University of Mumbai

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Academic Authorities,
Meetings &Services (AAMS)
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Re- accredited with A ++ Grade (CGPA 3.65) by NAAC
Category- I University Status awarded by UGC

No.AAMS_UGS/ICC/2025-26/48 Date: 18th June, 2025

CIRCULAR :-

Attention of all the Principals of the Affiliated Colleges, Directors of the Recognized Institutions and the Heads, University Departments is invited to this office Circular No. AAMS_UGS/ICC/2022-23/94 dated 20th August, 2022 relating to the syllabus of **B.Sc. (Data Science and Sports Studies) Sem I & II (CBCS).**

They are hereby informed that the recommendations made by the **Ad-hoc Board of Studies** in **Sports Science & Management** at its meeting held on 16th May, 2025 and subsequently passed by the Board of Deans at its meeting held on 19th May, 2025 **vide** item No. 8.19 (N) have been accepted by the Academic Council at its meeting held on 20th May, 2025 **vide** item No. 8.40 (N) that the accordance therewith syllabus for **B.Sc. (Data Science and Sports Studies) (Sem III, IV, V and VI) (CBCS)** is introduced as per appendix with effect from the academic year 2024-25 progressively.

(The Circular is available on the University's website www.mu.ac.in).

(Dr. Prasad Karande)
REGISTRAR

MUMBAI – 400 032
18th June, 2025

To

All the Principals of the Affiliated Colleges, Directors of the Recognized Institutions and the Heads, University Departments.

A.C./8.40 (N)/20/05/2025

Copy forwarded with Compliments for information to:-

1) The Chairman, Board of Deans,
2) The Dean, Faculty of Interdisciplinary Studies,
3) The Chairman, **Ad-hoc Board of Studies in Sports Science & Management**,
4) The Director, Board of Examinations and Evaluation,
5) The Director, Board of Students Development,
6) The Director, Department of Information & Communication Technology,
7) The Director, Centre for Distance and Online Education (CDOE), Vidyanagari.
8) The Deputy Registrar, Admissions, Enrolment, Eligibility & Migration Department (AEM),

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	**Faculty of Humanities,** **Offg. Dean** 1. Prof.Anil Singh Dranilsingh129@gmail.com **Offg. Associate Dean** 2. Prof.Manisha Karne mkarne@economics.mu.ac.in 3. Dr.Suchitra Naik Naiksuchitra27@gmail.com
	Faculty of Commerce & Management, **Offg. Dean,** 1 Prin.Ravindra Bambardekar principal@model-college.edu.in **Offg. Associate Dean** 2. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in 3. Dr.Ravikant Balkrishna Sangurde Ravikant.s.@somaiya.edu 4. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology **Offg. Dean** 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in **Offg. Associate Dean** 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, **Offg. Dean** 1.Dr. Anil K. Singh aksingh@trcl.org.in **Offg. Associate Dean** 2.Prin.Chadrashekhar Ashok Chakradeo cachakradeo@gmail.com 3. Dr. Kunal Ingle drkunalingle@gmail.com
3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in DSW direcotr@dsw.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

AC: 20/05/2025
Item No. 8.40

UNIVERSITY OF MUMBAI

Program: B.Sc. (Data Science and Sports Studies)

SEM III, IV, V, VI

(Choice Based and Credit System)

From: A.Y. 2024-2025 Progressively

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**S. Y .B.Sc. Data Science and Sports Studies, Sem III, IV,V,VI**
2	Eligibility for Admission	As per University regulations
3	Passing Marks	40% (Internals 10/25 Marks and External 30/75)
4	Ordinances / Regulations (if any)	
5	No. of Years / Semesters	Three Years Program/Six Semester Programme(Syllabus for Semester III & IV)
6	Level	**UG**
7	Pattern	**Semester**
8	Status	**Revised**
9	To be implemented from Academic Year	From Academic Year: 2024-25

Sd/-	Sd/-	Sd/-	Sd/-
Sign of the BOS Chairman **Dr. Manoj N. Reddy** **Ad-hoc Board of Studies in Sports Science and Management**	**Sign of the Offg. Associate Dean** **Dr. C.A.Chakradeo** **Faculty of Interdisciplinary Studies**	**Sign of the Offg. Associate Dean** **Dr. Kunal Ingle** **Faculty of Interdisciplinary Studies**	**Sign of the Offg. Dean** **Prof. A. K. Singh** **Faculty of Interdisciplinary Studies**

No: 6769

Title of the course - BSc (Data Science and Sports Studies)

O.No. 6770

Eligibility: XIIth Pass under 10+ 2 scheme of any recognized State / Central / International Board

Scheme of Examination

The Semester End Examination will be conducted for 60 Marks each subjectInternal Assessments will be conducted for 40 Marks each subject

The allocation of 40 marks shall be on the following basis: -

a) Periodical class tests/presentations held in the given semester (30 Marks)

b) Attendance and Active participation in routine class instructional deliveries(05 Marks)

c) Overall Conduct as a responsible student, mannerism and articulation and Exhibition of leadership qualities in organizing related academic activities. (05Marks)

Question Paper Pattern for Semester End Examination (60 Marks)

There will be Seven Questions in all.

Q1 would be compulsory and would carry ----20 Marks

In addition to Q1, there would be six questions.
Each question would carry 10 Marks. Q7 will have three sub – questions and each sub – question would carry 05 Marks

Students have to attempt any four out of the remaining six Questions and within Q7; students have to attempt any two out of three sub – questions.

In all, students have to attempt five questions i.e. (Q1+Any Four of theremaining)

Q1 = 20 Marks (Compulsory)

Attempt Any Four out of the

Remaining Six

Q2 – Q6 = 10 Marks

Q7 Any two from (a) or (b) or (c)----------(5x2) = 10 Marks

Standard of Passing: A Student has to separately secure minimum 50% marks (i.e. 20 outof 40) in The internal assessments and secure minimum 50% marks (i.e. 30 out of 60) in the Semester End Examination in every subject to be declared as Pass.

Intake Capacity: The maximum intake capacity of B.Sc. (Data Science and Sports Studies) course as per University of Mumbai is 60 per academic year.

Syllabi for BSc. Data Science and Sports Studies – SEM III & IV

BSc. Data Science and Sports Studies
Semester – III

SEMESTER – III COURSE	CREDITS
CORE	
Data Warehousing and Multidimensional Modelling	3
Operations Management	3
Software Engineering	3
Design and Analysis of Algorithms	3
SCHOOL ELECTIVES 2/3	
Python Programming for Data Science	3
Principles of Marketing	3
Operating System	3
SPECIAL ELECTIVES 1/3	
Sports Facility and Event Management	3
International Economics	3
Introduction to Philosophy	3

SEMESTER – III			
Course Code: DSC301	**Course Title: Data Warehousing and Multidimensional Modelling**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Understand the purpose and benefits of data warehousing in an organization.
- Learn the process of designing and building a data warehouse.
- Gain knowledge of multidimensional modeling techniques for representing complex business data.
- Explore the principles of data integration and data quality in a data warehousing environment.
- Understand the role of Extract, Transform, Load (ETL) processes in populating a data warehouse.
- Develop skills in querying and analyzing data from a multidimensional data model.
- Learn best practices for data warehouse administration and performance optimization.

Course Description: Data Warehousing and Multidimensional Modeling is a comprehensive course that explores the fundamental concepts and methodologies involved in building and managing data warehouses. The course emphasizes the design and implementation of multidimensional data models to facilitate efficient data analysis and decision-making.

Unit I	An introduction to data warehousing, Data warehouse architectures, Two-layer architecture, Three-layer architecture, Data staging and ETL, Decision support applications, Data warehouse functional definitions.	**Hours** 7
Unit II	Data warehouse & modeling, Data warehouse modeling, Types of data warehouse models, Data warehouse implementation, Normal system for metadata sharing, Data warehouse environment, Data warehouse and data mart, Operational data store, Data warehouse data modeling styles, OLTP data model considerations, Data warehouse usage, Data mart, Warehouse modeling approaches, Global data warehouse architecture, Independent data mart architecture, Approaches to implement the architecture, Data warehouse delivery process, Data warehouse modelling: Techniques and guidelines, ER modeling, The ER model, Normalization: First normal form, Normalization: Second normal form, Normalization: Third normal form, OLAP (Online Analytical Processing), Multi-dimensional data analysis, Drill-down and roll-up.	7
Unit III	Requirements analysis: Base activities, Representation of the query as a cube, Requirements modeling, Measures, Candidate measures, Dimensions, The grain of a dimension, Granularity of a measure, Facts, Terminologies in a multi-dimension model, Advantage of multi-dimensional modelling, Multi-dimensional queries, Dimension entities and attributes, Dimension hierarchies, Aggregation levels, MD model structures, Star schema, Snowflake schema, Example for snowflake schema, Considerations star and snowflake, Hints, tips, and guidelines, Business-related facts, What is fact constellation schema? Applications for data warehouse, Fact identifiers, dimension keys and uniqueness, Identifiers in an MD model, Dimension roles, Requirements analysis, Solution validation, Base activities, Detailed dimension modeling, Why needed? Detailed dimension modeling– approach, Detailed dimension modeling– considerations.	6

