerations in key-value stores, Column-family and wide-column store modeling techniques, Graph modeling and its applications Schema-less design in NoSQL databases, Understanding data structures specific to each NoSQL type, Considering denormalization and its impact on data modeling	
UNIT III	Performance and Optimization	06
	Indexing strategies in NoSQL databases, Query optimization and best practices, Scaling strategies and sharding. Document-Based Databases (e.g., MongoDB), Key-Value Stores (e.g., Redis, DynamoDB), Column-Family Stores (e.g., Cassandra, HBase)	
UNIT IV	Security and Backup Strategies	08
	Understanding security features in NoSQL databases, Authentication and Authorization, Encryption, Auditing and Logging, Firewalls and Network Security, Patch Management and Updates, Backup, recovery, and disaster management,	

Course Outcomes: - Students will be able to...

1. Understanding the Need for NoSQL Databases
2. Understanding Security Features in NoSQL Databases
3. Understanding the graph data model and its application in representing complex relationships
4. Ability to optimize queries to enhance database performance

References:

1. Seema Acharya, Demystifying NoSQL, Wiley, 2020
2. Serge Gershkovich, Kent Graziano, Data Modeling with Snowflake, Packt Publishing Limited, 2023
3. Adam Fowler, NoSQL for Dummies, Wiley, 2015
4. by Peter Membrey , Eelco Plugge, DUPTim Hawkins, The Definitive Guide to MongoDB, APress, 2010
5. Peter Membrey , The Definitive Guide to MongoDB: The NoSQL Database for Cloud and Desktop Computing (Expert's Voice in Open Source), APress, 30 September 2010
6. Mayuri Mehta, Knowledge Modelling and Big Data Analytics in Healthcare: Advances and Applications, CRC Press, 8 December 2021
7. Ajit Singh , Data Modeling with NoSQL Database: 3rd Edition, 5 November 2022

BDSP 413 Lab I Based On BDST 411

Course Objectives: - Student should be able to...

1. The objective of this module is to make students exercise the fundamentals of statistical analysis in an R environment.
2. They would be able to analyse data for the purpose of exploration using Descriptive and Inferential Statistics.
3. Students will understand Probability and Sampling Distributions and learn the creative application of Linear Regression in multivariate context for predictive purpose.

Credits (Total Credits 2)	Practical Paper - II Data Analytics with R Programming List of Practical (20)	No. of hours per Practical
	<ol style="list-style-type: none"> 1. Program to create Vector using R 2. Program to implement Arithmetic operator using R 3. Program to implement logical operator using R 4. Program to create Barplot. Histogram using R. 5. Program to create ogive curve using R 6. Program to create frequency polygon, pie chart using R. 7. Program to create Matrix. 8. Program to create Array. 9. Program to create list. 10. Program to create data frame. 11. Program to add/delete/merge in a data frame. 12. Program to read csv file using R. 13. Program to import data from excel. 14. Program to create function. 15. Program to implement if condition using R. 16. Program to implement if-else condition using R 17. Program to implement multiple if-else. 18. Program to implement for loop. 19. Program to implement while loop. 20. Statistical analysis using R 	

Course Outcomes: - Students will be able to ...

1. Understand how to create, access, and manipulate vectors in R, applying operations such as indexing, slicing, and mathematical operations.
2. Proficiency in matrix creation, manipulation, and basic operations like addition, multiplication, transposition, and inversion using R.
3. Understand and effectively use control statements (like if-else, loops) in R programming to control program flow, make decisions, and perform iterative tasks.

- Acquire the skills to calculate and interpret measures like mean, median, and mode using R, understanding their significance in summarizing data distribution.

References: –

- Seema Acharya, Demystifying NoSQL, Wiley, 2020
- Serge Gershkovich, Kent Graziano, Data Modeling with Snowflake, Packt Publishing Limited, 2023
- Adam Fowler, NoSQL for Dummies, Wiley, 2015
- by Peter Membrey, Eelco Plugge, DUPTim Hawkins, The Definitive Guide to MongoDB, APress, 2010
- Kent D. Lee, Foundations of Programming Languages (Undergraduate Topics in Computer Science), Springer International Publishing AG, 20 December 2017
- Garrett Grolemond, Hands on Programming With R: Write Your Own Functions and Simulations, Shroff/O'Reilly, 1 January 2014
- Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, 11 October 2011

BDSP 414 Lab II Based On BDST 412

Course Objectives: - Student should be able to...

