Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. III (Data Science)

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2025-2026

Syllabus for Bachelor of Science (B. Sc.) Part – III Data Science

PREAMBLE:

The B.Sc. Data Science course under the autonomy framework will be introduced in the academic year 2025–2026. It has been thoughtfully designed to meet the emerging demands of the digital age and the growing relevance of data-driven decision-making across sectors. In line with the NEP 2020 guidelines, the curriculum emphasizes a balanced integration of theoretical knowledge and practical skills. It builds a strong foundation in statistics, mathematics, and computer science while promoting interdisciplinary applications of data science in fields such as healthcare, finance, agriculture, environment, and social sciences.

The program aims to equip students with the ability to collect, process, analyze, and interpret complex data using modern tools and technologies. With a strong focus on hands-on learning, the course includes practical exercises, real-world datasets, and projects that foster critical thinking and problem-solving skills. Students will gain exposure to programming languages, machine learning techniques, data visualization, and ethical data handling practices. The course is structured to nurture innovation, inspire research, and encourage entrepreneurship, while also preparing students for higher studies or employment in data-centric industries and research organizations.

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 impact 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
    a. Data Scientist.
    b. Business Analyst.
    c. Data Analytics Manager.
    d. Data Architect.
    e. Data Administrator.
    f. Business Intelligence Manager.
    g. Entrepreneur in Computer Science industry.
7. To Develop designing, analyzing and critical thinking skill among students.

PROGRAMME OUTCOMES

After completing the B.Sc. program, graduates will:

1. Possess a strong foundation of knowledge in their chosen field of study.
2. Develop a scientific mindset, becoming open-minded, critical, and curious, which will support their entry into research and innovation.
3. Be skilled in practical work, experiments, and the use of laboratory materials.
4. Be eligible to pursue higher studies in their field, both in India and abroad.
5. Qualify to appear for examinations for jobs in government organizations.
6. Meet the minimum eligibility requirements for various science-related job opportunities.
7. Be prepared to establish their own entrepreneurial ventures.
8. Enhance critical thinking, develop a scientific attitude, solve problems, improve practical skills, boost communication abilities, and strengthen social interactions.

PROGRAMME SPECIFIC OUTCOMES

After completing the B.Sc. (Data Science) program, students will:

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.

1. TITLE: **Data Science**

2. YEAR OF IMPLEMENTATION: **2025-2026**

3. DURATION: **01 year**

4. PATTERN: **Semester examination**

5. MEDIUM OF INSTRUCTION: **English**

6. STRUCTURE OF COURSE:

As per NEP-2020 (1.0)

<table>
<tr><th rowspan="3">Level</th><th rowspan="3">Sem.</th><th colspan="4">Subject</th><th rowspan="3">VSC</th><th rowspan="3">FP</th><th rowspan="3">CEP</th><th rowspan="3">OJT</th><th rowspan="3">Total</th></tr>
<tr><th colspan="2">DSC</th><th colspan="2">DSE*</th></tr>
<tr><th>T</th><th>P</th><th>T</th><th>P</th></tr>
<tr><td rowspan="2">5.5</td><td rowspan="2">V</td><td>DSC I (2)</td><td rowspan="2">DSC P (4)</td><td>DSE I (2)</td><td rowspan="2">DSE P (2)</td><td rowspan="2">VSC (4)</td><td rowspan="2">FP (2)</td><td rowspan="2">CEP (2)</td><td rowspan="2">--</td><td rowspan="2">22</td></tr>
<tr><td>DSC II (2)</td><td>DSE II (2)</td></tr>
<tr><td rowspan="2">5.5</td><td rowspan="2">VI</td><td>DSC I (2)</td><td rowspan="2">DSC P (4)</td><td>DSE I (2)</td><td rowspan="2">DSE P (2)</td><td rowspan="2">VSC (2)</td><td rowspan="2">FP (2)</td><td rowspan="2">--</td><td rowspan="2">OJT (4)</td><td rowspan="2">22</td></tr>
<tr><td>DSC II (2)</td><td>DSE II (2)</td></tr>
</table>

* DSE - 2 Papers out of four for each semester.

7. COURSE TITLE

1) Semester - V

Sr. No.	Subject	Theory				Practical		
		Course No. & Course Code	**Title of Paper**	**No. of lectures per week**	**Credits**	**Course No. & Course Code**	**No. of Practical Per week**	**Credits**
1.	DSC I	BDST 351	Cloud Computing	2	2	BDSP 357	1	2
2.	DSC II	BDST 352	Data Structures and Algorithms using Python	2	2	BDSP 358	1	2
3.	DSE I	BDST 353 E-1	Cyber Security	2	2	BDSP359	1	2
4.	DSE I	BDST 354 E-2	Machine Learning					
5.	DSE II	BDST 355 E-3	Tableau for Data Science	2	2			
6.	DSE II	BDST 356 E-4	Recommended System Using Python					
7.	VSC	--	--	--	--	BDSPVSC III	1	2
		--	--	--	--	BDSPVSC IV	1	2
8.	FP	--	--	--	--	BDSPFP I	--	2
9.	CEP	--	--	--	--	BDSPCEP I	2	2

2) Sixth Semester

Sr. No.	Subject	Theory				Practical		
		Course No. & Course Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC I	BDST 361	Image Processing	2	2	BDSP 367	1	2
2.	DSC II	BDST 362	Time series Analysis	2	2	BDSP 368	1	2
3.	DSE I	BDST 363 E-1	Git Hub	2	2	BDSP 369	1	2
4.	DSE I	BDST 364 E-2	Data Engineering					
5.	DSE II	BDST 365 E-3	Data Governance	2	2			
6.	DSE II	BDST 366 E-4	Data Science for Business Forecasting					
7.	VSC	--	--	--	--	BDSPVSCV	1	2
8.	FP	--	--	--	--	BDSPFPII	1	2
9.	OJT	--	--	--	--	BDSPOJTI	2	4

8. EVALUATION STRUCTURE:

- **B.Sc. III NEP 1.0**
  - Semester V (5.5)

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	Mid - Semester	CCE-II			
DSC	T	BDST 351	05	10	05	30	50	02
	T	BDST 352	05	10	05	30	50	02
	P	BDSP 357	--	--	--	50	50	02
	P	BDSP 358	--	--	--	50	50	02
DSE (2 Theory Papers Out of Four)	T	BDST 353	05	10	05	30	50	02
	T	BDST 354	05	10	05	30	50	02
	T	BDST 355	05	10	05	30	50	02
	T	BDST 356	05	10	05	30	50	02
	P	BDSP 359	--	--	--	50	50	02
VSC	P	BDSPVSC III	--	--	--	50	50	02
	P	BDSPVSC IV	--	--	--	50	50	02
FP	P	BDSPFP I	--	--	--	50	50	02
CEP	P	BDSPCEP I	--	--	--	50	50	02
Total							**550**	**22**

OE : Open Elective Course, IKS : Indian Knowledge System ,VSC : Vocational Skill Course, FP: Field Project, CEP : Community Engagement Program

-Semester VI (5.5)

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	Mid - Semester	CCE-II			
DSC	T	BDST 361	05	10	05	30	50	02
	T	BDST 362	05	10	05	30	50	02
	P	BDSP 367	--	--	--	50	50	02
	P	BDSP 368	--	--	--	50	50	02
DSE (2 Theory Papers Out of Four)	T	BDST 363	05	10	05	30	50	02
	T	BDST 364	05	10	05	30	50	02
	T	BDST 365	05	10	05	30	50	02
	T	BDST 366	05	10	05	30	50	02
	P	BDSP 369	--	--	--	50	50	02
VSC	P	BDSPVSC V	--	--	--	50	50	02
FP	P	BDSPFP II	--	--	--	50	50	02
OJT	P	BDSPOJT I	--	--	--	100	100	04
Total							**550**	**22**

OE : Open Elective Course, IKS : Indian Knowledge System ,VSC : Vocational Skill Course, FP: Field Project, CEP : Community Engagement Program

9. **OTHER FEATURES:**

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) **EQUIPMENT:**

a) Computer, LCD projector, visualizer, smart board

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) **Faculty of Science and Technology**
	Yashavantrao Chavan Institute of Science, Satara
	Board of Studies in Computer Science
Programme: B.Sc.	**Semester** - V
Type : DSC I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
	Name of the Course: BDST 351, Cloud Computing

Course Objectives:

1) understand cloud computing and its key characteristics

2) differentiate between Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a service (SaaS)

3) compare and contrast public, private, hybrid, and multi-cloud deployment models

4) understand the architecture of cloud computing systems

Course Outcomes:

1) define cloud computing and its key characteristics.

2) understand the service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid).

3) knowledge of major cloud service providers (e.g., Amazon Web Services, Microsoft Azure, Google cloud Platform) and their offerings.

4) ability to compare different cloud services.

Module	Title and Contents	Hrs
Module -1:	**Module -1: Cloud Services and Cloud Models** 1.1 Introduction to Cloud Computing vs. Cluster vs. Grid Computing 1.2 Cloud Service Models, Introduction to IaaS, PaaS, SaaS, Characteristics and Benefits of Each Model, Security Aspects of Service Models, Applications of IaaS, PaaS, SaaS 1.3 Cloud Deployment Models, Public Cloud, Private Cloud, Hybrid Cloud	08
Module -2:	**Module -2: Cloud Architecture** 2.1 Cloud Computing Architecture. 2.2 Community Cloud. 2.3 Amazon Web Services (AWS), Amazon EC2 (Elastic Compute Cloud), Amazon ECS (Elastic Container Service), AWS Lambda for Serverless	08

	Computing. 2.4 Scalability in Cloud, Service-Oriented Architecture (SOA), Auto Scaling, Load Balancing, Definition and Basic Concepts, Cloud APIs (RESTful APIs), Relating SOA to Cloud Computing.	
Module -3:	**Module -3: Multi Core Architecture** 3.1 Introduction to Multi-Core Architecture. 3.2 Parallel Programming in Cloud. 3.3 Cloud Migration, Migration Strategies, Migration Processes. 3.4 Cloud Bursting, Data Migration in Cloud.	07
Module -4:	**Module -4: Cloud Security** 4.1 Working with Data Sources. 4.2 Data Ingestion Techniques, From CSV, From Excel, From SQL Databases. 4.3 Data Preprocessing and Cleaning in Cloud. 4.4 Database Integration Using Python, Creating and Searching Tables, Reading and Storing Configuration Information, Programming with Database Connections.	07

Reference Books:-

1) Bahga, Arshdeep, Madisetti, Vijay. Cloud Computing: A Hands-on Approach. Hyderabad: The Orient Blackswan, 2014.

2) Buyya, Rajkumar. Cloud Computing: Principles and Paradigms. New Delhi: Wiley, 2013.

3) Buyya, Rajkumar. Mastering Cloud Computing . New Delhi: McGraw Hill, 2024.