Unit IV	R-OLAP, OLAP query against RDBMS (ROLAP), R-OLAP design techniques, OLAP, Fundamental OLAP analytical practices, Types of OLAP systems, Architecture of ROLAP, Star schema and star join queries, Star join support, Efficient star join, Dynamic bitmap index ANDing –DB2 UDB for distributed platforms, Star join: DB2 UDB for distributed platforms, Star join: Snowflake schema context, Collapse dimensions, Effects of dimension collapse, Dimension split, Redundant attributes in facts, Fact-oriented design techniques, Fact aggregation, Consolidated facts, Utilize cubing services to improve R-OLAP and M-OLAP performance, Cubing services architecture, Cubing services performance and scalability, Scalability, Cubing services security, Benefits of cubing services: Improved data mart performance, Data marts, Data marts: Materialized query tables, Materialized query table example, Performance with MQT refresh options, Implementation example: MQT, Multi-dimension cluster tables, MDC table example, Terminology-dimension, Terminology -slice, Terminology-cell, Block based index: Dynamic bitmap index ANDing, Query processing examples, MDC performance example, Example: Object size comparisons, Power of block prefetch coupled, Performance results for a query, Performance results from a query, Example: Index oring of block and RID indexes, Example: Joins with block index.	**6**
Unit V	Introduction to MOLAP, MOLAP framework, M-OLAP architecture, OLAP schemes types, Cognos functional architecture, Cognos Transformer: Functions, Storage method, Hyperion, Hyperion data load, Hyperion: data load rules, Hyperion calculation storage types, MOLAP characteristics, ROLAP characteristics, Online data analysis.	**7**
Unit VI	Keeping history about dimensions, Customer attrition: Business requirements, Customer attrition: Exercise, Customer attrition: Base analysis, Customer attrition: Solution, Primary key change, The historical customer, Customer address: Business requirement, Customer address: Exercise, Customer address: Solution, Issues, Time normalization, Customer address: Time normalized, Neighborhoods: Business requirements, Neighborhoods: Exercise, Neighborhoods: Base solution, Neighborhoods: Review, Neighborhoods: HTK solution, Customer classes: Business requirement, Customer classes: Exercise, Customer classes: Proposed solution.	**8**

Unit VII	Process architecture: Data warehouse, Contrasting OLTP and data warehousing environments, Common data warehouse tasks, Architectures of the data warehouse, Centralized process architecture, Distributed process architecture, Peer-to-Peer architecture, Data warehouse tools, 25 BEST data mining tools in 2020, 18 BEST reporting tools in 2020, IBM data warehouse case study: American Airlines.	**4**

References:

- The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball and Margy Ross.
- Building the Data Warehouse" by W. H. Inmon, Richard D. Hackathorn, and Kent Graziano.
- Data Warehouse Design: Modern Principles and Methodologies" by Matteo Golfarelli and Stefano Rizzi.
- Data Warehouse Design: Modern Principles and Best Practices" by Christopher Adamson and Michael Venerable.
- Data Warehousing in the Age of Big Data" by Krish Krishnan.

Lab Exercises –

Exercise 1: Downloading and Installing Talend
Exercise 2: Launching Talend
Exercise 3: Creating First Project
Exercise 4: Working with a simple Job
Exercise 5: CSV file as an Input
Exercise 6: Edit Schema for CSV Input
Exercise 7: Adding Logging Component
Exercise 8: Propagating the Data and Running the CSV File as an Input
Exercise 9: Excel as an Input and Output
Exercise 10: Configure the components
Exercise 11: Execute the Job
Exercise 12: Sorting a File
Exercise 13: Storing the Data & Adding Rules
Exercise 14: Storing the Sorted Result in a File
Exercise 15: Creating Metadata for Delimited File
Exercise 16: Create a Job and Use the Created Metadata
Exercise 17: Adding tLogRow and Run the Metadata Project
Exercise 18: Creating a Metadata Database Connection
Exercise 19: Reading a MySQL Table Using Metadata
Exercise 20: Creating Project, Metadata and Job for tMap
Exercise 21: Creating and Configuring tMap
Exercise 22: Add tLogRow and LinkExercise 23: Run the tMap Job
Exercise 24: Storing the tMap Output in a File

Semester – III			
Course Code: **DSC302**	**Course Title: Operations Management**	**Credits: 3**	**Lectures /Week:3**

Learning Objectives:
Understand the different elements of operations and how to analyse an operational environment in terms of these elements. Appreciate the tools and techniques applicable in the context of operationsin global dynamic organizations. Understand the challenges facing the operations manager to exploit innovative practices.

Course Description: The Operations Management course aims to provide students with a critical understanding of the scope and strategic importance of operations management and the role of operations managers; and an appreciation of the interaction of operations with the organization, employees and customers. You will gain a critical understanding of the nature and importance of operations management, not only in your own but in other organizations competing in the global environment.

Unit I	**Understanding operations management and strategy** The concept of operations management • The input-process-output model • Operations strategy and contribution • The five performance objectives • The 4Vs and their influence on process management **Process design, type, layout and mapping** Process design • Processes and volume/variety dimensions • Manufacturing and service process types • Process layouts • Job design • Process mapping	**Hours** 10
Unit II	**Product and service innovation** • Definitions and types of innovation • Innovation as a process • Beyond product and service innovation • The significance of product and process innovation and service innovation **Capacity and demand management** The objectives of capacity management • Medium- and long-term capacity management • Reconciling capacity and demand • Short- and long-term outlooks affecting volume **Inventory management** Inventory control • Understanding the impact of order quantity on inventory turns • The periodic review approach • Cycle safety stocks	15
Unit III	**Quality methodologies** The importance of quality • The gap model and expectation-perception gaps • Total Quality Management (TQM) and quality costs • Six Sigma • Lean • Causes of waste • Involvement of everyone for successful improvement • Lean tools • Lean improvements across different sectors **Sustainable operations** The triple bottom line (TBL) • The 3Ps in operations management •	15

	Processdesign for environmental sustainability	
Unit IV	**Technology in operations management** Technology in operations management • ERP systems • Industry 4.0 in operations • Challenges in technology adoption	5

References:

- Slack, N., Brandon-Jones, A. (2018) Essentials of Operations Management, 2nd Edition, London, Pearson.
- Quantitative Techniques in Management : N.D.Vohra, Tata McGraw Hill
- Operations Research : H.Taha, Prentice Hall
- Quantitative Methods for Management Decisions : William P.Cooke, McGraw Hill
- Principle of Operations Research: with Applications to Management Decisions – H.M.Wagner, Prentice-Hall.

Semester – III			
Course Code: **DSC303**	**Course Title: Software Engineering**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Knowledge of basic SW engineering methods and practices, and their appropriate application.
- Describe software engineering layered technology and Process frame work.
- A general understanding of software process models such as the waterfall and evolutionary models.
- Understanding of software requirements and the SRS documents.
- Understanding of implementation issues such as modularity and coding standards. Understanding on quality control and how to ensure good quality software.

Course Description:

- Software Engineering (SE) comprises the core principles consistent in software construction and maintenance: fundamental software processes and life-cycles, mathematical foundations of software engineering, requirements analysis, software engineering methodologies and standard notations, principles of software architecture and re-use, software quality frameworks and validation, software development, and maintenance environments and tools.

		Hours
Unit I	Overview of System Analysis & Design, Business System Concept,System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, COCOMO model.	10
Unit II	System Design–Context diagram and, DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional v/s Object-Oriented approach.	8
Unit III	Coding & Documentation–Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. Testing–Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment,Validation & Verification.	12
Unit IV	Software Project Management–Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.	5
Unit V	Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.	10

References:

1. Pressman, Software Engineering: A practitioner's approach–(TMH)
2. Pankaj Jalote, Software Engineering-(Wiley-India)
3. N. S. Gill, Software Engineering–(Khanna Publishing House)
4. Rajib Mall, Software Engineering -(PHI)

Semester – III			
Course Code: **DSC304**	**Course Title: Design and Analysis of Algorithms**	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

- The aim of this module is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them.
- Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.

Course Description:

- This course introduces basic methods for the design and analysis of efficientalgorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures.

Unit I	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time andspace trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem	**Hours** 6
Unit II	Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and- Boundand Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and theirapplication domains.	8
Unit III	Graph and Tree Algorithms: Traversal algorithms:Depth First Search (DFS) and Breadth First Search(BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topologicalsorting, Network Flow Algorithm .	6
Unit IV	Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P,NP, NP completeand NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.	6
Unit V	Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyondNP – P SPACE.	6

References:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition,Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley,Reading,MA

Course Title: Design and Analysis of Algorithms Lab	**Duration: 13 hours**
Topics to be covered:	• Implement Binary Search using Divide and Conquer approach • Implement Merge Sort using Divide and Conquer approach • Implement Quick Sort using Divide and Conquer approach • Find Maximum and Minimum element from a array of integer using Divide andConquer approach • Find the minimum number of scalar multiplication needed for chain of matrix • Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) • Implement Traveling Salesman Problem • Implement 15 Puzzle Problem • Implement 8 Queen problem • Graph Coloring Problem • Hamiltonian Problem • Knapsack Problem • Job sequencing with deadlines