- Understanding the Need for NoSQL Databases
- Understanding the simplicity and speed advantages of key-value stores for basic data retrieval operations. Column-Family Stores
- Understanding Security Features in NoSQL Databases
- Understanding query optimization methods and patterns in NoSQL databases for enhanced performance.

<p>Credit: 2</p> <p>Group A:</p>	<p>Practical List:</p> <ol style="list-style-type: none"> Installation on MongoDB Creating Database using MongoDB Perform CRUD Operation in MongoDB Perform the Basic Method in MongoDB Perform the Operation using Comparison Operator in MongoDB Perform the Operation using Logical Operator in MongoDB Perform the Operation using Arithmetic Operator in MongoDB Perform the Operation using Update Operator in MongoDB Perform the Operation using Array Operator in MongoDB Perform the Operation using String Operator in MongoDB Perform the Operation using Indexing Operator in MongoDB Use the MongoDB shell or a GUI tool to create a new database. Within your database, create collections to organize your data Insert sample documents into your collections. 	<p>No. of hours per unit (60)</p>
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| <ol style="list-style-type: none">15. Practice querying documents using 'find' with various conditions.16. Update documents using 'update one' and 'update many'.17. Delete documents using 'delete one' and 'delete many'.18. Create indexes on fields to improve query performance.19. Use the aggregation framework for complex data manipulations.20. Perform a backup of your database and restore it to ensure data recovery. | |
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Course Outcomes: - Students will be able to ...

1. Understanding the Need for NoSQL Databases
2. Understanding Security Features in NoSQL Databases
3. Understanding the graph data model and its application in representing complex relationships
4. Ability to optimize queries to enhance database performance

Reference Books:

1. Seema Acharya, Demystifying NoSQL, Wiley, 2020
2. Serge Gershkovich, Kent Graziano, Data Modeling with Snowflake, Packt Publishing Limited, 2023
3. Adam Fowler, NoSQL for Dummies, Wiley, 2015
4. by Peter Membrey , Eelco Plugge, DUPTim Hawkins, The Definitive Guide to MongoDB, APress, 2010
5. Peter Membrey , The Definitive Guide to MongoDB: The NoSQL Database for Cloud and Desktop Computing (Expert's Voice in Open Source), APress, 30 September 2010
6. Mayuri Mehta, Knowledge Modelling and Big Data Analytics in Healthcare: Advances and Applications, CRC Press, 8 December 2021
7. Ajit Singh , Data Modeling with NoSQL Database: 3rd Edition, 5 November 2022

Credits=2	SEMESTER-IV IOT For Data Science	No. of hours perunit/ credits
UNIT I	Introduction to IoT and Data Science:	(8)
	Overview of IoT concepts and applications, Introduction to Data Science and its relevance in IoT, Programming Fundamentals, Programming languages commonly used in IoT (e.g., Python, C++), Electronics and Sensors, Basics of electronics and circuits, Types of sensors used in IoT devices.	
UNIT II	IoT Device Architecture	(7)
	Understanding the architecture of IoT devices, Hardware components and software stack. Data Collection and Storage, Methods for collecting data from IoT devices, Storage options for IoT data (databases, cloud storage).	
UNIT III	IoT Security and Privacy	(7)
	Overview of IoT Security and Privacy, Challenges in IoT Security, Cryptography Basics, Authentication and Authorization, Security Analytics for IoT	
UNIT IV	Machine Learning for IoT	(8)
	Definition, scope, and applications of IoT, Challenges and opportunities in IoT. supervised learning, unsupervised learning, and reinforcement learning based	

**B.Sc. II- Semester-IV
Theory: Course IV: BDST 415
IOT For Data Science**

Course Objectives: Student will be able to learn ...