4) Elayidom, M. Sudheep. Cloud Computing & Big Data: From the Basics to Practical Use Cases (1st Edition). New Delhi: Cengage Learning India Pvt. Ltd., 2024.

5) Jayaswal, Kailash. Cloud Computing Black Book. New Delhi: Dreamtech Press, 2014.

6) Misra, Rajiv. Cloud and Distributed Computing: Algorithms and Systems. New Delhi: Wiley, 2020.

7) Srinivasan. Cloud Computing: A Practical Approach for Learning and Implementation. New Delhi: Pearson Education India, 2014.

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks): • CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective Note: Conversion of 40 marks of internal evaluation to 20 Marks	**End Semester Examination (30 Marks):** • Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) Note: Conversion of 50 marks of ESE evaluation to 30Marks

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(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSC II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDST 352, Data Structures and Algorithms using Python

Course Objectives: Students will be able to…

1) understand the fundamental concepts of data structures and their importance in solving computational problems.
2) learn and apply algorithmic strategies for searching, sorting, and managing data efficiently using python.
3) analyze the performance and complexity (time and space) of algorithms using big-o notation.
4) implement linear and non-linear data structures (such as stacks, queues, linked lists, trees, and graphs) in python.

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

1) describe and distinguish between various data structures and their use-cases.
2) implement linear data structures such as arrays, stacks, queues, and linked lists using python.
3) apply non-linear data structures such as trees and graphs to solve hierarchical and network-based problems.
4) evaluate and compare the efficiency of sorting and searching algorithms.

Module	Title and Contents	Hrs
Module -1:	**Module -1: Foundations of Algorithm and Data Structures** 1.1 Fundamentals of Data Structures, Need of Data Structure, Definition of Data Structure, Types of Data Structures 1.2 Algorithm Complexity Analysis, Complexity of Algorithms, Space Complexity, Time Complexity. 1.3 Asymptotic Notation and Efficiency Measures, Asymptotic Notations, Big-O, Theta and Omega, Standard Measures of Algorithmic Efficiency	08
Module -2:	**Module -2: Non-Linear Data Structures** 2.1 Trees and Binary Trees, Trees, Binary Trees (Traversal: Inorder, Preorder, Postorder), Binary Search Trees (BST), Tree Operations (Insert, Delete, Search). 2.2 Graphs and Representations, Graphs, Graph Representation (Adjacency List	08

	& Matrix). 2.3 Graph Traversals and Pathfinding, Graph Traversals (BFS, DFS), Shortest Path Algorithms (Dijkstra, Bellman-Ford).	
Module -3:	**Module -3: Linked List** 3.1 Introduction to Linked List, List as a Data Structure, Differences with Array, Dynamic Implementation of Linked List, Internal and External Pointers 3.2 Types and Operations on Linked List, Singly Linked List, Doubly Linked List, Circular Linked List, Operations – Create, Traverse, Insert, Delete, Search, Sort, Reverse, Concatenate, Merge. 3.3 Applications and Complexity, Time Complexity of Operations	07
Module -4:	**Module -4: Hashing, Dictionaries, Searching and Sorting Algorithms** 4.1 Hashing and Hash Tables, Hashing Concepts, Hash Functions, Collision Resolution Techniques (Chaining, Open Addressing) 4.2 Dictionaries in Python, Dictionaries, Dictionary Operations (Insert, Update, Delete, Search), Applications of Hash Tables, Searching and Sorting Algorithms 4.3 Searching, Linear Search, Binary Search, Sorting – Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort	07

Reference Books:-

1) Chatterjee, A. Linked List Problems: Algorithms that Make You a National Programmer. Chennai: Notion Press, 2022.
2) Goodrich, M.T., Tamassia, R., Mount, D.M. Data Structures and Algorithms in C++. Hoboken: John Wiley & Sons Inc., 2009.
3) Karumanchi, N. Data Structure and Algorithmic Thinking with Python. Hyderabad: CareerMonk Publications, 2015.
4) Karumanchi, N. Data Structures and Algorithms for GATE. Hyderabad: CareerMonk Publications, 2011.
5) Karumanchi, N. Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles. Hyderabad: CareerMonk Publications, 2023.
6) Mailund, T. The Joys of Hashing. New York: Apress, 2019.
7) Martin, W.A., Ness, D.N. Optimizing Binary Trees Grown with a Sorting Algorithm. Charleston: Legare Street Press, 2022.

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective • Note: Conversion of 40 marks of internal evaluation to 20 Marks	• Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

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Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSC I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP 357, Cloud Computing

Course Objectives: Students will be able to…

1) understand cloud computing and its key characteristics.
2) differentiate between Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
3) understand the memory requirement for various data structures.
4) operate on the various structured data

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

1) Demonstrate proficiency in building various Tableau visualizations, from basic charts to advanced analytics.
2) Design and publish interactive dashboards tailored to business needs.
3) Efficiently handle large datasets using Tableau's data preparation and performance optimization features.
4) Apply Tableau for real-world scenarios, leveraging advanced features like LOD calculations, mapping, and integrations.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Create an Amazon AWS Account. 2) Create Your First Amazon S3 Bucket. 3) Implementation VCP. 4) Create Your First Amazon EC2 Instance (Window) 5) Amazon Elastic Load Balancer (ELB) 6) Amazon RDS & DynamoDB 7) Deploying machine learning models into production was time-consuming and error-prone. 8) Case Study on Enhancing Predictive Analytics in Healthcare Using Cloud Computing. 9) Real-Time Fraud Detection for E-Commerce Using Cloud Infrastructure. 10) Climate Prediction Models Using Cloud Computing for Academic	30

	Research.	

Reference Books:-

1) Armstrong, S. Codeless Data Structures and Algorithms: Learn DSA Without Writing a Single Line of Code. Apress, 2020.
2) Buyya, R. Mastering Cloud Computing (2nd Edition). McGraw Hill, 2024.
3) Elayidom, M. S. Cloud Computing & Big Data: From the Basics to Practical Use Cases (1st Edition Paperback). Cengage Learning India Pvt. Ltd, 2024.
4) Goodrich, M. T., Tamassia, R., & Mount, D. M. Data Structures and Algorithms in C++. John Wiley & Sons Inc., 2009.
5) Jayaswal, K. Cloud Computing Black Book. Dreamtech Press, 2014.
6) Karumanchi, N. Data Structures and Algorithms for Gate. CareerMonk Publications, 2011.
7) Martin, W. A., & Ness, D. N. Optimizing Binary Trees Grown with a Sorting Algorithm. Legare Street Press, 2022.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Programme: B.Sc.	**Semester** - V
Type : DSC II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP 358, Data Structures and Algorithms using Python

Course Objectives: Students will be able to…

1) understand the fundamental concepts of data structures and their importance in solving computational problems.
2) learn and apply algorithmic strategies for searching, sorting, and managing data efficiently using python.
3) analyze the performance and complexity (time and space) of algorithms using big-o notation.
4) implement linear and non-linear data structures (such as stacks, queues, linked lists, trees, and graphs) in python.

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

1) describe and distinguish between various data structures and their use-cases.
2) implement linear data structures such as arrays, stacks, queues, and linked lists using python.
3) apply non-linear data structures such as trees and graphs to solve hierarchical and network-based problems.
4) evaluate and compare the efficiency of sorting and searching algorithms.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Write a Python program to search for an element in a list using linear search. 2) Write a program to implement binary search on a sorted list. 3) Implement binary search using recursion in Python. 4) Solve the problem of searching in a rotated sorted array. 5) Implement bubble sort to arrange elements in ascending order. 6) Write a Python program to implement selection sort. 7) Implement insertion sort for sorting elements. 8) Use the divide-and-conquer approach to implement merge sort. 9) Write a program to implement quick sort using a pivot element. 10) Implement counting sort for an array of integers.	30

Reference Books:-

1) Chatterjee, A. Linked List Problems: Algorithms that Make You a National Programmer. Chennai: Notion Press, 2022.
2) Goodrich, M.T., Tamassia, R., Mount, D.M. Data Structures and Algorithms in C++. Hoboken: John Wiley & Sons Inc., 2009.
3) Karumanchi, N. Data Structure and Algorithmic Thinking with Python. Hyderabad: CareerMonk Publications, 2015.
4) Karumanchi, N. Data Structures and Algorithms for GATE. Hyderabad: CareerMonk Publications, 2011.
5) Karumanchi, N. Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles. Hyderabad: CareerMonk Publications, 2023.
6) Mailund, T. The Joys of Hashing. New York: Apress, 2019.
7) Martin, W.A., Ness, D.N. Optimizing Binary Trees Grown with a Sorting Algorithm. Charleston: Legare Street Press, 2022.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Programme: B.Sc.	**Semester** - V
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 353 E-1, Cyber Security	

Course Objectives: Students will be able to…

1) understand the basics of computer, network and information security.
2) study operating system security and malwares.
3) acquaint with security issues in internet protocols.
4) analyze the system for vulnerabilities

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

1) use cryptographic techniques in secure application development.
2) apply methods for authentication, access control, intrusion detection and prevention.
3) apply the scientific method for security assessment.
4) illustrate computer forensics knowledge.

Module	Title and Contents	Hrs
Module -1:	**Module -1: Basic concepts of Cyber Security** 1.1 Introduction to Cyber Security Concepts, Elements of Information Security, Security Policies and Techniques, 1.2 Security Process and Categories, Steps in Information Security, Categories of Security Measures. 1.3 Network Security Basics, Operational Model of Network Security, Basic Terminologies in Network Security. 1.4 Threats and Vulnerability, Definition and Types of Threats, Identifying System Vulnerabilities 1.5 Security vs Privacy, Understanding the Differences	08
Module -2:	**Module -2: Data Encryption Techniques And Standards** 2.1 Introduction to Encryption, Encryption Concepts and Need, Encryption Techniques , Symmetric vs Asymmetric Encryption, Basics of Cryptography 2.3 Classical Encryption Methods, Substitution and Transposition Ciphers, Steganography – Applications and Limitations 2.4 Modern Encryption Algorithms, Block Ciphers and Modes of Operation, Feistel Cipher Structure 2.5 Standard Encryption Algorithms, Data Encryption Standard (DES), Triple	07

	DES,Weak Keys in DES, Advanced Encryption Standard (AES)	
Module -3:	**Module -3: Public Key and Management** 3.1 Public Key Cryptography Overview, RSA Algorithm – Working, Key Length, Security 3.2 Key Exchange and Management, Key Distribution Techniques, Diffie-Hellman Key Exchange 3.3 Elliptic Curve Cryptography, ECC Arithmetic and Cryptography, ECC Security and Applications 3.4 Authentication and Integrity, Message Digest and Hashing, Kerberos and X.509 Authentication Service 3.5 Digital Signatures, Implementation and Algorithms, DSS and Authentication Protocols	08
Module -4:	**Module -4: Firewall And Intrusion** 4.1 Computer Intrusions 4.2 Firewall Fundamentals, Characteristics and Types of Firewalls, Benefits and Limitations of Firewalls 4.3 Firewall Architecture, Trusted Systems and Access Control Models 4.4 Intrusion Detection Systems (IDS), IDS Concepts, Need, and Methods, Types of IDS and Their Implementation 4.5 Password Management, Password Policies and Protection, Limitations and Security Challenges.	07