<table>
<tr><th colspan="4">Semester – III</th></tr>
<tr><td>Course Code:
DSE3011</td><td>Course Title: Python Programming forData Science</td><td>Credits: 3</td><td>Lectures /Week: 3</td></tr>
<tr><td colspan="4">Learning Objectives:
Apply various Python data structures types of data.
Explore various steps of data science pipeline with role of Python.
Design applications applying various operations for data cleansing and transformation.
Use various data visualization tools for effective interpretations and insights of data.</td></tr>
<tr><td colspan="4">Course Description: This course covers basic and advanced features of Python programming including data structures, python libraries like matplotlib, numpy, pandas.</td></tr>
<tr><td>Unit I</td><td colspan="2">Overview of Python and Data Structures: Basics of Python including datatypes, variables, expressions, objects and functions. Python data structures including String, Array, List, Tuple, Set, Dictionary and operations them.</td><td>Hours
4</td></tr>
<tr><td>Unit II</td><td colspan="2">Discovering the match between data science and python: Defining the Sexiest Job of the 21st Century, Considering the emergence of data science, Outlining the core competencies of a data scientist, Linking datascience, big data, and AI , Understanding the role of programming, Creating the Data Science Pipeline, Preparing the data, Performing exploratory data analysis, Learning from data, Visualizing, Obtaining insights and data products, Understanding Python's Role in Data Science,Considering the shifting profile of data scientists, Working with a multipurpose, simple, and efficient language, Learning to Use Python Fast, Loading data, Training a model, Viewing a result.</td><td>4</td></tr>
<tr><td>Unit III</td><td colspan="2">Introducing Python's Capabilities and Wonders: Why Python?, Grasping Python's Core Philosophy, Contributing to data science, Discovering present and future development goals, Working with Python, Getting a taste of the language, Understanding the need for indentation, Workingat the command line or in the IDE, Performing Rapid Prototyping and Experimentation, Considering Speed of Execution, Visualizing Power, Using the Python Ecosystem for Data Science, Accessing scientific tools using SciPy, Performing fundamental scientific computing using NumPy,Performing data analysis using pandas, Implementing machine learning using Scikit-learn, Going for deep learning with Keras and Tensor Flow, Plotting the data using matplotlib, Creating graphs with NetworkX, Parsing HTML documents using Beautiful Soup.</td><td>4</td></tr>
<tr><td>Unit IV</td><td colspan="2">Using the Jupyter Console, Interacting with screen text, Changing the window appearance, Getting Python help, Getting IPython help, Using magic functions, Discovering objects, Using Jupyter Notebook, Workingwith styles, Restarting the kernel, Restoring a checkpoint, Performing Multimedia and Graphic Integration, Embedding plots and other images,</td><td></td></tr>
</table>

	Loading examples from online sites, Obtaining online graphics and multimedia. Working with Real Data: Uploading, Streaming, and Sampling Data, Uploading small amounts of data into memory, Streaming large amounts of data into memory, Generating variations on image data, Sampling data in different ways, Accessing Data in Structured Flat-File Form ,Reading from a text file Reading CSV delimited format, Reading Excel and other Microsoft Office files, Sending Data in Unstructured File Form, Managing Data from Relational Databases, Interacting with Data from NoSQL Databases, Accessing Data from the Web. Conditioning Your Data: Juggling between NumPy and pandas, Knowing when to use NumPy, Knowing when to use pandas, Validating Your Data, Figuring out what's in your data, Removing duplicates, Creating a data map and data plan, Manipulating Categorical Variables, Creating categorical variables, Renaming levels, Combining levels, Dealing with Dates in Your Data, Formatting date and time values, Using the right time transformation, Dealing with Missing Data, Finding the missing data, Encoding missingness, Imputing missing data, Slicing and Dicing: Filtering and Selecting Data, Slicing rows, Slicing columns, Dicing, Concatenating and Transforming, Adding new cases and variables, Removing data, Sorting and shuffling, Aggregating Data at Any Level.	6
Unit V	Data Visualization: Visualizing Information: Starting with a Graph, Defining the plot, Drawing multiple lines and plots, Saving your work to disk, Setting the Axis, Ticks, Grids, Getting the axes, Formatting the axes, Adding grids, Defining the Line Appearance, Working with line style, Using colors, Adding markers, Using Labels, Annotations, and Legends, Adding labels, Annotating the chart, Creating a legend.	4
Unit VI	Visualizing the Data: Choosing the Right Graph, Showing parts of a whole with pie charts, Creating comparisons with bar charts, Showing distributions using histograms, Depicting groups using boxplots, Seeing data patterns using scatterplots, Creating Advanced Scatterplots, Depicting groups, Showing correlations, Plotting Time Series, Representing time on axes, Plotting trends over time, Plotting Geographical Data, Using an environment in Notebook, Getting the Basemap toolkit, Dealing with deprecated library issues, Using Basemap to plot geographic data, Visualizing Graphs, Developing undirected graphs, Developing directed graphs.	4
Unit VII	Wrangling Data: Playing with Scikit-learn, Understanding classes in Scikit-learn, Defining applications for data science, Performing the Hashing Trick, Using hash functions, Demonstrating the hashing trick, Working with deterministic selection, Considering Timing and Performance, Benchmarkin, with,timeit, Working with the memory profiler, Running in Parallel on Multiple Cores, Performing multicore parallelism, Demonstrating multiprocessing. Exploring Data Analysis: The EDA	6

	Approach, Defining Descriptive Statistics for Numeric Data, Measuring central tendency, Measuring variance and range ,Working with percentiles, Defining measures of normality, Counting for Categorical Data, Understanding frequencies, Creating contingency tables, Creating Applied Visualization for EDA ,Inspecting boxplots, Performing t-tests after boxplots, Observing parallel coordinates, Graphing distributions, Plotting scatterplots ,Understanding Correlation, Using covariance and correlation, Using nonparametric correlation, Considering the chi-square test for tables ,Modifying Data Distributions, Using different statistical distributions, Creating a Z-score standardization, Transforming other notable distributions.	

References:

1. Python for data science for dummies 2nd Edition, John Paul Mueller, Luca Massaron, Wiley
2. Programming through Python, M. T. Savaliya, R. K. Maurya, G. M. Magar, STAREDU Solutions
3. Pandas for everyone :Python Data Analysis, Daniel Y. Chen, Pearson
4. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, Arno D.B. Meysman, et al., Minning
5. Applied Data Science with Python and Jupyter: Use powerful industry-standard tools to unlock new, actionable insights from your data, , Packt
6. Data Analytics, Anil Maheshwari , McGrawHill
7. Data Science From Scratch: First Principles with Python, Joel Grus , SPD
8. Star Data Science Specialist, STAR CERTIFICATION

Course Name:: Python Programming for Data Science Lab	**No of Labs : 13 (each lab duration 1 hour)**
List of Programs	Practical should be performed by students based on – • Use of Python Data Structures • Using NumPy and Panda for Data Analysis Matplotlib for Visualization

Semester – III			
Course Code: **DSE3012**	**Course Title: Principles of Marketing**	**Credits: 3**	**Lectures /Week: 3**

Learning Objectives:

- Define marketing.
- Outline the 4Ps of marketing.
- Explain the difference between the 4 components of marketing in the definition of marketing and the 4P components.
- Define what value means in marketing.
- Identify the differences between market-oriented, product-orientated, and selling-oriented companies.

Course Description:

- In this course, you will **learn about the marketing process and examine the range of marketing decisions an organization must make to sell its products and services**.
- You will also learn how to think like a marketer – and the best marketers know that the focus of marketing has always been on the consumer.

Unit I	Introduction to marketing- Definition, Scope, Functions and Evolution ofMarketing. Marketing environment, Macro and micro environment, SWOT analysis,Marketing mix.	**Hours** 5
Unit II	Consumer Behaviour- Meaning, Determinants- Cultural, Social, Personal,Psychological Industrial Buying Behaviour- Meaning, characteristics; differences betweenconsumer buying and industrial buying behaviour Marketing research process - Defining research problem, research objective research techniques, sampling, data collection and analysis, report writing Market Segmentation Targeting & Positioning (STP) - meaning, benefits ofmarket segmentation, basis of segmentation; Target Market; Branding- definition, importance, branding strategy; Packaging.	15
Unit III	Concepts of products, Product Mix, Product Line, Product width, depth; Product Life Cycle meaning and stages, New Product Development- steps Pricing- meaning, objectives and methods of pricing Distribution Channel- meaning, Types of Distribution channel- Direct &Indirect. Role of intermediaries and distribution channel	15

	management	
Unit IV	Promotion – elements of promotion mix Sales management- selling process, functions of sales manager Service Marketing- meaning, Service Marketing Mix, Characteristics of Service. Reasons for growth of service sector, Service Quality Model	10

References:

- Marketing Management – P Kotler – Prentice Hall
- Marketing Management – Stanton, Etzel and Walker – McGraw Hill

Semester – III			
Course Code: **DSE3013**	**Course Title: Operating System**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management.

Course Description:

- This course examines the important problems in operating system design and implementation.
- The operating system provides an established, convenient, and efficient interfacebetween user programs and the bare hardware of the computer on which they run.

Unit I	Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of VirtualMachine. Case study on UNIX and WINDOWS Operating System.	**Hours** 4
Unit II	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria:CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	4
Unit III	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problematic.	4
Unit IV	**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	6
Unit V	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing,Disadvantages of paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirtybit –	6

	Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance(SC), Not recently used (NRU) and Least Recently	
Unit VI	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent, I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms **File Management**: Concept of File, Access methods,File types, File operation, Directory structure, File System structure, Allocation methods (contiguous,linked, indexed), Free-space management (bit vector,linked list, grouping), directory implementation (Linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling -FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	8

References:

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz,Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition,WilliamStallings, Prentice Hall of India.
3. Operating System Concepts, Ekta Walia, Khanna Publishing House(AICTE Recommended Textbook – 2018)
4. Operating System: A Design-oriented Approach, 1st Edition by CharlesCrowley, Irwin Publishing
5. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
6. Design of the Unix Operating Systems, 8th Edition by Maurice Bach,Prentice-Hall of India.

Course Title: Operating System Lab	Duration : 13 Hours
Topics to be Covered:	• Managing Unix/Linux Operating System :Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions,Partitions, Swap space, Device files, Rawand Block files, Formatting disks, • Making file systems, Superblock, I- nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and

	methods Kernel loading, init and the inittab file, Run-levels, Run level scripts.Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user. Switching group, Removing users &usergroups. • Process : starting new process, replacinga process image, duplicating aprocess image, waiting for a process,zombie process. • Signal : signal handling, sending signals,signal interface, signal sets. • Semaphore : programming with semaphores (use functions semctl,semget,semop,set_semvalue, del_semvalue, semaphore_p, semaphore_v). • Inter-process communication [6P]: pipes(use functions pipe, popen, pclose),named pipes(FIFOs, accessing FIFO),message passing & sharedmemory(IPC version V).