1. Core concepts of the Internet of Things (IoT), including its architecture, devices, and connectivity.
2. Establish the relationship between IoT and data science, emphasizing how data generated by IoT devices can be leveraged for meaningful insights.
3. Develop programming skills in languages commonly used in IoT and data science, such as Python, to manipulate and analyze data.
4. Educate students about the security challenges associated with IoT and the importance of implementing robust security measures.
5. Address privacy issues related to IoT data collection, storage, and analysis, and introduce privacy-preserving techniques.

Course Outcomes: - Students will be able to...

1. Understand the fundamental concepts of the Internet of Things (IoT) and its wide-ranging applications across industries.
2. Acquire foundational programming skills, with a focus on languages commonly used in IoT, such as Python and C++.
3. Gain insights into the layered architecture of IoT devices, encompassing both hardware components and the software stack.
4. Comprehend the overarching importance of security and privacy in the context of IoT.

Reference Books:

1. Souvik Pal ,IoT Hardcover ,CRC Press,2020
2. Pelin Yildirim Taser ,Emerging Trends in IoT and Integration With Data Science,Business Science Reference,30 November 2021
3. P. G. Madhavan,Data Science for IoT Engineers: A Systems Analytics Approach,9 November 2021
4. Fausto Pedro García Márquez,IoT and Data Science in Engineering Management: Proceedings of the 16th International Conference on Industrial Engineering and Industrial Management,Springer International Publishing AG,25 March 2023

Lab Course III: BCSP416: Lab (based on BDST415)**Course Objectives:** Student will be able to learn...

1. Core concepts of the Internet of Things (IoT), including its architecture, devices, and connectivity.
2. Establish the relationship between IoT and data science, emphasizing how data generated by IoT devices can be leveraged for meaningful insights.
3. Develop programming skills in languages commonly used in IoT and data science, such as Python, to manipulate and analyze data.
4. Educate students about the security challenges associated with IoT and the importance of implementing robust security measures.
5. Address privacy issues related to IoT data collection, storage, and analysis, and introduce privacy-preserving techniques.

Credit: 2		No. of hours per unit (60)
	<ol style="list-style-type: none"> 1. Installation of python in Arduino 2. Perform basic python program in Arduino 3. Perform the basic Arithmetic Operation in Arduino 4. Demonstration of Raspberry Pi 5. Connect and set up IoT devices (e.g., Raspberry Pi, Arduino) with basic sensors. 6. Collect data from sensors (e.g., temperature, humidity) using IoT devices. 7. Write a simple program to control and read data from IoT devices. 8. Store sensor data in a local database (e.g., SQLite) on the IoT device. 9. Implement basic security measures for IoT devices (e.g., secure communication, authentication). 10. Use Python libraries (e.g., Matplotlib, Seaborn) to visualize IoT data. 11. Integrate IoT data with external sources for analysis. 12. Develop an anomaly detection system for sensor data. 13. Classify sensor data into categories or classes. 14. Create a system to monitor sensor data in real-time and trigger alerts. 15. Perform collect sensor data from iot device (temperature, vibration, 	

	<p>humidity, ., Raspberry Pi, Arduino).</p> <p>16. Perform the operation store the sensor data in data base (such as mongo db or lifluxudb).</p> <p>17. Perform the visualization sensor data using python library such as pandas matplotlib.</p> <p>18. Perform the ML algorithm on real time sensor data.</p> <p>19. Use the python library like pandas and sickest-learn to pri-processor the data and train predictive models for equipment's failure production.</p> <p>20. Utilize sensor Iot device to collect realtiome data</p>	
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Course Outcomes: - Students will be able to...

1. Understand the fundamental concepts of the Internet of Things (IoT) and its wide-ranging applications across industries.
2. Acquire foundational programming skills, with a focus on languages commonly used in IoT, such as Python and C++.
3. Gain insights into the layered architecture of IoT devices, encompassing both hardware components and the software stack.
4. Comprehend the overarching importance of security and privacy in the context of IoT.