Reference Books:-

1) Antonucci, D. The Cyber Risk Handbook: Creating and Measuring Effective Cybersecurity Capabilities. Hoboken: Wiley, 2017.
2) Chio, C., & Freeman, D. Machine Learning and Security: Protecting Systems with Data and Algorithms. Sebastopol: O'Reilly Media, 2018.
3) Gregory, P. H. CISSP For Dummies (8th ed.). Hoboken: Wiley, 2024.
4) Kumar, V., Chaisiri, S., & Ko, R. Data Security in Cloud Computing. London: The Institution of Engineering and Technology, 2020.
5) McDonough, B. R. Cyber Smart: Five Habits to Protect Your Family, Money, and Identity from Cyber Criminals. Hoboken: Wiley, 2019.
6) Tehranipoor, M. Emerging Topics in Hardware Security. Cham: Springer, 2020.
7) Troncone, P., & Albing, C. Cybersecurity Ops with Bash: Attack, Defend, and Analyze from the Command Line. Sebastopol: O'Reilly Media, 2020

Evaluation Pattern:	
Total Marks: 100 / 50	
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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 354 E-2, Machine Learning	

Course Objectives: Students will be able to…

1) gain a foundational understanding of machine learning concepts, applications, and the distinctions among various types of machine learning approaches.
2) understand the concept of regression and classification and their practical significance.
3) develop an understanding of clustering techniques such as k-means, hierarchical clustering, and gaussian mixture models (gmms).
4) grasp the fundamental principles of reinforcement learning and its types.

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

1) demonstrate the ability to apply supervised and unsupervised learning techniques to solve real-world problems effectively.
2) evaluate the performance of machine learning models using appropriate metrics such as accuracy, precision, recall, f1-score, and auc-roc.
3) design and implement machine learning pipelines, including preprocessing, model building, and evaluation, for various applications.
4) explain and implement reinforcement learning techniques and dimensionality reduction methods, understanding their applications in real-world scenarios

Module	Title and Contents	Hrs
Module -1:	**Module -1: Concepts of Machine Learning** 1.1 Introduction to Machine Learning, Overview and Applications of Machine Learning, Problems Suitable for Machine Learning 1.2 Types of Machine Learning, Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning 1.3 Benefits and Challenges of Machine Learning, Advantages and Disadvantages, Common Challenges in ML 1.4 Process of Machine Learning, Steps Involved in ML Workflow	08
Module -2:	**Module -2: Supervised Learning** 2.1 Concepts in Machine Learning, Inductive Learning and Generalization, Bias, Variance, Overfitting, and Underfitting 2.2 Learning Algorithms, Parametric vs Non-Parametric Algorithms	07

	2.3 Regression Techniques, Concept of Regression and Linear Regression 2.4 Classification Techniques, Logistic Regression, Decision Tree, K-Nearest Neighbors (KNN) 2.5 Evaluation Metrics, Accuracy, Precision, Recall, F1-Score, Confusion Matrix, ROC Curve, and AUC	
Module -3:	**Module -3: Unsupervised Learning** 3.1 Clustering Techniques, Concept of Clustering and K-Means, Gaussian Mixture Models (GMMs) 3.2 Dimensionality Reduction, Criteria for Reduction and Feature Selection, Principal Component Analysis (PCA), Singular Value Decomposition (SVD).	07
Module -4:	**Module -4: Reinforcement Learning** 4.1 Basics of Reinforcement Learning, Introduction and Types of RL 4.2 Working of Reinforcement Learning, Agent, Environment, Rewards, and States 4.3 Algorithms in RL, Q-Learning Algorithm, Markov Decision Process (MDPs) 4.4 Applications of RL, Real-World Use Cases in Gaming, Robotics, etc	08

Reference Books:-

1) Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, Shroff/O'Reilly, 2016.

2) Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, Shroff Publishers, 2019.

3) Anuradha Srinivasaraghavan, Machine Learning, Wiley India, 2019.

4) Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, Packt Publishing, 2017.

5) Tom M. Mitchell, Machine Learning for Absolute Beginners: A Plain English Introduction, Sanage Publishing House LLP, 2024.

6) Manaranjan Pradhan and U. Dinesh Kumar, Machine Learning using Python, Wiley India, 2019.

7) Tom M. Mitchell, Machine Learning, McGraw-Hill Science/Engineering/Math, 2017.

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective • Note: Conversion of 40 marks of internal evaluation to 20 Marks	• Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDST 355 E-3, Tableau for Data Science

Course Objectives: Students will be able to…

1) equip students with foundational to advanced tableau skills for data visualization and analytics.
2) enable learners to effectively connect, prepare, and transform data for insights.
3) teach the creation of dynamic and interactive dashboards and visualizations.
4) prepare students for real-world applications and tableau certification

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

1) Demonstrate proficiency in building various Tableau visualizations, from basic charts to advanced analytics.
2) Design and publish interactive dashboards tailored to business needs.
3) Efficiently handle large datasets using Tableau's data preparation and performance optimization features.
4) Apply Tableau for real-world scenarios, leveraging advanced features like LOD calculations, mapping, and integrations.

Module	Title and Contents	Hrs
Module -1:	**Module -1: Overview of Tableau** 1.1 Introduction to Tableau Ecosystem, Tableau Desktop, Tableau Online, Tableau Server, Applications of Tableau in Business Intelligence 1.2 Installation and Interface, Installing Tableau Desktop, Tableau Interface: Worksheets, Dashboards 1.3 Data Import and Connection Management, Importing Data from Excel, CSV, and Relational Databases, Managing Live Connections and Extracts 1.4 Understanding Tableau Data Handling, Data Types and Metadata, Tableau's Data Interpreter 1.5 Data Preparation Techniques, Cleaning and Transforming Data, Pivoting, Splitting, and Merging Fields, Using Tableau Prep Builder for Advanced Data Preparation	08
Module -2:	**Module -2: Advanced Analytics and Calculations** 2.1 Calculated Fields and Table Calculations, Creating Custom Calculated Fields, Table Calculations: Running Totals, Percentages, Moving Averages	

	2.2 Functions and Expressions, Logical Functions (IF, CASE), String Functions, Level of Detail (LOD) Expressions: FIXED, INCLUDE, EXCLUDE 2.3 Forecasting and Trend Analysis, Applying LOD for Advanced Aggregations, Forecasting Techniques and Trend Analysis 2.4 Advanced Analytics Features, Reference Lines, Bands, and Distributions, Clustering and Statistical Summaries 2.5 Parameters and Interactivity, Creating and Using Parameters, Parameter Actions for Dynamic Filtering and Visualizations, Using Parameters with Calculated Fields.	07
Module -3:	**Module -3: Data Integration** 3.1 Data Blending and Joining, Combining Data from Multiple Sources Using Joins, Data Blending with Different Granularity 3.2 Working with Relationships and Data Models, Understanding Relationships in Tableau, Techniques for Improving Workbook Performance 3.3 Extract Optimization and Performance, Extract Aggregations and Optimization Techniques, Reducing Dashboard Load Time 3.4 Publishing and Sharing, Publishing Dashboards to Tableau Server/Online, Sharing Dashboards via Tableau Public, Managing User Roles and Permissions 3.5 Advanced Integrations, Connecting Tableau with R and Python, Embedding Dashboards in Web Applications, Using Tableau Extensions and APIs	08
Module -4:	**Module -4: Data Visualization and Dashboard Creation** 4.1 Basic Visualizations, Bar Charts, Line Charts, Pie Charts, Crosstabs, Text Tables, Scatter Plots, and Bubble Charts 4.2 Advanced Visualizations, Heat Maps, Tree Maps, Bullet Charts, Gantt Charts and Waterfall Charts, Geographic Maps and Spatial Visualizations 4.3 Dashboard Design and Interactivity, Combining Sheets into Dashboards, Adding Filters, Actions, and Parameters, Designing Guided and User-Friendly Dashboards. 4.4 Storytelling with Tableau, Building Data Narratives with Stories, Adding Story Points and Annotations, Sharing and Publishing Stories.	07

Reference Books:-

1) Joshua N. Milligan, Learning Tableau 2022: Creating Effective Data Visualizations and Dashboards, Packt Publishing, 2022.
2) George Peck, Tableau 2022: The Complete Reference, McGraw Hill, 2022.
3) Ryan Sleeper, Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, O'Reilly

Media, 2020.

4) Tim Costello and Lori Sinnamon, Mastering Tableau 2021, Packt Publishing, 2021.

5) Carl Allchin, Tableau Prep Up & Running, O'Reilly Media, 2021.

6) Daniel G. Murray, Tableau Your Data: Fast and Easy Visual Analysis with Tableau Software, Wiley, 2016.

7) Ben Jones, Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations, O'Reilly Media, 2014.

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective • Note: Conversion of 40 marks of internal evaluation to 20 Marks	• Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 356 E-4, Recommended System using Python	

Course Objectives: Students will be able to…

1) foundation of recommender systems concepts.
2) expose to a variety of recommender systems algorithms.
3) knowledge on the different evaluation methods of recommender systems.
4) build up the capability to develop a recommender system solution.

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

1) characterize different types of recommender systems, map a given real world problem to appropriate model, understand and identify the stages and issues in the deployment of the system.
2) apply principles and techniques of recommender systems in applications related to recommender systems design and analysis.
3) analyze and evaluate various recommender algorithms.
4) implement appropriate recommender system for real world applications

Module	Title and Contents	Hrs
Module -1:	**Module -1: Recommender Systems** 1.1 Introduction to Recommender Systems, Definition and Importance of Recommendation Systems, Types of Recommendation Systems 1.2 Filtering Techniques, Content-Based Filtering, Collaborative Filtering, Hybrid Methods 1.3 Applications and Tools, Applications in E-Commerce, Streaming Services, and Other Domains, Python Tools and Libraries: NumPy, Pandas, Scikit-learn, Surprise, TensorFlow/Keras.	08
Module -2:	**Module -2: Collaborative Filtering** 2.1 Rule-Based and Statistical Models, Decision and Regression Trees, Rule-Based Collaborative Filtering, Associative Rule-Based Filtering, Naive Bayes Collaborative Filtering 2.2 Latent Factor Models, Introduction to Latent Factor Models, Integrating Factorization and Neighborhood Models	07
Module -3:	**Module -3: Context-Sensitive Recommender Systems** 3.1 Concepts and Models, Context-Sensitive Recommender Systems, The Multidimensional Approach	

	3.2 Contextual Approaches, Contextual Pre-Filtering, A Reduction-Based Approach, Post-Filtering Methods, Contextual Modeling	07
Module -4:	**Module -4: Evaluation of Recommender Systems** 4.1 Evaluation Frameworks, Evaluating Recommender Systems, Evaluation Paradigms, Design Issues in Offline Recommender Evaluation 4.2 Evaluation Metrics, Accuracy Metrics – Precision, Recall, F1-Score, Error Metrics – Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Ranking Metrics – Mean Average Precision (MAP), Normalized Discounted Cumulative Gain (nDCG) 4.3 Advanced Techniques in Recommender Systems, Deep Learning in Recommendation Systems (e.g., Neural Collaborative Filtering), Context-Aware Recommendations, Reinforcement Learning for Recommendations	08

Reference Books:-

1) Aggarwal, C.C. Recommender Systems: The Textbook. Cham: Springer, 2016.