Semester –III			
Course Code: DSE3021	**Course Title: Sports Facility and Event Management**	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

- Explain the basic issues related to planning facilities, including site selection, design and construction process
- Explain the different forms of public and private funding of sport facilities and ethical issues involved in utilising public funds
- Describe the process involved in event planning and management
- Explain the event and facility issues pertinent to participants, spectators and sponsors
- Describe the operation of venues and events including staffing, box office management, security, concessions and maintenance
- Explain the legal issues facing event and facility management including the risk management process
- Analyse the process of event bidding and venue selection

Course Description: This course module will enable a sports manager to understand a core component of planning and operating sports and recreational facilities and events.

Unit I	Understanding the Sports Industry – Players and OpportunitiesSports Infrastructure – the cradle of the sporting ecosystem Overview and Facility Planning Facility Construction and Event Planning	**Hours** 5
Unit II	Designing, Planning and Controlling Event Logistics Providing Hospitality and Sports Events Sports SponsorshipsBid Assignment Evaluating Events and Managing Staff	5
Unit III	Negotiations and Contracts Risk Management – Protecting your InvestmentEvent Marketing Merchandising, Sales, Ticketing Law, Ethics, Marketing and Finance QuizEconomics of Sports Facilities Officials, Athletes, Match Day – Planning and Process	8

	Alcohol + F&B Management	
Unit IV	Opportunities and challenges towards building an Olympics Event Bidding Assignment Evaluating Events and Managing Staff Field Trip – Fire, Health and Safety Drill, Quality Control Crowd Engagement Facility Design Project – Presentation – Event Objective Financial Plan Supply List Promotion Plan Staffing Plan Registration Plan Evaluation Plan Cancellation plan Critical Dates Event Evaluation SAI Centre – Case Study Odisha Government – Case Study (Adoption of Hockey)	12

Unit V	Practical Presentation - In groups, students to study and present on a Design, Build, Operate and Maintain basis – the following TransStadia sport facilities viz: Football ground, swimming pool, Indoor sports hall & tennis courts. Students will present on the facility design, the sport surface used (natural / synthetic), the costs of building such a surface, pros and cons, the Lighting systems used, maintenance processes, Field visit - Visit to the DY Patil stadium, to understand all facilities Event proposal - Present a Sport event plan proposal for the Hosting of a NON-TELEVISED event within the TS Indoor Arena Event organization - Organise a multi-sport school event / organize a non-mainstream sport FIELD event focused around fitness (American Ninja Warrior / Devils Circuit Obstacle Course Race)	15

References:

- Sports turf science, construction and maintenance
- Foundations of managing Sporting events
- "Contemporary Sport Management" by Paul M. Pedersen, Lucie Thibault, and Paul Pedersen
- "Managing Sport Facilities and Major Events" by Hans Westerbeek, Aaron Smith, Paul Turner, and Paul Emery

Semester – III

Course Code: DSE3022	Course Title: International Economics	Credits: 3	Lectures/Week: 3

Learning Objectives:

- Defines the types of international economic integration by understanding the purpose and significance of international organizations
- Explains the international organizations with economic and social objectives in the United Nations and this system
- Explains organizations operating in the area of international monetary, trade and development at the global level and evaluates the activities of these organizations.
- Explains regional economic integration organizations and compares them.
- Explains the aims and activities of regional development banks

Course Description:

- Students are able to critically explore issues and policies in International Economics are equipped to apply theoretical principles of international trade to the prevailing global economic environment. Students are imbibed with skill sets to comprehend the critical issues involved in framing and implementation of international trade policies.

		Hours
Unit I	Introduction to the global environment – Environment for foreign trade and investment ● Effects of globalization on firms ● External influences on India's business environment	5
Unit II	International trade theories, Barriers to trade and their impact on the economy. ● Costs and benefits of trade ● Theory of comparative advantage, H-O Theory ● International product cycle ● New trade theory ● Porter's theory of national competitive advantage ● Governmental influence on trade, Tariff	15
Unit III	International institutions and trade blocs Global market entry strategies Foreign investment	10
Unit IV	The foreign exchange market International taxation and transfer pricing Foreign trade in India Direction and composition of India's trade.	15

References:

- **International Business, Environments and Operations, 12th edition, by John Daniels, Lee Radebaugh (Pearson)**
- **International Business, 6th edition by Charles Hill, Arun Jain (Tata McGraw Hill)**
- **International Finance by Prakash Apte, Mc**
- **International Economics, 2nd edition, by Robert Feenstra, Alan Taylor (Palgrave Macmillan)**
- **International Economics by Paul Krugman, Maurice Ostfeld, 8th edition (Pearson)**

Semester –III			
Course Code: DSE3023	**Course Title: Introduction to Philosophy**	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

- Analyze key events (including historical, social, economic, and/or personal) that influenced a particular form of creative human expression.
- Analyze key events (including historical, social, economic, and/or personal) that demonstrate how a particular form of creative human expression influenced other works.
- Evaluate a particular form of creative human expression in the context of the appropriate academic discipline.
- D. Create or reconstruct an expression of the human experience and share with others (if the class is performance based).

Course Description:

- This course provides an introduction to the types of philosophy and the study of the great thinkers' contributions to studies which investigate the principles and facts of reality, human nature and basic problems of conduct relevant to man. Emphasis is on early Greek philosophy: Plato and Aristotle. This course will include writing assignments.

Unit I	**Introduction**: **RHETORIC vs LOGIC** ● Truth & Rhetoric ● Plato's theory of the forms ● Logic: Pre & Post scientific revolution ● Identifying arguments: Deductive vs. Inductive Readings ● Bertrand Russell (1949): Philosophy for laymen ● Armstrong: "What is Philosophy?" ● George Hole "How to read Philosophy"	**Hours** 5
Unit II	**Formal Argument** ● Core questions in Philosophy ● Does God exist? ● Meaning & morality of God's existence: Humanism via being God like **Readings** ● Dennett (2005): "Atheism & Evolution" ● Pascals' wager: Blaise Pascal. "The Wage" from Pensées	10

Unit III	**Epistemology** ● What is epistemology ● Descartes & the scientific revolution ● Arguments **Readings** ● Descartes in Cottingham, pp 21-25 ● Locke in Cottingham, pp 25-31	10
Unit IV	**Metaphysics** ● Mind body problem ● Dualism ● Functionalism ● Metaphysics of identity **Readings** ● Theseus' ship ● Descartes Meditation IV & VI ● What does Mary Learn? (Exercise) ● Frank Jackson, (1982:130) Raymond Smullyan, "An unfortunate dualist"	10
Unit V	**Applications** ● Ethics & Decision making ● Free will **Case studies** Michael J. Sandel, "The Case Against Perfection", The Atlantic, April 2004 https://www.theatlantic.com/magazine/archive/2004/04/the-case-against-perfection/302927/ Alastair Norcross, "Puppies, Pigs & People", RiceUniversity, 2004 (PDF) https://spot.colorado.edu/~heathwoo/readings/norcross.pdf	10

References:

- **Western Philosophy: An Anthology, 3rd edition, John Cottingham, Wiley-Blackwell.**
- **On Bullshit, Harry G. Frankfurt, Princeton University Press**
- **The Philosophy Book: Big Ideas Simply Explained, Will Buckingham, DK**
- **Modern Philosophy: An Introduction and Survey, Roger Scruton, Penguin Books**

Evaluation Scheme

Continuous Assessment (C.A.) -

C.A. – I: Test – Rubric to assess

C.A. – II:

Organization and Development of Ideas	Analysis and Evaluation

Semester End Examination (SEE) -

Passing marks shall be 45% for all subjects compulsorily

**Curated by TransStadia Institute - Centre of Excellence, Mumbai*

BSc. Data Science and Sports Studies
Semester – IV

SEMESTER – IV COURSE	CREDITS
CORE	
R Programming	3
Machine Learning	4
Descriptive Analytics	3
Organizational Behaviour	3
SCHOOL ELECTIVES 2/3	
Natural Language Processing	3
Cloud Computing	3
Financial Management	3
SPECIAL ELECTIVES 1/3	
Doping Control in Sport	3
Talent Management in Sport	3
Financial Services	3

Semester –IV			
Course Code: **DSC401**	**Course Title: R Programming**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- To learn basic concept of R programming
- To learn basic and advanced data structure in R Programming
- To learn and implement advanced concept of data visualization techniques using R

Course Description: In this course students will learn how to program in R and how to use R for effective data analysis. You will learn how to install and configure software necessary for a statistical programming environment, discuss generic programming language concepts as they are implemented in a high-level statistical language. The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, and organizing and commenting R code. Topics in statistical data analysis and optimization will provide working examples.

		Hours
Unit I	Introduction to R – Help Functions in R – Vectors – Vectorized Operations – Functions in R – Packages in R.	4
Unit II	Matrices, Arrays and Lists Matrix Operations – Adding and Deleting Rows and Columns – Higher Dimensional Arrays – Lists – General List Operations – Accessing List Components and Values – Applying functions to Lists	6
Unit III	Data Frames Creating Data Frames – Matrix-like Operations on a Data Frame – Merging Data Frames – Applying functions to Data Frames – Factors and Tables – Common Functions used with Factors – Working with Tables.	8
Unit IV	OOP S3 Classes – S4 Classes – Managing the Objects – Input/Output – Accessing Keyboard and Monitor – Reading and Writing Files – accessing the Internet – String Manipulation.	8
Unit V	Data Visualization Introduction to GGPlot2 – Factors – Aesthetics – Plottingwith Layers – Overriding Aesthetics – Mapping vs Setting – Histograms – Density Charts – Statistical Transformation – Facets – Coordinates – Themes.	6

References:

1. Norman Matloff , “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.
2. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.
3. Mark Gardener, “ Beginning R – The Statistical Programming Language”, Wiley, 2013
4. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2013.