Reference Books:

1. Souvik Pal ,IoT Hardcover ,CRC Press,2020
2. Pelin Yildirim Taser ,Emerging Trends in IoT and Integration With Data Science,Business Science Reference,30 November 2021
3. P. G. Madhavan,Data Science for IoT Engineers: A Systems Analytics Approach,9 November 2021
4. Fausto Pedro García Márquez,IoT and Data Science in Engineering Management: Proceedings of the 16th International Conference on Industrial Engineering and Industrial Management,Springer International Publishing AG,25 March 202

SEMESTER-II
VSC Vocational Skill Course
BDSTVSC 2 Internet Data Security II

Learning Objectives: Student should be able to...

1. Covers expertise in Advanced Cryptography concepts, methodologies.
2. Understanding of technologies related to securing data within the realm of internet-based systems.
3. Understanding of IoT (Internet of Things), Cloud Security.
4. Exploring advanced techniques, tools, and strategies for safeguarding information in diverse online environments.

Credits=2	SEMESTER-II Learning techniques	No. of hours per unit/credits
UNIT I	Advanced Cryptography	8
	Public-key cryptography, Digital signatures and certificates, Cryptographic protocols (SSL/TLS, SSH, etc.), Cryptanalysis techniques, Encryption Techniques	
UNIT II	IoT (Internet of Things and Cloud Security)	8
	Security risks in IoT devices and networks, IoT security architectures, IoT security standards and best practices, , Security challenges in cloud computing, Secure cloud architecture and services, Cloud security controls and compliance	
UNIT III	Operating System Security, Software Security	8
	Security models in operating systems, Access control mechanisms (DAC, MAC, RBAC), Hardening and securing operating systems, Secure software development life cycle, Static and dynamic code analysis, Software vulnerabilities and exploitation	
UNIT IV	Ethical and Legal Aspects of Cyber security	6
	Ethical considerations in cyber security practices, Cyber laws, regulations, and privacy issues, Intellectual property rights and cyber security	

Course Outcomes: - Student will be able to ...

1. Understand and implement advanced Cryptography methodologies to secure data transmission and storage over the internet.
2. Develop skills in handling and responding to security incidents, including incident handling procedures, digital forensics, and recovery strategies in internet-based environments.
3. Understand and implement advanced encryption methodologies to secure data transmission and storage over the internet.
4. Awareness of Ethical and Legal Aspects of Cyber security.

Reference Books:

1. Marius Iulian Mihailescu, Stefania Loredana Nita, Cryptography and Cryptanalysis in MATLAB, APress ; 1st ed. edition 2021
2. Raghavendra. A, IoT Security Paperback, Notion Press,2022
3. Theodore A. Linden, Operating System Structures to Support Security and Reliable Software, Forgotten Books,2018
4. Juan Cayón Peña, Security and Defense, Springer Nature Switzerland AG,2023

SEC Skill Enhancement course
BDSTSEC 3: Data Visualization Skills for Data Scientist

Course Objectives: - Student should be able to...

1. Understanding of Measures of variability (variance, standard deviation) Visual representation of descriptive statistics Introduction to statistical tests
2. Understanding of Application of statistical tests in data exploration
3. Understanding of cleaning process, Importance of clean data for accurate analysis, Common challenges in dirty data
4. Understand the concept of data visualization and its significance in data analysis.

Credits=2	SEMESTER II BDSTSEC 3: Data Visualization Skills for Data Scientist	No. of hours per unit/ credits
UNIT I	Introduction to Data Visualization	08
	Definition and purpose of data visualization Historical perspective and evolution of data visualization Importance in data-driven decision-making Integration of data visualization in the data science workflow Communicating insights through visual storytelling. Relationship between data visualization and exploratory data analysis (EDA) Comparing visual communication with tabular and textual presentation Cognitive aspects of visual perception Advantages and limitations of data visualization	
UNIT II	Understanding Data for Visualization	08
	Overview of the EDA process Importance of EDA in data visualization, Exploratory data analysis vs. explanatory data analysis Key descriptive statistics (mean, median, mode, range) Measures of variability (variance, standard deviation) Visual representation of descriptive statistics Introduction to statistical tests (t-tests, chi-square tests) Application of statistical tests in data exploration Interpreting statistical test results for decision-making	
UNIT III	Data Cleaning and Preparation	08
	Overview of the data cleaning process, Importance of clean data for accurate analysis, Common challenges in dirty data, Strategies for identifying missing data, Techniques for handling missing values (imputation, removal), Best practices for mitigating the impact of missing data	