2) Beel, J., Gipp, B., Langer, S., Breitinger, C. Research-paper Recommender Systems: A Literature Survey. Cham: Springer, 2016.

3) Friedman, A. Mastering Recommender Systems with Python. Birmingham: Packt Publishing, 2021.

4) Koren, Y., Bell, R., Volinsky, C. Matrix Factorization Techniques for Recommender Systems. IEEE Computer, 2009.

5) Kumar, S. Recommender Systems with Python. New Delhi: BPB Publications, 2021.

6) Ricci, F., Rokach, L., Shapira, B., Kantor, P.B. Recommender Systems Handbook. New York: Springer, 2011.

7) Singhal, S. Building Recommendation Systems in Python. Birmingham: Packt Publishing, 2021

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective • Note: Conversion of 40 marks of internal evaluation to 20 Marks	• Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

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Faculty of Science and Technology

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Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP359, Cyber Security

Course Objectives: Students will be able to…

1) understand the basics of computer, network and information security.
2) study operating system security and malwares.
3) acquaint with security issues in internet protocols.
4) analyze the system for vulnerabilities.

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

1) use cryptographic techniques in secure application development.
2) apply methods for authentication, access control, intrusion detection and prevention.
3) apply the scientific method for security assessment.
4) illustrate computer forensics knowledge.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) practical on cyber-attacks. 2) Hands on Network Security. 3) Exercise on Symmetric encryption algorithm. 4) practical on Asymmetric Symmetric encryption algorithm. 5) Exercise on Intrusion detection. 6) practical on Cryptography. 7) Hands on Public encryption algorithm. 8) Exercise on on Authentication Protocol. 9) practical on Digital Signature 10) Exercise on Firewall And Intrusion	30

Reference Books:-

1) Andress, J. The Basics of Information Security: Understanding the Fundamentals of InfoSec in Theory and Practice. Burlington: Syngress, 2014.
2) Chapple, M., & Seidl, D. CompTIA Security+ Study Guide: Exam SY0-601. Hoboken: Wiley, 2021.
3) Grimes, R. A. Hacking the Hacker: Learn From the Experts Who Take Down Hackers. Hoboken: Wiley, 2017.
4) Kaufman, C., Perlman, R., & Speciner, M. Network Security: Private Communication in a Public World. Upper Saddle River: Prentice Hall, 2002.
5) Kim, D., & Solomon, M. G. Fundamentals of Information Systems Security. Burlington: Jones & Bartlett Learning, 2016.
6) Pfleeger, C. P., & Pfleeger, S. L. Security in Computing. Upper Saddle River: Prentice Hall, 2015.
7) Stallings, W. Cryptography and Network Security: Principles and Practice. Boston: Pearson, 2016.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• **Section I: Attempt any three questions (Five questions of 10 Marks)**

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP359, Machine Learning

Course Objectives: Students will be able to…

1) gain a foundational understanding of machine learning concepts, applications, and the distinctions among various types of machine learning approaches.
2) understand the concept of regression and classification and their practical significance.
3) develop an understanding of clustering techniques such as k-means, hierarchical clustering, and gaussian mixture models (gmms).
4) grasp the fundamental principles of reinforcement learning and its types.

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

1) use python libraries like numpy and pandas for data manipulation and analysis.
2) create effective data visualizations using matplotlib and seaborn.
3) ingest, clean, and preprocess data from various sources.
4) build, evaluate, and tune supervised machine learning models.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Implementation of Linear regression. 2) Implementation of Logistic regression. 3) Exercise on Decision Tree algorithm in Python. 4) Practical on K-Nearest Neibours. 5) Hands-on Task on K-means Clustering in Python 6) Implementation of Summary Statistics in Python. 7) Practical on Principal Component Analysis (PCA). 8) Implementing the K-means clustering algorithm. 9) Perform the functions like accuracy, precision, recall. 10) Perform the functions like F1-score, confusion matrix.	30

Reference Books:-

1) Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, Shroff/O'Reilly, 2016.
2) Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, Shroff Publishers, 2019.
3) Anuradha Srinivasaraghavan, Machine Learning, Wiley India, 2019.
4) Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, Packt Publishing, 2017.
5) Tom M. Mitchell, Machine Learning for Absolute Beginners: A Plain English Introduction, Sanage Publishing House LLP, 2024.
6) Manaranjan Pradhan and U. Dinesh Kumar, Machine Learning using Python, Wiley India, 2019.
7) Tom M. Mitchell, Machine Learning, McGraw-Hill Science/Engineering/Math, 2017.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP359, Tableau for Data Science

Course Objectives: Students will be able to…

1) equip students with foundational to advanced tableau skills for data visualization and analytics.
2) enable learners to effectively connect, prepare, and transform data for insights.
3) teach the creation of dynamic and interactive dashboards and visualizations.
4) prepare students for real-world applications and tableau certification.

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

1) demonstrate proficiency in building various tableau visualizations, from basic charts to advanced analytics.
2) design and publish interactive dashboards tailored to business needs.
3) efficiently handle large datasets using tableau's data preparation and performance optimization features.
4) apply tableau for real-world scenarios, leveraging advanced features like lod calculations, mapping, and integrations.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Installing Tableau Desktop and navigate its interface. 2) Connect Tableau to Excel, CSV, and SQL databases. 3) Automate basic data cleaning and explore metadata in Tableau using data interpreter. 4) Extract data from a live connection and optimize for performance. 5) Build bar charts, line charts, and pie charts using sample data. 6) Create heat maps, tree maps, and scatter plots for advanced visualizations. 7) Visualize spatial data and create filled maps. 8) Combine sheets into a dashboard with interactive filters and actions.	30

	9) Develop calculated fields for custom metrics and KPIs. 10) Implement running totals, moving averages, and percent of totals	

Reference Books:-

1) Joshua N. Milligan, "Learning Tableau 2022: Creating Effective Data Visualizations and Dashboards", Packt Publishing, 2022.
2) George Peck, "Tableau 2022: The Complete Reference", McGraw Hill, 2022.
3) Ryan Sleeper, "Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master", O'Reilly Media, 2020.
4) Tim Costello and Lori Sinnamon, "Mastering Tableau 2021", Packt Publishing, 2021.
5) Carl Allchin, "Tableau Prep Up & Running", O'Reilly Media, 2021.
6) Daniel G. Murray, "Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software", Wiley, 2016.
7) Ben Jones, "Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations", O'Reilly Media, 2014.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Programme: B.Sc.	**Semester** - V
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP359, Recommended System Using Python

Course Objectives: Students will be able to…

1) foundation of recommender systems concepts.
2) expose to a variety of recommender systems algorithms.
3) knowledge on the different evaluation methods of recommender systems.
4) build up the capability to develop a recommender system solution.

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

1) characterize different types of recommender systems, map a given real world problem to appropriate model, understand and identify the stages and issues in the deployment of the system.
2) apply principles and techniques of recommender systems in applications related to recommender systems design and analysis.
3) analyze and evaluate various recommender algorithms.
4) implement appropriate recommender system for real world applications

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Linked List Implementation: Create a singly linked list and implement basic operations like insert, delete, and search. 2) Binary Search Algorithm: Write a program to perform binary search on a sorted array. 3) Bubble Sort Algorithm: Implement the bubble sort algorithm to sort an array of integers. 4) Merge Sort Algorithm: Implement the merge sort algorithm to sort an array of integers. 5) Hash Table Implementation: Implement a simple hash table with basic operations like insert, delete, and search. 6) Binary Search Tree: Create a binary search tree and implement basic operations like insert, delete, and search.	30

7) Graph Representation: Represent a graph using an adjacency matrix and an adjacency list, and implement basic graph traversal algorithms.

8) Depth-First Search (DFS): Implement the DFS algorithm for graph traversal.

9) Breadth-First Search (BFS): Write a program to perform BFS traversal of a graph.

10) Dijkstra's Algorithm: Implement Dijkstra's algorithm to find the shortest path in a weighted graph.

Reference Books:-

1) Aggarwal, C.C. Recommender Systems: The Textbook. Cham: Springer, 2016.

2) Beel, J., Gipp, B., Langer, S., Breitinger, C. Research-paper Recommender Systems: A Literature Survey. Cham: Springer, 2016.

3) Friedman, A. Mastering Recommender Systems with Python. Birmingham: Packt Publishing, 2021.

4) Koren, Y., Bell, R., Volinsky, C. Matrix Factorization Techniques for Recommender Systems. IEEE Computer, 2009.

5) Kumar, S. Recommender Systems with Python. New Delhi: BPB Publications, 2021.

6) Ricci, F., Rokach, L., Shapira, B., Kantor, P.B. Recommender Systems Handbook. New York: Springer, 2011.

7) Singhal, S. Building Recommendation Systems in Python. Birmingham: Packt Publishing, 2021.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Faculty of Science and Technology

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Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : VSC	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSPVSC III, Hypothesis testing

Course Objectives: Students will be able to…

1) understand the fundamental concepts of hypothesis testing and the difference between parametric and non-parametric methods.
2) learn how to apply appropriate statistical tests based on data type, distribution, and sample size.
3) develop practical skills for performing hypothesis tests on real-world data.
4) interpret and communicate statistical test results effectively in the context of scientific or business decision-making.

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

1) identify and apply suitable parametric or non-parametric tests for different research questions and data types.
2) perform hypothesis testing using tools such as R, Python, or Excel, and draw meaningful conclusions.
3) evaluate the assumptions behind statistical tests and choose alternative methods when assumptions are violated.
4) interpret p-values, confidence intervals, and test statistics to support data-driven conclusions and decisions.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) One-Sample t-test 2) Independent Two-Sample t-test 3) Paired Sample t-test 4) Z-test for Mean 5) Z-test for Proportion 6) ANOVA (Analysis of Variance) 7) Pearson's Correlation Coefficient 8) Simple Linear Regression	

	9) Multiple Linear Regression 10) Levene's Test for Equality of Variances 11) Chi-Square Test of Independence 12) Mann–Whitney U Test 13) Wilcoxon Signed-Rank Test 14) Kruskal–Wallis H Test 15) Friedman Test 16) Spearman's Rank Correlation Coefficient 17) Sign Test 18) Runs Test (Wald–Wolfowitz Test) 19) Kolmogorov–Smirnov Test 20) McNemar's Test	60

Reference Books:-

1) Gupta S. C. & Kapoor V. K. Applied Statistics, Sultan Chand & Sons, New Delhi, 2018

2) Hartshorn, Scott. Hypothesis Testing: A Visual Introduction to Statistical Significance. Independently published, 2017.