Course Title: R Programming Lab	**Duration: 13 hours**

Topics to be covered:	1. Creating and displaying Data. 2.Matrix manipulations 3. Creating and manipulating a List andan Array 4. Creating a Data Frame and Matrix-likeOperations on a Data Frame 5. Merging two Data Frames 6. Applying functions to Data Frames 7. Using Functions with Factors 8. Accessing the Internet 9. String Manipulations 10. Visualization Effects 11. Plotting with Layers 12. Overriding Aesthetics 13. Histograms and Density Charts 14. Simple Linear Regression – Fitting,Evaluation and Visualization 15.Multiple Linear Regression, Lasso andRidge Regression

Semester –IV			
Course Code: **DSC402**	**Course Title: Machine Learning**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.

Course Description: This Course covers the basic concepts of Machine Learning techniques including supervised and un supervised learning .

Unit I	Introduction: Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine Learning – Supervised Learningand Unsupervised Learning – Mathematical Foundations of Machine Learning – Applications of Machine Learning.	**Hours** 10
Unit II	Supervised Learning-I: Simple Linear Regression – Multiple Linear Regression – Polynomial Regression – Ridge Regression – Lasso Regression – Evaluating Regression Models – Model Selection – Bagging – Ensemble Methods.	8
Unit III	Supervised Learning - II : Classification – Logistic Regression – Decision Tree Regression and Classification – Random Forest Regression and Classification – Support Vector Machine Regression and Classification - Evaluating Classification Models.	10
Unit IV	Unsupervised Learning :Clustering – K-Means Clustering – Density-Based Clustering – Dimensionality Reduction – Collaborative Filtering.	8
Unit V	Association Rule :Learning and Reinforcement Learning Association Rule Learning – Apriori – Eclat – Reinforcement Learning – Upper Confidence Bound – Thompson Sampling – Q-Learning.	9

References:

1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
5. Stanford Lectures of Prof. Andrew Ng.

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SEMESTER -IV			
Course Code: DSC403	**Course Title: Descriptive Analytics**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Understand the purpose and importance of descriptive analytics in data analysis.
- Learn various statistical techniques for summarizing and interpreting data.
- Develop skills in data visualization to effectively communicate findings.
- Apply descriptive analytics techniques to real-world datasets.
- Gain proficiency in using software tools for descriptive analytics.

Course Description:

- Descriptive Analytics is a course designed to provide students with the knowledge and skills required to analyze and interpret historical data to gain insights into past eventsand trends.
- The course emphasizes the use of various statistical and data visualization techniques to summarize and describe data effectively.

Unit I	Business intelligence, BI architecture & components, Functional areas of BI tool, Applications of BI tool, Enterprise analytics capabilities, Complex vs volume operations, The nature of industry: Online retailers, Examples of nature of industry, Complex vs volume operations, IT vs business and fact-based culture, A strong data infrastructure, Analytics workforce, Future of business intelligence.	**Hours** 7
Unit II	Decision support, Examples of decision support, Exploring and analyzing data, Data warehouse, Data warehouse properties, Types of data, Multidimensional data, Schemas, Star schemas, Snowflake schemas, Constellation schemas, Conceptual modeling of data warehouses, Data warehouse design process, Multi-tiered architecture, Cross tabulation of sales by item-name and color, Data cube, Hierarchies on dimensions, OLAP server architectures, Discovery-driven data cubes, Typical OLAP operations, OLTP vs. OLAP, Business query, Dashboards and scorecards development, Metadata model, Automated tasks and events, Mobile BI, Disconnected BI, Collaborative BI, Real-time monitoring Software Development Kit (SDK), Making BI easy to consume	8

Unit III	Business transformation projects, Where are we now? ASUG BI maturity model, Measuring BI success and value (McDonald 2004), BI effectiveness scorecard, BI value scorecard, Five key areas of strategy, Planning a BI Project, BI design and development, Engagement activities, Pre- engagement activities, Business environment, Engagement process, Project tasks Task 1: Knowledge capture goals - Discuss business objectives and prior learning, Interview key stakeholders Task 2: Consolidate findings Task 3: Map the customer situation - Current environment,Business/functional requirements sample diagram, Logical BI diagram Task 4: Methodology and approach Task 5: Standards and governance Task 6: Sections, milestones, and tasks Task 7: Proof of Concept (POC) Task 8: Table creation Task 9: OLAP creation Task 10: Three final deliverables Server administration data measurement, KDD: Knowledge Discovery in database, The Cross Industry Standard Process for Data Mining (CRISP- DM).	10
Unit IV	Metrics, Senior managers should take care of metrics, Metrics drive behavior in several ways, Kaplan-Norton balanced scorecard, The Rayport-Jaworski performance dashboard and strategy framework, Introducing the R-J performance dashboard, Blueprint to the R-J performance dashboard, Building reports, Relational reporting style, Dimensional reporting style, Dashboard: Definition, Layers of information, Evolution of dashboards, Information discovery and delivery, Dashboard design principles, Chart overview, Singular components, Alerts overview, Example of a dashboard, Display media for dashboards, Sales simulation (what-if scenarios) What-if scenarios: Example 1: Calculation of a monthly rate for a home loan What-if scenarios: Example 2: Calculation of the average profit margin What-If scenarios: Input components What-if scenarios: Output components Setting up the business scenario for a sales simulation, List report, Crosstab report, Chart report, Map report, Data group and sort, Filters in report, Add calculations to report, Conditions in report, Adding summary values in report, Drilling in report: Drill up and down, Drilling in report: Drill through, Run report: On demand or schedule, Charts, Parts of a graph, Chart types, Chart type: Bar chart, Chart type: Line, Chart type: Pie, Chart type: Area, Chart type: Scatter.	10
Unit V	Data mining Data mining process Data mining Benefits Data mining disadvantages Data mining challenges Data mining examples Data mining methods	10

References:

1. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
2. "Deep Learning with Python" by François Chollet.
3."Deep Learning for Computer Vision" by Adrian Rosebrock.
4."Deep Reinforcement Learning" by Pieter Abbeel and John Schulman.
5."Generative Deep Learning" by David Foster.
6."Deep Learning with PyTorch" by Eli Stevens, Luca Antiga, and Thomas Viehmann.

Lab Exercises –

Exercise 1: Power BI desktop
Exercise 2: Power BI service Exercise 3: Architecture
Exercise 4: Supported Data SourcesExercise 5: Data Modeling
Exercise 6: Dashboard Options Exercise 7: Visualization Options 1
Exercise 8: Visualization Options 2
Exercise 9: Excel Integration
Exercise 10: Sharing Power BI Dashboards1
Exercise 11: Sharing Power BI Dashboards 2
Exercise 12: DAX Basics 1
Exercise 13: DAX Basics 2
Exercise 14: DAX Basics 3
Exercise 15: DAX Advanced 1
Exercise 16: DAX Advanced 2
Exercise 17: DAX Advanced 3
Exercise 18: Starting with Shiny
Exercise 19: Build a Shiny app
Exercise 20: Customize reactions
Exercise 21: How to customize appearance
Exercise 22: Shiny Project
Exercise 23: Basic python operations
Exercise 24: Creating of Arrays
Exercise 25: Introduction to pandas package
Exercise 26: Introduction to NumPy
Exercise 27: Data merging
Exercise 28: Data Cleaning
Exercise 29: Data transformation
Exercise 30: Introduction to matplotlib
Exercise 31: Introduction to matplotlib - 2
Exercise 32: Customizing Plots with Matplotlib
Exercise 33: Using Seaborn for data visualization
Exercise 34: Exploratory analysis – 1
Exercise 35: Exploratory analysis – 2a
Exercise 36: Exploratory analysi2b
Exercise 37: Introduction to Web visualization using D3.js
Exercise 38: Building Interactive Bar Charts

Semester – IV			
Course Code: **DSC404**	**Course Title: Organizational Behavior**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Organizational behavior studies how and why individual employees and groups of employees behave the way they do within an organizational setting. The three main reasons for studying organizational behavior in your organization are to be able to explain it, predict it, and influence it.

Course Description:

- This course aims to lay the foundation of understanding of human behavior in organizations through an exposure to organizational behavior theories, case studies and live examples. This course has a large applied component to it in order to facilitate hands-on learning of contemporary organizational challenges.

Unit I	Introduction to Organizational behavior – nature and Structure Contemporary Approaches to organizational behavior Social learning frame work Individual differences – personality, diversity	**Hours** 5
Unit II	Perception Attitudes and satisfactionJob stress Group dynamics Informal organization structureInformal communication Information processing	10
Unit III	Conflict resolution Negotiations Decision making and control Control process and its elementsOrganizational culture Change management	15
Unit IV	Cases, Simulation games, blogs and audio visual material, psychometrictests	15

References:

- Mullins, L. J. (2007). *Management and organisational behaviour*. Pearson education.
- Business Organization and Management by Bhushan Y.K.
- Business Organization by Gupta C.B
- Organizational Behaviour by L.M. Prasad
- Wood, J. M., Zeffane, R. M., Fromholtz, M., Wiesner, R., Morrison, R., Factor, A. Osborn, R. N. (2016). *Organisational behaviour: Core concepts and applications*. John Wiley & Sons Australia, Ltd.