UNIT IV	Interactivity in Visualizations	06
	Overview of interactive data visualizations Importance of interactivity in enhancing user engagement Examples of successful interactive visualizations Tools and platforms for building interactive dashboards (e.g., Plotly Dash, Tableau, Power BI) Design principles for effective dashboards Hands-on exercises in creating a basic interactive dashboard	

Course Outcomes: - Student will be able to ...

1. Understand the importance of interactivity in enhancing user engagement with data.
2. Recognize the significance of data cleanliness for accurate analysis.
3. Introduce statistical tests and their role in exploring data patterns.
4. Understand the concept of data visualization and its significance in data analysis.
5. Introduce statistical tests and their role in exploring data patterns.

Reference Books:

1. Dr Zacharias Voulgaris Ph.D, Data Scientist: The Definitive Guide to Becoming a Data Scientist, Technics Publications LLC, 2014.
2. May Yuan, Kathleen S. Hornsby, Computation and Visualization for Understanding Dynamics in Geographic Domains: A Research Agenda, CRC Press, 2019.
3. Tamraparni Dasu (Author), Theodore Johnson, Exploratory Data Mining and Data Cleaning, Wiley-Interscience, 2003.
4. David Mertz, Cleaning Data for Effective Data Science, Packt Publishing Limited, 2021.

BDSTCC II:

Rayat Shikshan Sanstha's
Yashavantrao Chavan Institute of Science, Satara (Autonomous)
(Lead college, Karmaveer Bhaurao Patil University, Satara)

Co-curricular Course**Sports Activity****Course Name: BDSTCC 2 Sport Event Management****Structure of the Course:**

Duration	Theory Periods	Total Periods	Credits	No. of Students in batch
1 Year	30	30	2	

Course objectives:

Students should be able to ...

1. Understand the Principles of Sport Event Management
2. Learn Event Planning and Organization
3. Understand Marketing and Promotion Strategies
4. Utilize Technology in Event Management
5. Understand Sponsorship and Revenue Generation
6. Explore Venue Selection and Management

Credit(1)	Name of the Unit	No of Hrs. (30)
Unit I	Principles of Sport Event Management	8
	<ul style="list-style-type: none"> • Introduction to Sport Event Management • Marketing Management • Risk Management • Promoting Sports Events and Sponsorship. 	
Unit II	Government Support / Financial Management	7
	<ul style="list-style-type: none"> • Introduction to Government Support and Financial Management • Sport policy. • Sport law. • Government Support Application Process 	
Unit III	Role of data science in sport event management	8
	<ul style="list-style-type: none"> • Role of data science in sport event management • Data Collection in Sports Events • Performance Analysis in Sports Events • Marketing and Promotion Strategies with Data 	
	Sport management case studies	

Unit IV	<ul style="list-style-type: none"> • YCIS Marathon Competition • IPL Competition • Football Competition • Pro Kabaddi Competition 	7
<p>Course outcomes:</p> <p>Students will be able to...</p> <ol style="list-style-type: none"> 1. Demonstrate Understanding of Sport Event Management Principles 2. Plan and Execute Sporting Events 3. Manage Budgets Effectively 4. Select and Manage Venues 5. Implement Marketing and Promotion Strategies 6. Ensure Risk Management and Safety 		
<p>Reference Books:</p>		
<ol style="list-style-type: none"> 1. Danny O'Brien, Milena M. Parent, Strategic Management in Sport, 2019. 2. DR Basavaraj wali, Sports event management, 2022 3. Julia Tum , Philippa Norton ,Management of Event Operations, 2005 4. Simon Chadwick John Beech,The Business of Sport Management, 2019 5. Dr. Yatendra kumar Singh, Key Concepts in Sports Event Management, 2023 6. Stephen Frawley, Managing Sport Mega-Events, 2016 		