3) Sharma, S. K. Testing of Hypothesis and Applied Statistics. New Delhi: New Academic Science, 2023.

4) Veeraraghavan, V. Textbook of Parametric and Nonparametric Statistics. New Delhi: Sage Publications India, 2016.

5) Suresh K. & Usman Ahmed. Hands-On Exploratory Data Analysis with Python. Birmingham, UK: Pocket Publishing, 2020.

6) Gareth J., Daniela W., Trevor H. ,An Introduction to Statistical Learning: With Applications in Python, Springer Nature, 2023.

7) Kumar, Ashish, and Gary Dougan. *Learning Predictive Analytics with Python.* Birmingham, UK: Packt Publishing, 2015.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

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Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : VSC	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSPVSC IV, Generative AI

Course Objectives: Students will be able to…

1) Understand key concepts and foundations of generative AI models.
2) Learn architectures like GANs, VAEs, and Transformers.
3) Apply generative AI techniques to real-world tasks.
4) Explore ethical and social implications of generative AI.

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

1) Understand and explain how GANs, VAEs, and other generative models work.
2) Build and train simple generative AI models using tools like TensorFlow or PyTorch.
3) Evaluate the performance of generative models based on real-world data and use cases.
4) Assess the ethical concerns of generative AI and design responsible practices for its deployment.

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Explore tools ChatGPT, DALL·E, Bing Image Creator, and Copilot. 2) Create prompts for summarization, question-answering, and story generation. 3) Use a GenAI tool to summarize news articles or Wikipedia pages. 4) Input 5 sentences and rewrite them in different tones formal, casual, humorous. 5) Input personal data and generate a professional resume or student bio. 6) Generate formal emails for internship requests, complaints, or invitations. 7) Generate 5 images using DALL·E. 8) Modify a prompt and observe how small changes affect the generated	

	image. 9) Remove or replace objects in images using AI tools like DALL·E inpainting. 10) Design an event poster using GenAI for visuals and text. 11) Generate Python code for basic problems like factorial, calculator, sorting. 12) Paste broken code and use AI to identify and correct errors. 13) Ask GenAI to write SQL queries from plain English questions. 14) Generate fake customer or student data (CSV) using AI for testing databases. 15) Generate speech from written text using ElevenLabs, Google TTS, or similar. 16) Use tools like Suno or ChatGPT to create song lyrics or melody prompts. 17) Give factual prompts and check for hallucinations or incorrect answers. 18) Use prompts that may trigger biased outputs; observe and record findings. 19) Use Python + OpenAI API to build a simple chatbot that answers college-related queries. 20) Create a GenAI-Powered Mini Project Note summarizer, Recipe generator, Portfolio builder.	60

Reference Books:-

1) Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning. MIT Press, 2016.
2) Ian Goodfellow, Yoshua Bengio, & Aaron Courville Deep Learning. MIT Press, 2016.
3) Brownlee, J. Generative Adversarial Networks with Python: Deep Learning with Keras, TensorFlow, and PyTorch. Machine Learning Mastery, 2020.
4) Kingma, D. P., & Welling, M. Auto-Encoding Variational Bayes. ICLR, 2014.
5) Rojas, R. Neural Networks: A Systematic Introduction. Springer, 1996.
6) O'Reilly, T. Generative AI and Its Impacts on Society. O'Reilly Media, 2023.
7) Ng, A. Machine Learning Yearning: Technical Strategy for AI Engineers. Deeplearning.ai, 2018.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 361, Image Processing	

Course Objectives: Students will be able to…

1) fundamental concepts of image processing, including the representation and components of digital images.
2) provide a deep understanding of digital image representation, sampling, and quantization
3) understand and implement methods for image restoration, including noise reduction and filtering techniques
4) understand real-world applications of image processing in fields such as computer vision, medical imaging, and object recognition.

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

1) demonstrate a clear understanding of the fundamental principles of image processing, including digital image representation and the components of an image processing system.
2) perform basic pixel operations, arithmetic operations, and spatial filtering techniques for manipulating and enhancing images.
3) utilize spatial and frequency domain techniques for image enhancement and noise reduction.
4) explore the role of image processing in diverse fields such as medical imaging, remote sensing, computer vision, and entertainment,

Module	Title and Contents	Hrs
Module -1:	**Module -1: Image Processing Concepts** 1.1 Introduction to Image Processing 1.2 Digital Image Representation, Definition of a Digital Image, Representation of Images as Matrices 1.3 Components of Image Processing System, Image Sensors, Processing Hardware and Software 1.4 Pixel Operations, Basic Pixel Manipulation, Arithmetic Operations, Image Addition and Subtraction, Multiplication and Division, Applications of Image Processing, Medical Imaging, Remote Sensing, Industrial Inspection.	08
Module -2:	**Module -2: Digital Image Fundamentals and Image Enhancement** 2.1 Image Sampling and Quantization, Sampling Concepts, Quantization	

	Techniques 2.2 Color Models, RGB Model, CMYK Model, HSV Model 2.3 Basic Relationships Between Pixels, Neighbors, Connectivity 2.4 Spatial Domain Techniques, Contrast Stretching, Histogram Equalization, Filtering in the Spatial Domain, Smoothing Filters, Sharpening Filters	07
Module -3:	**Module -3: Image Restoration and Image** 3.1 Image Restoration, Concept and Techniques, Noise Reduction Using Filters, Spatial Domain Filters, Frequency Domain Filters 3.3 Inverse Filtering 3.4 Wiener Filtering, Fundamentals of Image Compression, Compression Models, Lossy Compression Techniques, JPEG Compression, MPEG Compression	07
Module -4:	**Module -4: Image Segmentation** 4.1 Thresholding Methods, Global Thresholding, Adaptive Thresholding 4.2 Edge Detection Techniques, Sobel Operator, Prewitt Operator, Canny Edge Detector 4.3 Region-Based Segmentation, Contours and Shape Descriptors 4.4 Texture Analysis, Face Detection and Recognition, Object Detection	08

Reference Books:-

1) Fernandez Villan, A. Mastering OpenCV 4 with Python: A comprehensive guide to building computer vision applications with OpenCV and Python. Birmingham: Packt Publishing, 2019.
2) Gonzalez, R.C., Woods, R.E. Digital Image Processing. 4th ed. Pearson/Prentice Hall, 2018.
3) McKinney, W. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. Sebastopol: O'Reilly Media, 2017.
4) Russ, J.C. The Image Processing Handbook. 5th ed. Boca Raton: CRC Press, 2010.
5) Rosebrock, A. Practical Python and OpenCV: An Introductory, Example Driven Guide to Image Processing and Computer Vision. PyImageSearch, 2015.
6) Shanmugamani, R. Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras. Birmingham: Packt Publishing, 2018.
7) Dey, S. Hands-On Image Processing with Python: Expert techniques for advanced image analysis and effective interpretation of image data. Birmingham: Packt Publishing, 2018

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks): • CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective • Note: Conversion of 40 marks of internal evaluation to 20 Marks	**End Semester Examination (30 Marks):** • Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - V
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 362, Time series Analysis	

Course Objectives: Students will be able to…

1) Understand fundamental concepts of time series data and components.
2) equip students with techniques for modeling, analyzing, and forecasting time-dependent data.
3) develop understanding of time series models such as arima, exponential smoothing, and others.
4) provide hands-on experience using software tools.

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

5) decompose components of time series data.
6) apply and interpret various time series models including ar, ma and exponential smoothing.
7) use statistical software to perform time series analysis and generate forecasts.
8) evaluate the accuracy of forecasting models using performance metrics such as mse, rmse

Module	Title and Contents	Hrs
Module -1:	**Module -1: Time Series Analysis** 1.1 Fundamentals of Time Series, Definition and basic terminology, Characteristics of time series data, Differences between time series and cross-sectional data 1.2 Components of Time Series, Trend component, Seasonal component, Cyclical component, Irregular (random) component.	08
Module -2:	**Module -2: Applications of time series Analysis** 2.1Applications of Time Series Analysis, Business and economics, Weather and environment, Health and social sciences 2.2 Working with Time Series Data using Python, Indexing and parsing dates, Loading and visualizing time series with Pandas, Time-based indexing and slicing 2.3 Time Series Decomposition, Additive vs multiplicative models, Seasonal decomposition using moving averages (STL)	07
Module -3:	**Module -3: Preprocessing and Smoothing Techniques** 3.1 Data Cleaning and Preprocessing, Handling missing data,Identifying and	

	treating outliers 3.2 Smoothing Techniques, Simple moving average, Weighted moving average, Exponential smoothing	07
Module -4:	**Module -4: Time Series Analysis for Data Science** 4.1 Real-world Applications and Case Studies, Stock market forecasting, Weather prediction, Demand and sales forecasting 4.2 Python Libraries for Time Series, pandas, statsmodels, prophet, scikit-learn 4.3 tensorflow, keras, seaborn, matplotlib	08

Reference Books:-

1) Box, G.E.P., Jenkins, G.M., Reinsel, G.C., & Ljung, G.M. Time Series Analysis: Forecasting and Control. Hoboken: Wiley, 2015.
2) Brockwell, P.J., & Davis, R.A. Introduction to Time Series and Forecasting. New York: Springer, 2016.
3) Cowpertwait, P.S.P., & Metcalfe, A.V. Introductory Time Series with R. New York: Springer, 2009.
4) Hamilton, J.D. Time Series Analysis. Princeton: Princeton University Press, 1994.
5) Hyndman, R.J., & Athanasopoulos, G. Forecasting: Principles and Practice. Melbourne: OTexts, 2018.
6) Montgomery, D.C., Jennings, C.L., & Kulahci, M. Introduction to Time Series Analysis and Forecasting. Hoboken: Wiley, 2015.
7) Shumway, R.H., & Stoffer, D.S. Time Series Analysis and Its Applications: With R Examples. New York: Springer, 2017

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks):	**End Semester Examination (30 Marks):**
• CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective • Note: Conversion of 40 marks of internal evaluation to 20 Marks	• Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - VI
Type : DSC I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDSP 367, Image processing	

Course Objectives: Students will be able to…

1) provide a deep understanding of digital image representation, sampling, and quantization
2) understand and implement methods for image restoration, including noise reduction and filtering techniques
3) develop understanding of time series models such as arima, exponential smoothing, and others.
4) provide hands-on experience using software tools

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

1) perform basic pixel operations, arithmetic operations, and spatial filtering techniques for manipulating and enhancing images.
2) utilize spatial and frequency domain techniques for image enhancement and noise reduction.
3) apply and interpret various time series models including ar, ma and exponential smoothing.
4) use statistical software to perform time series analysis and generate forecasts

Module	Title and Contents	Hrs
Section I:	**List of Practical** 1) Reading and Displaying Images 2) Image Resizing and Cropping 3) Image Rotation and Translation 4) Drawing Shapes and Text on Images 5) Blurring and smoothing 6) Image Conversion: Grayscale and Binary 7) Increase or decrease the brightness of an image. 8) Detect edges in an image using methods like Canny edge detection. 9) Perform operations like dilation, erosion, opening, and closing. 10) Detect and highlight a specific color (e.g., red objects) in an image	30

Reference Books: -

1) Box, G.E.P., Jenkins, G.M., Reinsel, G.C., & Ljung, G.M. Time Series Analysis: Forecasting and Control. Hoboken: Wiley, 2015.