Semester – IV			
Course Code: **DSE4011**	**Course Title: Natural Language Processing**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Learn the basics of natural language processing and understand various steps in it.
- To introduce the fundamentals of language processing from the algorithmic viewpoint.
- To discuss various issues that make natural language processing a hard task**.**

Course Description: This courses covers basic concepts of Natural Language Processing including morphology and Probabilistic models**.**

Unit I	Introduction Overview: Origins and challenges of NLP- Theory of Language -Features of Indian Languages – Issues in Font –Models andAlgorithms- NLP Applications.	**Hours** 4
Unit II	MORPHOLOGY AND PARTS-OF-SPEECH Phonology – Computational Phonology - Words and Morphemes – Segmentation – Categorization and Lemmatisation – Word Form Recognition – Valency - Agreement - Regular Expressions – Finite State Automata – Morphology-Morphological issues of Indian Languages – Transliteration.	9
Unit III	PROBABILISTIC MODELS Probabilistic Models of Pronunciation and Spelling – Weighted Automata – N- Grams – Corpus Analysis – Smoothing – Entropy - Parts-of-Speech – Taggers – Rule based – Hidden Markov Models – Speech Recognition	9
Unit IV	SYNTAX Basic Concepts of Syntax – Parsing Techniques – General Grammar rules for Indian Languages – Context Free Grammar – Parsingwith Context Free Grammars – Top Down Parser – Earley Algorithm – Features and Unification - Lexicalised and Probabilistic Parsing.	14
Unit V	SEMANTICS AND PRAGMATICS (6 hours) Representing Meaning – Computational Representation – Meaning Structure of Language –Semantic Analysis – Lexical Semantics – WordNet – Pragmatics – Discourse – Reference Resolution – Text Coherence – Dialogue Conversational Agents.	9

References:

1. Daniel Jurafskey and James H. Martin “Speech and Language Processing”, Prentice Hall, 2009.
2. Christopher D.Manning and Hinrich Schutze, “Foundation of Statistical Natural Language Processing”, MIT Press, 1999.
3. Ronald Hausser, “Foundations of Computational Linguistics”, Springer-Verleg, 1999.
4. James Allen, “Natural Language Understanding”, Benjamin/Cummings Publishing Co. 1995

<table>
<tr><th colspan="4">Semester – IV</th></tr>
<tr><td>Course Code:

DSE4012</td><td>Course Title: Cloud Computing</td><td>Credits: 3</td><td>Lectures/Week:3</td></tr>
<tr><td colspan="4">Learning Objectives:
Identify the technical foundations of cloud systems architectures.
Analyze the problems and solutions to cloud application problems.
Apply principles of best practice in cloud application design and management.
Identify and define technical challenges for cloud applications and assess their importance.</td></tr>
<tr><td colspan="4">Course Description: This course gives students an insight into the basics of cloud computing along with virtualization, cloud computing is one of the fastest growing domain from a while now. It will provide the students basic understanding about cloud and virtualization along with it how one can migrate over it.</td></tr>
<tr><td>Unit I</td><td colspan="2">Introduction Evolution of Cloud Computing –Essential Characteristics of cloud computing – Operational models such as private, dedicated, virtual private, community, hybrid and public cloud – Service models such as IaaS, PaaS and SaaS – Governance and Change Management – Business drivers, metrics and typical use cases. Example cloud vendors – Google cloud platform, Amazon AWS, Microsoft Azure, Pivotal cloud foundry and Open Stack.</td><td>Hours

9</td></tr>
<tr><td>Unit II</td><td colspan="2">Infrastructure Services Basics of Virtual Machines - Taxonomy of Virtual Machines. Virtualization Architectures. Challenges with Dynamic Infrastructure - Principles of Infrastructure as Code - Considerations for Infrastructure Services and Tools - Monitoring: Alerting, Metrics, and Logging - Service Discovery - Server Provisioning via Templates - Patterns and Practices for Continuous Deployment - Organizing Infrastructure and Testing Infrastructure - Change Management Pipelines for Infrastructure.</td><td>9</td></tr>
<tr><td>Unit III</td><td colspan="2">Platform Engineering Cloud Native Design and Microservices– Containerized - Dynamically orchestrated design – Continuous delivery - Support for a variety of client devices – Monolithic vs Microservices Architecture - Characteristics of microservice architecture – 12 factor application design - Considering service granularity – Scalable Services - Sharing dependencies between microservices - Stateless versus Stateful microservices - Service discovery – Service Registry – Performance Considerations</td><td>9</td></tr>
<tr><td>Unit IV</td><td colspan="2">Serverless Architecture and DevOps Function as a Service (FaaS) - Backend as a Service (BaaS) - Advantages of serverless architectures - Taking a hybrid approach to serverless architecture - Function deployment and Function invocation. Introduction to DevOps - The Deployment Pipeline - The Overall Architecture - Building and Testing - Deployment - Crosscutting Concerns such as Monitoring, Scalability,</td><td>9</td></tr>
</table>

	Repeatability, Reliability, Recoverability, Interoperability, Testability, and Modifiability.	
Unit V	Cloud Security Security Considerations – STRIDE Threat Model - Cloud Security Challenges – Cloud specific Cryptographic Techniques – CIA Triad – Security by Design – Common Security Risks - Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.	9

References:

1. Software Architect's Handbook, by Joseph Ingeno, Published by Packt Publishing, 2018
2. Architecting Cloud Computing Solutions by Scott Goessling, Kevin L. Jackson, Publisher: Packet Publishing, Release Date: May 2018
3. Microservices: Flexible Software Architecture, by Eberhard Wolff, Publisher: Addison-Wesley Professional, Release Date: October 2016

Semester –IV			
Course Code: **DSE4013**	**Course Title: Financial Management**	**Credits: 3**	**Lectures/Week:3**
Learning Objectives: : • Understand basic concepts of financial management and their application in investment, financing and dividend decisions. • Understand concepts of cost of capital, leverage analysis, capital structure and dividend theories and identify courses of action in financial environment that would result in maximization of wealth of an organization. • Understand management of working capital and estimate the same for an organization.			
Course Description: This course is designed to survey the field of finance and provide the foundation for more advanced finance coursework. Topics include sources of business and financial information, financial statement, analysis, risk and return, asset valuation, capital budgeting, capital structure, business financial planning and working capital management.			
Unit I	Introduction of Business Finance Financial Manager's role Financial Goal and Firms Objectives Limitations of various type of sources of fund		**Hours** 15
Unit II	Capital structure and Leverage Meaning of Financial Leverage, Measures of financial Leverage, Financial leverage and shareholders Return Combining financial and Operating leverage Venture capital financing Development of Venture capital in India Future Prospects of Venture Financing.		15
Unit III	Cost of Capital The cost of capital and opportunity cost concept Determining component, cost of capital Capital and Investment Analysis		15
References: 1. Handbook of Finance, Investment Management and Financial Management 2. Smart Financial Management: The Essential Reference for the Successful Small Business Richard Crawford, 2004			

Semester – IV			
Course Code: **DSE4021**	**Course Title: Doping Control in Sport**	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

After completing the course

- You will have knowledge about the role and responsibility of medical support personnel related to the administration of drugs to athletes and to the role of pharmacists in the prevention of doping
- You will have knowledge about the anti-doping rules (World Anti-Doping Code, International standards, national rules) and national and international anti-doping work
- You will have knowledge about WADAs prohibited list, therapeutic use exemption and the Norwegian drug search database, and how to use this knowledge to advice athletes in correct use of drugs
- You will have knowledge about common diagnoses amongst athletes and treatment of these, included pain management, anti-inflammatory drugs, asthma treatment, hormonal treatment and the use of stimulating drugs including drugs of abuse
- You will have knowledge about doping analysis, including procedures, methods and result management, and dosing of drugs considering the prohibited list and doping analysis
- You will have knowledge about the use of dietary supplements, and the use of this knowledge to do risk assessments, and prevention of doping both in sport and the society.

Course Description:

- The course offers an introduction to the use of medicines for athletes and its relation to the anti-doping rules. It will focus on the role of pharmacists to avoid doping violations, as a result of either intended or inadvertent doping.
- This course is designed to provide basic understanding of Anti-Doping and to equip them and those working in the anti-doping field to advise and support athletes to make the best choices regarding anti-doping while ensuring compliance with the rules of the World Anti-Doping Code (WADC), sports federations, and national anti-doping agencies. It will also empower them to become educators and supporters to athletes and other athlete support personnel on anti-doping and clean sport matters, including the safe and informed selection of medications and supplements.
- This course outline the roles and responsibilities and to strengthen their understanding on doping in sports, this course covers the testing procedures, education, Anti-Doping Rule Violations (ADRV) and many more.