2) Brockwell, P.J., & Davis, R.A. Introduction to Time Series and Forecasting. New York: Springer,

2016.

3) Cowpertwait, P.S.P., & Metcalfe, A.V. Introductory Time Series with R. New York: Springer, 2009.

4) Hamilton, J.D. Time Series Analysis. Princeton: Princeton University Press, 1994.

5) Hyndman, R.J., & Athanasopoulos, G. Forecasting: Principles and Practice. Melbourne: OTexts, 2018.

6) Montgomery, D.C., Jennings, C.L., & Kulahci, M. Introduction to Time Series Analysis and Forecasting. Hoboken: Wiley, 2015.

7) Shumway, R.H., & Stoffer, D.S. Time Series Analysis and Its Applications: With R Examples. New York: Springer, 2017.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - VI
Type : DSC II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDSP 368, Time series Analysis	

Course Objectives: Students will be able to…

1. provide a deep understanding of digital image representation, sampling, and quantization
2. understand and implement methods for image restoration, including noise reduction and filtering techniques
3. develop understanding of time series models such as arima, exponential smoothing, and others.

1) provide hands-on experience using software tools

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

1) dentify and decompose components of time series data.
2) apply and interpret various time series models including ar, ma and exponential smoothing.
3) use statistical software to perform time series analysis and generate forecasts.
4) evaluate the accuracy of forecasting models using performance metrics such as mse, rmse, and mape.

Module	Title and Contents	Hrs
	List of Practical 1) Reading and Displaying Images 2) Image Resizing and Cropping 3) Image Rotation and Translation 4) Drawing Shapes and Text on Images 5) Blurring and Smoothing 6) Image Conversion: Grayscale and Binary 7) Increase or decrease the brightness of an image. 8) Detect edges in an image using methods like Canny edge detection. 9) Perform operations like dilation, erosion, opening, and closing. 10) Detect and highlight a specific color (e.g., red objects) in an image.	30

Reference Books:-

1) Box, G.E.P., Jenkins, G.M., Reinsel, G.C., & Ljung, G.M. Time Series Analysis: Forecasting and

Control. Hoboken: Wiley, 2015.

2) Brockwell, P.J., & Davis, R.A. Introduction to Time Series and Forecasting. New York: Springer, 2016.

3) Cowpertwait, P.S.P., & Metcalfe, A.V. Introductory Time Series with R. New York: Springer, 2009.

4) Hamilton, J.D. Time Series Analysis. Princeton: Princeton University Press, 1994.

5) Hyndman, R.J., & Athanasopoulos, G. Forecasting: Principles and Practice. Melbourne: OTexts, 2018.

6) Montgomery, D.C., Jennings, C.L., & Kulahci, M. Introduction to Time Series Analysis and Forecasting. Hoboken: Wiley, 2015.

7) Shumway, R.H., & Stoffer, D.S. Time Series Analysis and Its Applications: With R Examples. New York: Springer, 2017.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - VI
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 363 E-1, Git Hub	

Course Objectives: Students will be able to…

1) understand the fundamentals of git and github, including version control concepts and repository management.
2) apply branching, merging, and collaboration techniques to work effectively on projects with teams.
3) implement advanced git features such as stashing, rebasing, cherry-picking, and git hooks for automation.
4) utilize github for devops, project management, and continuous integration/deployment (ci/cd) workflows.

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

1) demonstrate proficiency in using git commands for version control and repository management.
2) collaborate effectively on projects using github features such as pull requests, forks, and issues.
3) resolve conflicts, manage branches, and automate workflows using git and github actions.
4) develop and maintain software projects using github best practices, including security and ci/cd pipelines.

Module	Title and Contents	Hrs
Module -1:	**Module -1: Overview Time Series Analysis** 1.1 Version Control Systems, Centralized Version Control Systems, Distributed Version Control Systems 1.2 Introduction to Git, Features and Benefits of Git, Installing Git and Configuring User Information 1.3 Basic Git Commands, git init, git clone, git status, git add, git commit, git log 1.4 Understanding Git Workflow, Creating a Repository, Cloning, Pushing, and Pulling, GitHub vs. GitLab vs. Bitbucket	08
Module -2:	**Module -2: Preprocessing and Smoothing Techniques** 2.1 Branches in Git, Creating, Switching, and Deleting Branches (git branch, git checkout, git switch)	

	2.2 Merging Branches, git merge, git rebase 2.3 Resolving Merge Conflicts 2.4 Collaboration on GitHub, Forks, Pull Requests, and Code Reviews, Managing Permissions and Issues in GitHub, GitHub Actions and Workflow Automation	07
Module -3:	**Module -3: Time Series Forecasting Models** 3.1 Stashing and Cleaning, git stash, git clean 3.2 Undoing Changes, git reset, git revert, git checkout 3.3 Configuration Files, .gitignore, .gitattributes 3.4 Rebasing Techniques, git rebase, git rebase -i (Interactive Rebase), Working with Submodules, Cherry-Picking Commits (git cherry-pick), Git Hooks for Automation	08
Module -4:	**Module -4: GitHub for DevOps and Project Management** 4.1 Using GitHub for Open Source Projects 4.2 Managing Large Repositories, Git LFS (Large File Storage) 4.3 Agile Development with GitHub, GitHub Issues, Project Boards 4.4 CI/CD with GitHub, Continuous Integration (CI), Continuous Deployment (CD) using GitHub Actions, Security Best Practices in Git and GitHub, Monitoring and Auditing Changes	07

Reference Books:-

1) Ahmad, J., Belanger, C., & Raywenderlich Tutorial Team. Advanced Git (Second Edition): Understanding Git Collaboration & Workflows. New York: Razeware LLC, 2021.
2) Cardoso, D. GIT Expert: Guide to Version Control Mastery. São Paulo: Douglas Cardoso Technology Publications, 2025.
3) Carter, T. Mastering Git for Version Control: Optimize Collaborative Workflows and Conflict Resolution With Git's Most Advanced Features. Independently Published, 2024.
4) Haack, P., & Guthals, S. GitHub for Dummies. New York: Wiley, 2019.
5) McQuaid, M. Git in Practice: Includes 66 Techniques. New York: Manning, 2014.
6) Mishra, P. Ultimate Git and GitHub for Modern Software Development: Unlock the Power of Git and GitHub Version Control and Collaborative Coding to Seamlessly Manage and Streamline Software Projects. New Delhi: Orange Education Pvt Ltd, 2024.
7) Mishra, P. Ultimate Git and GitHub for Modern Software Development: Unlock the Power of Git and GitHub Version Control and Collaborative Coding to Seamlessly Manage Software Projects. New Delhi: Orange Education Pvt Ltd, 2024.

<table>
<tr><th colspan="2">Evaluation Pattern:</th></tr>
<tr><td colspan="2">Total Marks: 100 / 50</td></tr>
<tr><td>Internal Continuous Evaluation (20 Marks):
• CCE - I : 10 Marks: Objective
• CCE - II: 10 Marks: Objective
• Mid Semester Exam: 20 Marks: Subjective
Note: Conversion of 40 marks of internal evaluation to 20 Marks</td><td>End Semester Examination (30 Marks):
• Question -1: Solve the following questions (Five questions of 2 Marks)
• Question -2: Attempt any two questions (Three questions of 10 Marks)
• Question -3: Attempt any four questions (Five questions of 5 Marks)
• Note: Conversion of 50 marks of ESE evaluation to 30Marks</td></tr>
</table>

Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - VI
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDST 364 E-2, Data Engineering

Course Objectives: Students will be able to…

1) develop the skills of managing the data with respect to knowledge generation.
2) provide the ability to design the data engineering process.
3) propose the data reliability models.
4) define how to use machine learning models

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

1) building the storage system with appropriate data technologies.
2) designing the data pipelines and data flow.
3) processing the data infrastructure demonstrate use of advanced foss computing environments for big health care data.
4) training and measuring the serving infrastructure for machine learning models

Module	Title and Contents	Hrs
Module -1:	**Module -1: Data Engineering Concepts** 1.1 Business Requirements to Technical Design, Translating business needs into data engineering solutions, Understanding technical aspects of enterprise data 1.2 Data Types and Structure, Structured, semi-structured, and unstructured data, Schema design considerations 1.3 Building and Operationalizing Storage Systems, Cloud SQL: Use cases and operations, Cloud Spanner: Global RDBMS for scalable workloads, Cloud Bigtable: NoSQL wide-column database, Cloud Firestore: Document database, BigQuery: Serverless data warehouse, Cloud Memorystore: Redis and Memcached, Cloud Storage: Object storage system	08
Module -2:	**Module -2: Designing Data Pipelines** 2.1 Overview of Data Pipelines, Lifecycle and components of a pipeline 2.2 Google Cloud Platform (GCP) Pipeline Components, Cloud Pub/Sub, Dataflow, BigQuery, Cloud Functions, Integration and orchestration	

	2.3 Migrating Hadoop and Spark to GCP, GCP alternatives to Hadoop ecosystem, Migration best practices and tools 2.4 Designing a Data Processing Solution, Infrastructure design for distributed processing, Building scalable and fault-tolerant pipelines, Migrating traditional data warehouses to BigQuery	07
Module -3:	**Module -3: Designing for Security and Compliance** 3.1 Identity and Access Management (IAM), Principles of IAM in GCP, Using IAM with storage and processing services 3.2 Data Security and Privacy, Encryption, key management, and secure access, Data Loss Prevention API: Classification and redaction, Privacy-preserving analytics 3.3 Legal and Regulatory Compliance, Understanding GDPR, HIPAA, and other regulations, Ensuring compliance in cloud data projects	07
Module -4:	**Module -4: Data Operations for Flexibility and Portability** 4.1 Cataloging and Data Discovery, Google Data Catalog overview, Metadata management 4.2 Data Preprocessing and Visualization, Data wrangling with Dataprep, Visualization using Data Studio 4.3 Exploring and Analyzing Data, Cloud Datalab for data exploration, Use cases and example notebooks	08

Reference Books:-

1) Brunton, S.L., & Kutz, J.N. Data Driven Science and Engineering. Cambridge: Cambridge University Press, 2019.
2) Housley, M., & Verner, A. Fundamentals of Data Engineering. Cambridge: Cambridge University Press, 2019.
3) Kleppmann, M. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems. Cambridge: Cambridge University Press, 2019.
4) Kumar, V., Chaisiri, S., & Ko, R. Data Security in Cloud Computing. London: The Institution of Engineering and Technology, 2020.
5) Riscutia, V. Data Engineering on Azure. Shelter Island: Manning Publications, 2021.
6) Schiller, R.J., & Larochelle, D. Data Engineering Best Practices. Cambridge: Cambridge University Press, 2019.
7) Sullivan, D. Professional Data Engineer. Indianapolis: Sybex – Wiley, 2020.