Unit I	What is doping? Why do athletes give in to doping? Organizations and doping: prevention and repressionBio analytical and forensic approaches to doping	**Hours**

Unit II	WADA – Information/ Education Guidelines to Prevent Doping in Sport Psychological Support for Athletes Sports Genetics and PerformanceExercise Immunology	
Unit III	Athlete Handbook – InformationPocket Guide Coaches Guide Health Advantages and Disadvantages to athletesTesting Guidelines National Anti- Doping Policy Athlete – Rights and Responsibilities GuideNon – Analytical Investigations Principles Whereabouts Policy Whistleblowing Policy World Anti- Doping Code Testing and Investigations International Standards Protection of Privacy and Personal Information International Standard Laboratories – International Standard Results Management – International Standard Prohibited List – International Standard Therapeutic Exemptions – International Standards Therapeutic Exemptions Policy – International Standards	
Unit IV	Substance Abuse Treatment, Prevention and Policy. Legal, Regulatory and Prevention Practice Provisions	
Unit V	Movie Review – IcarusTour de France Sharapova Case Narsingh Yadav Case NADA Review WADA Review UNESCO's Convention Against Doping	

Unit VI	Practicals Individual assignment - Students will select a sport and explore the motivation for doping in eachof these. They will also present the kind of drugs that will largely be “beneficial” to them in this particular sport. Through this, students will learn about why and how athletes are pushed towards doping (ignorancein substance intake, injury recovery, performance enhancement, weight loss etc) Movie Review - Icarus Case Studies - In groups, students to present the case studies of famous athletes who have been found guilty of doping. Students will present the background,the accusation, the journey through the charges being investigated, the reasons why the athlete indulged in doping, the sanctions Skit - one group will engage in Doping, the counter group will have to question and demonstrate the process by which they have been suspected, and theprocess followed to complete the investigation Guest lecture - WADA / NADA and the processes in place to avoid / detect doping	18

References:

- Doping In Elite Sports: Voices of French Sportspedic and Their Doctors Christophe Brissonneau, Jeffery
- Doping In Non-Olympic Sports: Challenging the legitimacy Lovely Dasgupta
- Fair play in sport: A moral Norm System Sigmund Toland
- Doping & Anti-doping Policy in Sport Mike Mcnamee, Verner Moller

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Semester –IV			
Course Code: DSE4022	**Course Title: Talent Management in Sport**	**Credits: 3**	**Lectures/Week: 2**

Learning Objectives:

- Define what talent management is and why it is critical.
- Identify the planning stages of talent management
- Searching and recognizing talent
- Summarize the processes for hiring talent
- Develop and improve talent
- Processes behind Performance Management, Talent Retention and succession planning.
- Mastery of Lesson content at Levels of 70% of higher.

Course Description:

- This course dives deep into the strategic process of identifying, developing, and retaining talented athletes and personnel within the sports industry.
- Students will explore the entire talent management lifecycle, from scouting and recruitment to performance optimization and career planning.
- The course will analyze successful strategies used by professional teams, academies, and governing bodies to maximize their human capital and achieve a competitive advantage.

Unit I	History of Talent Management and different approaches Definition of Talent in Business, Talent Management System Talent Management Practices Developing A systemic, Strategic Approach to Talent Management	**Hours**
Unit II	Managing Talent Commercial Management Player Management Talent Representation Types Talent Management Practices to Focus on Digital Talent Management	
Unit III	Organisational Gain Performance Management Diversity and Inclusion in leading Talent Strategic Talent Analytics Aligning Legal Aspects	
Unit IV	Movie Review: Moneyball Coach Carter Michael Jordan – Documentary Netflix Breaking Point – LeeHesh LinkedIn Learning – What is Talent Management Strategy (2017, June 2). *What is a talent management strategy?* [Video 3:53]. YouTube. The Predictive Index. (2019, August 9). *Talent strategy is changing consulting.* [Video 6:48]. YouTube Sen, S. (2019). *Talent management.* Society Publishing Quirk, E. (2018, May 14). *The top 5 benefits of having a talent management system.* LinkedIn Learning. (2017, June 2). What is a talent management strategy? [Video]. YouTube.	

	Whitesell, L. (2019, September 27). Why talent management is an important business strategy. *Sponsored Insights*. Quirk, E. (2018, May 14). *The top 5 benefits of having a talent management system.* I*ssues of secrecy versus transparency*	
Unit V	Practicals Movie Review - Movie: Moneyball / Jerry Maguire / Million Dollar Arm / Ballers/ Ford vs Ferrari Individual assignment: Report writing - Students to present a written assignment on "Managing an athlete the early years – from the personal side to the professional side" Presentation - Each group to select a sport and present how they would "acquire" a client from a particular club to represent, how they would manage his professional commitments – contracts, endorsements, image rights etc,; structuring of his/her athlete representation contract; how they would prevent their player from laving their agency and joining another	12
References: 1. "Talent Identification and Development in Sport: International Perspectives" edited by Joseph Baker, Stephen Cobley, and Jörg Schorer 2. "The Talent Lab: The Secret to Finding, Creating and Sustaining Success" by Owen Slot		

Semester-IV			
Course Code: DSE4023	**Course Title: Financial Services**	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives: Learn about the services offered by such companies • Analyze the ways these companies earn profits. • Introduces students to the main concepts behind investing • Discriminates among different ways to invest money. • Examine contemporary issues including the level of personal saving in the United States, ethics in the financial services industry, and the industry's effect on communities and families.

Course Description: This course gives students an overview of banks and other financial services companies. Financial Services provides students with an overview of banks and other financial services companies. The course begins by introducing students to the origins of money and banking, and then examines the early history of banking in the United States. Students move into an in-depth study of the financial services industry and explore the types of companies that make up this industry.

Unit I	Introduction to financial services Difference between product and services marketing Characteristics and Classification of services Paradigms in services marketingRole of Services in Economy	**Hours** 10
Unit II	Services marketing mix Augmented marketing mix Developing the service product Services product planning, pricing strategy and promotionsRole of communication in service marketing People and internal communication Process of operations and delivery of servicesRole of technology in services marketing.	10

Unit III	Personal Selling & Marketing Strategy: Sales Management Personal Selling and salesmanship Organizing the Sales Effort Sales Organization Distribution of financial services	10
Unit IV	Sales Force Management in financial services Recruiting and Selecting Sales Personnel Planning Executing and Evaluating Sales Training Programme Motivating and Compensating Sales Personnel Controlling the Sales Effort Sales control and cost analysis	10
Unit V	Live sales project, case analysis, group projects	5

References:

- Baron S and Harris K- *Services Marketing: Text and Cases* (Palgrave, 2003)
- Lovelock- *Services Marketing: People, Technology and Strategy* (Pearson Education, 5th edition).
- Zeithaml, V. A and Bitner, M. J. - *Services Marketing* (Tata McGraw-Hill).
- S. L. Gupta *Marketing of Services (Sultan Chand)*.

Evaluation Scheme

Continuous Assessment (C.A.) -
C.A. – I: Test – Rubric to assess
C.A. – II:

Organization and Development of Ideas	Analysis and Evaluation

Semester End Examination (SEE) -
Passing marks shall be 45% for all subjects compulsorily.

**Curated by TransStadia Institute - Centre of Excellence, Mumbai*

BSc Data Science & Sports Studies						
First Year						
Particulars	**Fee Category**					
	J and K Students (need to be confirm)	**NRI Student**	**Out side Maharashtra (equal to open)**	**within Maharashtra (Open Category)**	**within Maharashtra (Reserved)**	**University Fees for Students without Eligibility**
ID Card	25	25	25	25	25	25
Admission Form / Application Form Fees	50	50	50	50	50	50
Group Insurance	20	20	20	20	20	20
Ashvamedha	20	20	20	20	20	20
Admission processing fees	60	60	60	60	60	60
Dip Registration	15	15	15	15	15	15
Other Fee	125	125	125	125	125	125
Gymkhana Fees	190	190	190	190	190	190
Students welfare	500	500	500	500	500	500
Vice Chancellor's Fund	20	20	20	20	20	20
Eligibility Fees	500	500	500	500	500	500
Disaster Relief Fund	10	10	10	10	10	10
Development Fee	1,173	1,173	1,173	1,173	1,173	1,173
Exam Fee	700	700	700	700	700	700
Caution Money Deposit	-	-	-	-	-	-
Tuition Fee	1,41,592	7,00,000	1,41,592	1,41,592	-	1,41,592
Library Fee	1,000	1,000	1,000	1,000	1,000	1,000
Site Visit	5,000	10,000	5,000	5,000	5,000	5,000
IT Lab	20,000	10,000	20,000	20,000	20,000	20,000
Seminars (Industry Experts)	15,000	15,000	15,000	15,000	15,000	15,000
Sports Equipment	5,000	10,000	5,000	5,000	5,000	5,000
Kit Fee	1,000	1,000	1,000	1,000	1,000	1,000
Students' Activity	3,000	3,000	3,000	3,000	3,000	3,000
Total Amount	**1,95,000**	**7,53,408**	**1,95,000**	**1,95,000**	**53,408**	**1,95,000**

BSc Data Science & Sports Studies Second Year						
Particulars	**Fee Category**					
	J and K Students (need to be confirm)	**NRI Student**	**Out side Maharashtra (equal to open)**	**within Maharashtra (Open Category)**	**within Maharashtra (Reserved)**	**University Fees for Students without Eligibility**
ID Card	25	25	25	25	25	25
Admission Form / Application Form Fees	50	50	50	50	50	50
Group Insurance	20	20	20	20	20	20
Ashvamedha	20	20	20	20	20	20
Admission processing fees	60	60	60	60	60	60
Dip Registration	15	15	15	15	15	15
Other Fee	125	125	125	125	125	125
Gymkhana Fees	190	190	190	190	190	190
Students welfare	500	500	500	500	500	500
Vice Chancellor's Fund	20	20	20	20	20	20
Eligibility Fees	500	500	500	500	500	500
Disaster Relief Fund	10	10	10	10	10	10
Development Fee	1,173	1,173	1,173	1,173	1,173	1,173
Exam Fee	700	700	700	700	700	700
Caution Money Deposit	-	-	-	-	-	-
Tuition Fee	1,41,592	7,00,000	1,41,592	1,41,592	-	1,41,592
Library Fee	1,000	1,000	1,000	1,000	1,000	1,000
Site Visit	5,000	10,000	5,000	5,000	5,000	5,000
IT Lab	20,000	10,000	20,000	20,000	20,000	20,000
Seminars (Industry Experts)	15,000	15,000	15,000	15,000	15,000	15,000
Sports Equipment	5,000	10,000	5,000	5,000	5,000	5,000
Kit Fee	1,000	1,000	1,000	1,000	1,000	1,000
Students' Activity	3,000	3,000	3,000	3,000	3,000	3,000
Total Amount	**1,95,000**	**7,53,408**	**1,95,000**	**1,95,000**	**53,408**	**1,95,000**