Evaluation Pattern:

Total Marks: 100 / 50	
Internal Continuous Evaluation (20 Marks): • CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective Note: Conversion of 40 marks of internal evaluation to 20 Marks	**End Semester Examination (30 Marks):** • Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - VI
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26
Name of the Course: BDST 365 E-3, Data Governance	

Course Objectives: Students will be able to…

1) conceptualize the data governance.
2) understand the legal framework and essential compliances for data governance.
3) understanding the concern of privacy and security in data governance modules.
4) comprehend the ethical issues involved in data governance

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

1) demonstrate a comprehensive understanding of data governance, including its importance and benefits for organizations.
2) analyze real-world examples of data governance in action and evaluate their impact on business value.
3) apply data governance principles and tools, such as the enterprise dictionary and policy management, to support effective data management practices.
4) implement data governance practices throughout the data life cycle and effectively operationalize data governance within an organization

Module	Title and Contents	Hrs
Module -1:	**Module -1: Foundations of Data Governance and Its Strategic Business Value** 1.1 Understanding Data Governance, Definition of Data Governance, Importance and relevance in modern organizations, Examples of Data Governance in real-world scenarios 1.2 Business Value of Data Governance, Strategic advantages, Enhancing decision-making and compliance, Risk mitigation and cost efficiency 1.3 Developing and Preparing for Governance, Steps in developing a data governance framework, Readiness assessment for implementation 1.4 Driving Value through Data, Understanding the impact of Big Data, Identifying roles and responsibilities of data, Improving outcomes and performance with data	08
Module -2:	**Module -2: Implementing Data Governance People, Processes, and the Data Life**	

	Cycle 2.1 Core Components, The Enterprise Data Dictionary, People: Roles, responsibilities, and wearing multiple hats 2.2 Process Considerations, Adapting to diverse organizational needs, Common issues and strategic approaches, Integrating people and process for success 2.3 Data Life Cycle Governance, data life cycle, Phases of the data life cycle, Data life cycle management principles, Applying governance over the full data life cycle, Operationalizing data governance effectively	07
Module -3:	**Module -3: Foundations of Data Governance and Its Strategic Business Value** 3.1 Fostering a Data Culture, Establishing a culture of data responsibility, Business benefits of data governance culture, Aligning intention, training, and communication 3.2 Maintaining Agility and Compliance, Keeping governance agile and scalable, Legal and security collaboration, Incident handling and transparency mechanisms 3.3 Addressing Governance Challenges, Risk response strategies, Dealing with data governance obstacles	07
Module -4:	**Module -4: Data Protection Through Planning Advanced Techniques and Monitoring** 4.1 Planning for Data Protection, Fundamentals of data protection, Data protection in cloud and hybrid environments, Physical security of data assets 4.2 Advanced Protection Technques, Preventing data exfiltration, Identity and access management, Agile practices in data protection, Industry best practices 4.3 Monitoring and Evaluation, What is monitoring and why it matters, Identifying who should monitor data, Components of an effective monitoring system, Establishing criteria and processes for monitoring	08

Reference Books:-

1) Batchelder, W.S. Data Governance Handbook: A Practical Approach to Building Trust in Data. Birmingham: Packt Publishing, 2024.
2) Bollweg, L.M. Data Governance for Managers. Cham: Springer, 2022.
3) Eryurek, E., Gilad, U., & Lakshmanan, V. Data Governance: The Definitive Guide. Sebastopol: O'Reilly, 2021.
4) Eryurek, E. Data Governance: The Definitive Guide. Mumbai: Shroff/O'Reilly, 2021.
5) Hopper, M.A. Practitioner's Guide to Operationalizing Data Governance. Hoboken: Wiley, 2023.
6) Madsen, L. Disrupting Data Governance: A Call to Action. Basking Ridge: Technics Publications LLC, 2019.
7) Mahanti, R. Data Governance and Data Management: Contextualizing Data Governance Drivers,

<table>
<tr><td colspan="2">Technologies, and Tools. Cham: Springer, 2021.</td></tr>
<tr><td colspan="2">Evaluation Pattern:</td></tr>
<tr><td colspan="2">Total Marks: 100 / 50</td></tr>
<tr><td>Internal Continuous Evaluation (20 Marks):
• CCE - I : 10 Marks: Objective
• CCE - II: 10 Marks: Objective
• Mid Semester Exam: 20 Marks: Subjective
Note: Conversion of 40 marks of internal evaluation to 20 Marks</td><td>End Semester Examination (30 Marks):
• Question -1: Solve the following questions (Five questions of 2 Marks)
• Question -2: Attempt any two questions (Three questions of 10 Marks)
• Question -3: Attempt any four questions (Five questions of 5 Marks)
• Note: Conversion of 50 marks of ESE evaluation to 30Marks</td></tr>
</table>

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Computer Science

Programme: B.Sc.	**Semester** - VI
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDST 366 E-4, Data Science for Business Forecasting

Course Objectives: Students will be able to…

1) understand need and importance of business forecasting.
2) know various types of business forecasting techniques.
3) elucidate better understanding of the concepts related to different models of forecasting.
4) develop an understanding of application of forecasting tools in business through applications of technology

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

1. understanding of the need for and significance of business forecasting in strategic decision-making. designing the data pipelines and data flow.
2. accuracy and reliability of forecasting outputs and recommend improvements for optimizing business outcomes.
3. understand and evaluate the theoretical foundations and practical implications of different forecasting models to address specific business scenarios.
4. elucidate better understanding of the concepts related to different models of forecasting

Module	Title and Contents	Hrs
Module -1:	**Module -1: Basics of Business Forecasting** 1.1 Introduction to Forecasting, Meaning and significance of forecasting, History and evolution of forecasting 1.2 Types and Nature of Forecasting, Qualitative vs. Quantitative forecasting, Nature and scope of forecasting in business 1.3 Forecasting Process and Theory, Steps in the forecasting process, Role of economic theory in forecasting, Definition and application of business forecasting	08
Module -2:	**Module -2: Business Forecasting Models** 2.1 Correlation and Regression, Simple correlation: concepts and interpretation, Simple linear regression: model building and use 2.2 Time Series Analysis,Definition and components of time series, Components,Trend, Seasonal, Cyclical, and Irregular variations, Importance of	07

	decomposing time series for forecasting	
Module -3:	**Module -3: Methods of Forecasting** 3.1 Quantitative Forecasting Techniques, Moving averages method, Exponential smoothing methods, Advanced smoothing and trend projection techniques 3.2 Qualitative Forecasting Techniques, Delphi method, Sales force composite method, Consumer panel and market surveys, Evaluation and Selection of Forecasting Methods, Choosing appropriate forecasting models, Determining adequacy and accuracy of methods	08
Module -4:	**Module -4: Data Science for Business Forecasting** 4.1 Role of Data Science in Forecasting, Introduction to data-driven forecasting, Role and advantages of data science in forecasting 4.2 Forecasting Tools and Packages, Computer forecasting tools and software, Monitoring and controlling forecasting systems, Emerging forecasting packages 4.3 Business Applications and Case Studies, Sales and profit forecasting: methods and applications, Material forecasting approaches, Non-statistical approaches, Statistical approaches, Real-world case studies using data science in forecasting	07

Reference Books:-

1) Box, G.E.P., Jenkins, G.M., Reinsel, G.C., & Ljung, G.M. Time Series Analysis: Forecasting and Control. Hoboken: Wiley, 2015.
2) Gilliland, M. Business Forecasting: The Emerging Role of Artificial Intelligence and Machine Learning. Hoboken: Wiley, 2021.
3) Hanke, J.E., & Wichern, D.W. Business Forecasting. Upper Saddle River: Pearson, 2013.
4) Jain, C.L., & Malehorn, J. Practical Guide to Business Forecasting. Chicago: Graceway Publishing Company, 2005.
5) Ord, K., & Fildes, R. Principles of Business Forecasting. Mason: South-Western Cengage Learning, 2013.
6) Shumway, R.H., & Stoffer, D.S. Time Series Analysis and Its Applications: With R Examples. New York: Springer, 2017.
7) Wilson, J.H., & Keating, B. Business Forecasting with ForecastX. New York: McGraw-Hill Education, 2014

Evaluation Pattern:

Total Marks: 100 / 50

Internal Continuous Evaluation (20 Marks):	End Semester Examination (30 Marks):
• CCE - I : 10 Marks: Objective • CCE - II: 10 Marks: Objective • Mid Semester Exam: 20 Marks: Subjective Note: Conversion of 40 marks of internal evaluation to 20 Marks	• Question -1: Solve the following questions (Five questions of 2 Marks) • Question -2: Attempt any two questions (Three questions of 10 Marks) • Question -3: Attempt any four questions (Five questions of 5 Marks) • Note: Conversion of 50 marks of ESE evaluation to 30Marks

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Programme: B.Sc.	**Semester** - VI
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP 369, Git Hub

Course Objectives: Students will be able to…

1) understand the fundamentals of git and github, including version control concepts and repository management.
2) apply branching, merging, and collaboration techniques to work effectively on projects with teams.
3) implement advanced git features such as stashing, rebasing, cherry-picking, and git hooks for automation.
4) utilize github for devops, project management, and continuous integration/deployment (ci/cd) workflows.

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

1) demonstrate proficiency in using git commands for version control and repository management.
2) collaborate effectively on projects using github features such as pull requests, forks, and issues.
3) resolve conflicts, manage branches, and automate workflows using git and github actions.
4) develop and maintain software projects using github best practices, including security and ci/cd pipelines.

Module	Title and Contents	Hrs
	1) Install Git and Configure User Details 2) Initialize a Git Repository and Make the First Commit 3) Clone a GitHub Repository and Push Changes 4) Track File Changes Using Git (git status, git diff) 5) Undo Changes: git reset, git revert, git checkout 6) Create and Switch Between Branches 7) Merge Branches and Resolve Conflicts 8) Fork a Repository and Create a Pull Request 9) Collaborate with GitHub Issues and Discussions 10) Use GitHub Actions for Automated Testing	30

Reference Books:-

1) Ahmad, J., Belanger, C., & Raywenderlich Tutorial Team. Advanced Git (Second Edition): Understanding Git Collaboration & Workflows. New York: Razeware LLC, 2021.
2) Cardoso, D. GIT Expert: Guide to Version Control Mastery. São Paulo: Douglas Cardoso Technology Publications, 2025.
3) Carter, T. Mastering Git for Version Control: Optimize Collaborative Workflows and Conflict Resolution With Git's Most Advanced Features. Independently Published, 2024.
4) Haack, P., & Guthals, S. GitHub for Dummies. New York: Wiley, 2019.
5) McQuaid, M. Git in Practice: Includes 66 Techniques. New York: Manning, 2014.
6) Mishra, P. Ultimate Git and GitHub for Modern Software Development: Unlock the Power of Git and GitHub Version Control and Collaborative Coding to Seamlessly Manage and Streamline Software Projects. New Delhi: Orange Education Pvt Ltd, 2024.
7) Mishra, P. Ultimate Git and GitHub for Modern Software Development: Unlock the Power of Git and GitHub Version Control and Collaborative Coding to Seamlessly Manage Software Projects. New Delhi: Orange Education Pvt Ltd, 2024.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Programme: B.Sc.	**Semester** - VI
Type : DSE I	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP 369, Data Engineering

Course Objectives: Students will be able to…

1) develop the skills of managing the data with respect to knowledge generation.
2) provide the ability to design the data engineering process.
3) propose the data reliability models.
4) define how to use machine learning models

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

1) building the storage system with appropriate data technologies
2) designing the data pipelines and data flow
3) processing the data infrastructure demonstrate use of advanced foss computing environments for big health care data.
4) training and measuring the serving infrastructure for machine learning models

Module	Title and Contents	Hrs
	1) Demonstration of Cloud Spanner. 2) Practical on Unmanaged Databases. 3) Exercise on GCP Pipeline Components. 4) Demonstration of Migrating Hadoop and Spark To GCP. 5) Practical on Designing Infrastructure. 6) Demonstration of Migrating a Data Warehouse. 7) Exercise on Access Management with Cloud IAM. 8) Demonstration of Data Security. 9) Practical on Data Preprocessing with Data preparation . 10) Demonstration of Visualizing with Data Studio.	30

Reference Books:-

1) Brunton, S.L., & Kutz, J.N. Data Driven Science and Engineering. Cambridge: Cambridge University Press, 2019.

2) Housley, M., & Verner, A. Fundamentals of Data Engineering, Shelter Island: Manning

Publications, 2021.

3) Kleppmann, M. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, Cambridge University Press, 2019.

4) Kumar, V., Chaisiri, S., & Ko, R. Data Security in Cloud Computing. London: The Institution of Engineering and Technology, 2020.

5) Riscutia, V. Data Engineering on Azure. Shelter Island: Manning Publications, 2021.

6) Schiller, R.J., & Larochelle, D. Data Engineering Best Practices Cambridge University Press, 2019.

7) Sullivan, D. Professional Data Engineer. Indianapolis: Sybex – Wiley, 2020

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks): • Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	**Practical Exam Paper (30 Marks):** • **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Programme: B.Sc.	**Semester** - VI
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP 369, Data Governance

Course Objectives: Students will be able to…

1) conceptualize the data governance.
2) understand the legal framework and essential compliances for data governance.
3) understanding the concern of privacy and security in data governance modules.
4) comprehend the ethical issues involved in data governance.

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

1) Demonstrate a comprehensive understanding of Data Governance, including its importance and benefits for organizations.
2) Analyze real-world examples of Data Governance in action and evaluate their impact on business value.
3) Apply Data Governance principles and tools, such as the enterprise dictionary and policy management, to support effective data management practices.
4) Implement Data Governance practices throughout the data life cycle and effectively operationalize Data Governance within an organization.

Module	Title and Contents	Hrs
	1) Demonstration of Data Governance 2) Practical on Business Value of Data Governance 3) Hands on Enterprise Dictionary 4) Practical on The Process- Diverse Companies 5) Demonstration on Data Culture 6) Practical on Interplay with Legal and Security 7) Hands on on Incident Handling 8) Case study on Transparency 9) Case study on Data Protection 10) Case study on Monitoring	30

Reference Books:-

1) Batchelder, W.S. Data Governance Handbook: A Practical Approach to Building Trust in Data. Birmingham: Packt Publishing, 2024.
2) Bollweg, L.M. Data Governance for Managers. Cham: Springer, 2022.
3) Eryurek, E., Gilad, U., & Lakshmanan, V. Data Governance: The Definitive Guide. Sebastopol: O'Reilly, 2021.
4) Eryurek, E. Data Governance: The Definitive Guide. Mumbai: Shroff/O'Reilly, 2021.
5) Hopper, M.A. Practitioner's Guide to Operationalizing Data Governance. Hoboken: Wiley, 2023.
6) Madsen, L. Disrupting Data Governance: A Call to Action. Basking Ridge: Technics Publications LLC, 2019.
7) Mahanti, R. Data Governance and Data Management: Contextualizing Data Governance Drivers, Technologies, and Tools. Cham: Springer, 2021

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Programme: B.Sc.	**Semester** - VI
Type : DSE II	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSP 369, Data Science for Business Forecasting

Course Objectives: Students will be able to…

1) understand need and importance of business forecasting.
2) know various types of business forecasting techniques.
3) elucidate better understanding of the concepts related to different models of forecasting.
4) develop an understanding of application of forecasting tools in business through applications of technology.

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

1) understanding of the need for and significance of business forecasting in strategic decision-making. designing the data pipelines and data flow.
2) accuracy and reliability of forecasting outputs and recommend improvements for optimizing business outcomes.
3) understand and evaluate the theoretical foundations and practical implications of different forecasting models to address specific business scenarios.
4) elucidate better understanding of the concepts related to different models of forecasting.

Module	Title and Contents	Hrs
	1) Demonstration of Business Forecasting. 2) Demonstration of Forecasting Process. 3) Simple Correlation and Simple Regression in Forecasting. 4) Time Series Analysis in Forecasting. 5) Exponential Smoothing and Other Advanced Techniques in Forecasting. 6) Qualitative models of forecasting. 7) To determining the adequacy of forecasting method. 8) Demonstration of Emerging forecasting packages. 9) Method of sales/Profit in Forecasting. 10) Non-Statistical and Statistical Approach in forecasting.	30

Reference Books:-

1) Box, G.E.P., Jenkins, G.M., Reinsel, G.C., & Ljung, G.M. Time Series Analysis: Forecasting and Control. Hoboken: Wiley, 2015.
2) Gilliland, M. Business Forecasting: The Emerging Role of Artificial Intelligence and Machine Learning. Hoboken: Wiley, 2021.
3) Hanke, J.E., & Wichern, D.W. Business Forecasting. Upper Saddle River: Pearson, 2013.
4) Jain, C.L., & Malehorn, J. Practical Guide to Business Forecasting. Chicago: Graceway Publishing Company, 2005.
5) Ord, K., & Fildes, R. Principles of Business Forecasting. Mason: South-Western Cengage Learning, 2013.
6) Shumway, R.H., & Stoffer, D.S. Time Series Analysis and Its Applications: With R Examples. New York: Springer, 2017.
7) Wilson, J.H., & Keating, B. Business Forecasting with ForecastX. New York: McGraw-Hill Education, 2014.

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• **Section I: Attempt any three questions (Five questions of 10 Marks)**

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Faculty of Science and Technology

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Programme: B.Sc.	**Semester** - VI
Type : VSC	**Marks:** 50
Credits : 2	**From:** A. Y. 2025-26

Name of the Course: BDSPVSC V, Data Visualization Using Power BI

Course Objectives: Students will be able to…

1) provide a comprehensive understanding of power bi tools and their applications in business intelligence.
2) enable students to effectively clean, transform, and model data for analysis and reporting.
3) teach the creation of visually appealing and interactive dashboards and reports.
4) familiarize students with advanced features, including dax, dataflows, and power bi integration.

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

1) connect to various data sources, clean, and transform data using power query.
2) develop and optimize data models, leveraging dax for calculations and analysis.
3) create professional-grade reports and dashboards with advanced interactivity.
4) deploy and manage power bi solutions, ensuring security and collaboration in real-world scenarios.

Module	Title and Contents	Hrs
	1) Download and install Power BI Desktop and explore the interface. 2) Import data from Excel, SQL Server, and web data sources. 3) Perform operations like removing duplicates, splitting columns, and handling null values using power query. 6) Build and manage relationships between tables in Power BI. 7) Create a star schema data model and optimize for analytics. 8) Implement calculated columns for custom data fields. 9) Use basic DAX functions like SUM, AVERAGE, and COUNT. 10) Build year-over-year and month-to-date measures using DAX. 11) Create bar charts, line charts, and pie charts. 12) Add slicers, filters, and drill-through options to reports.	60

13) Apply themes, conditional formatting, and tooltips in report.

14) Create maps and work with location-based data.

15) Combine visuals into an interactive dashboard using bookmarks.

16) Publish a Power BI report to the Power BI Service and set up scheduled refresh.

17) Implement RLS to restrict data access for specific roles.

18) View and interact with dashboards on mobile devices.

19) Use Analyze in Excel and Power BI Publisher add-ins.

20) Explore Key Influencers and Decomposition Tree visuals to analyze data patterns

Reference Books:-

1. Aspin, A. High Impact Data Visualization with Power View, Power Map, and Power BI. Apress, 2014.
2. Deckler, G. Learn Power BI: A Comprehensive Guide to Creating Reports and Dashboards. Packt Publishing, 2023.
3. Ferrari, A., & Russo, M. The Definitive Guide to DAX: Business Intelligence with Microsoft Excel, SQL Server Analysis Services, and Power BI. Microsoft Press, 2022.
4. Powell, B. Mastering Microsoft Power BI: Expert Techniques for Effective Data Analytics and Business Intelligence. Packt Publishing, 2022.
5. Rad, R. Pro Power BI Architecture: Sharing, Security, and Deployment Options for Microsoft Power BI Solutions. Apress, 2020.
6. Raviv, G. Collect, Combine, and Transform Data Using Power Query in Excel and Power BI. Microsoft Press, 2018.
7. Seamark, P. DAX Patterns: Practical Solutions for Business Intelligence and Data Analysis. Apress, 2018

Evaluation Pattern:

Total Marks: 100 / 50

Journal, Students' Performance Viva, Project (20 Marks):	**Practical Exam Paper (30 Marks):**
• Journa1: 10 Marks • Students' Performance: 05 Marks • Viva: 05 Marks	• **Section I: Attempt any three questions (Five questions of 10 Marks)**