BSc Data Science & Sports Studies						
Third Year						
Particulars	**Fee Category**					
	J and K Students (need to be confirm)	**NRI Student**	**Out side Maharashtra (equal to open)**	**within Maharashtra (Open Category)**	**within Maharashtra (Reserved)**	**University Fees for Students without Eligibility**
ID Card	25	25	25	25	25	25
Admission Form / Application Form Fees	50	50	50	50	50	50
Group Insurance	20	20	20	20	20	20
Ashvamedha	20	20	20	20	20	20
Admission processing fees	60	60	60	60	60	60
Dip Registration	15	15	15	15	15	15
Other Fee	125	125	125	125	125	125
Gymkhana Fees	190	190	190	190	190	190
Students welfare	500	500	500	500	500	500
Vice Chancellor's Fund	20	20	20	20	20	20
Eligibility Fees	500	500	500	500	500	500
Disaster Relief Fund	10	10	10	10	10	10
Development Fee	1,173	1,173	1,173	1,173	1,173	1,173
Exam Fee	700	700	700	700	700	700
Caution Money Deposit	-	-	-	-	-	-
Tuition Fee	1,41,592	7,00,000	1,41,592	1,41,592	-	1,41,592
Library Fee	1,000	1,000	1,000	1,000	1,000	1,000
Site Visit	5,000	10,000	5,000	5,000	5,000	5,000
IT Lab	20,000	10,000	20,000	20,000	20,000	20,000
Seminars (Industry Experts)	15,000	15,000	15,000	15,000	15,000	15,000
Sports Equipment	5,000	10,000	5,000	5,000	5,000	5,000
Kit Fee	1,000	1,000	1,000	1,000	1,000	1,000
Students' Activity	3,000	3,000	3,000	3,000	3,000	3,000
Total Amount	**1,95,000**	**7,53,408**	**1,95,000**	**1,95,000**	**53,408**	**1,95,000**

Justification for introducing various new courses in the University of Mumbai

BSc (Data Science and Sports Studies)

1. Necessity of Starting the course

Considering the huge demand and supply gas of skilled professional in the industry especially in the domain of emerging fields like Artificial Intelligence and Data Science; it is evident that skilled professionals in the same domain will be high in demand in the industry. Considering this, they said courses are designed to create skilled, industry ready young talents. The courses are also designed keepingin mind the modern tech stacks of AI and Data science highly used in industry. These new gen courses also focus on applications of AI and Data science in the domain of sports where also skilled techies are highly required.

Moreover the courses are designed as per NEP -2020 standard facilitating the students to go through interdisciplinary subjects.

2. Whether UGC has recommended starting the courses

Yes, it has been recommended due to the rapid growth of the sports industry.

3. Whether all the courses have commenced from the academic year 2019-20?

No, it shall commence 2022 onwards

4. The courses started by the University are self-financed, whether an adequate number of eligible permanent faculties are available?

Yes, the courses are self-financed and faculties are available. They are a combination of academic,international and industry experts.

5. To give details regarding the duration of the course and is it possible to compress the course?

Not possible to further compress the course. The duration of 3 years is adequate to teach them nuancesof data science and sports studies.

6. The intake capacity of each course and no. of admissions given in the current academic year (2019-20)

The proposed batch size in 60 students. However, if there is increase in demand, can increase the batch size to up to 120 students

7. Opportunities of Employability/ Employment available after undertaking these courses?

There is enough employment opportunity, post the completion of this course. - Post completion of the courses the students will have opportunities in industry as Machine leaching engineer, Data Science Engineer, Data Analyst, Sports Analyst.

Signature Chairman of BoS

Dr. Manoj Reddy

AC – 20/05/2025

Item No. 8.40

UNIVERSITY OF MUMBAI

Syllabus for the
Program: T. Y. B.Sc. Semester V & VI (CBCS)

Course: Data Science and Sports Studies

(Choice Based and Credit System)

(Introduced with effect from the academic year 2025-26)

AC- 20/05/2025
Item No. 8.40

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**T. Y. B.Sc. Semester V & VI**
2	Eligibility for Admission	As per University regulations
3	Passing Marks	40% (Internal 10/25 Marks & External 30/75)
4	Ordinances / Regulations (if any)	
5	No. of Years / Semesters	Three Years Program/Six Semester Programme (Syllabus for semester V and VI)
6	Level	**UG**
7	Pattern	**Semester**
8	Status	**Revised**
9	To be implemented from Academic Year	From Academic Year: 2025-26

Dr. Manoj Reddy
Chairman of BoS

Dr. A.K. Singh
Dean, Interdisciplinary

No: 6769

Title of the course - BSc (Data Science and Sports Studies)

O.No. 6770

Eligibility: XIIth Pass under 10+ 2 scheme of any recognized State / Central / International Board

Scheme of Examination

The Semester End Examination will be conducted for 60 Marks each subjectInternal Assessments will be conducted for 40 Marks each subject

The allocation of 40 marks shall be on the following basis: -

d) Periodical class tests/presentations held in the given semester (30 Marks)

e) Attendance and Active participation in routine class instructional deliveries(05 Marks)

f) Overall Conduct as a responsible student, mannerism and articulation and Exhibition of leadership qualities in organizing related academic activities. (05Marks)

Question Paper Pattern for Semester End Examination (60 Marks)

There will be Seven Questions in all.

Q1 would be compulsory and would carry-----20 Marks

In addition to Q1, there would be six questions.
Each question would carry 10 Marks. Q7 will have three sub – questions and each sub – question would carry 05 Marks

Students have to attempt any four out of the remaining six Questions and within Q7; students have to attempt any two out of three sub – questions.

In all, students have to attempt five questions i.e. (Q1+Any Four of the remaining)

Q1 = 20 Marks (Compulsory)

Attempt Any Four out of the

Remaining Six

Q2 – Q6 = 10 Marks

Q7 Any two from (a) or (b) or (c) ---------- (5x2) = 10 Marks

Standard of Passing: A Student has to separately secure minimum 50% marks (i.e. 20 outof 40) in The internal assessments and secure minimum 50% marks (i.e. 30 out of 60) in the Semester End Examination in every subject to be declared as Pass.

Intake Capacity: The maximum intake capacity of B.Sc. (Data Science and Sports Studies) course as per University of Mumbai is 60 per academic year.

Syllabi for BSc. Data Science and Sports Studies- SEM V & VI

BSc. Data Science and Sports Studies
Semester – V

SEMESTER – V COURSE	CREDITS
CORE	
Business Research Methodology	3
Predictive Analytics	3
Big Data Analytics	3
Major Project-1	3
SCHOOL ELECTIVES 2/3	
Theory of Computation	3
Advanced Machine Learning	3
Cryptography and Cyber Security	3
SPECIAL ELECTIVES 1/3	
Fan Engagement	3
Consumer Psychology	3
Corporate Finance	3

Semester –V			
Course Code: DSC501	**Course Title: BusinessResearch Methodology – I**	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives: The primary goal of a Business Research Methodology course is to equip students with the skills and knowledge to conduct effective research to inform business decisions.

Course Description:

- Understanding the systematic steps involved in research.
- The course covers the entire research process, from problem identification and formulation to data collection, analysis, and report writing.

Unit I	Introduction to Research Methodology Importance, objectives, types of research and steps for research	**Hours** 5
Unit II	Formulation of the research problem Defining research problem, literature review, sources of problem for research, developing the research proposal into a research design,use of Statistics Research application in accounting, finance and marketing areas	7
Unit III	Data Collection Primary data collection methods (questionnaire method, online surveys, observation method), sources of secondary data, survey, questionnaire preparation (characteristics a good questionnaire, layout, pre-test, revision, final), organization of fieldwork, training interviewers, respondents' attitude, evaluation of field work	8
Unit IV	Scaling Techniques Introduction to scales of measurements (nominal, ordinal, interval,Likert) Sample Survey: population, sample, sampling techniques (probability sampling, nonprobability sampling, simple random sampling, stratified random sampling, cluster sampling, systematic sampling), random number table, sample size determination.	8
Unit V	Summarization and Analysis of Data: tabulation, validation, errors in data, use of computer, univariate and bivariate data analysis, measures of association for categorical data, correlation, regression, hypothesis testing (parametric), biometric tables Interpretation and Report Writing: meaning, steps, LATEX (officialsoftware for paper writing)	8
Unit VI	Introduction to SPSS/Excel	9

References:

- **Kothari, C. R.: Research Methodology, Methods and Techniques; New Age International Publishers**

Semester –V			
Course Code: DSC502	**Course Title: Predictive Analytics**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

1. Understand the fundamentals of data mining and its significance.
2. Gain practical experience in data preparation and exploration techniques.
3. Develop proficiency in building and evaluating predictive models.
4. Explore a variety of data mining techniques, from regression to neural networks.
5. Learn about web mining and its applications in analyzing web usage data.
6. Apply data mining skills to real-world scenarios and decision-making.
7. Understand the challenges and considerations in predictive analytics.
8. Explore the growth and applications of machine learning.

Course Description: This course provides a comprehensive introduction to data mining techniques and their applications.
Students will learn the process of extracting valuable insights from diverse datasets, including data
preparation, model development, evaluation, and deployment. The course covers a wide range of topics,
from linear regression to neural networks and web mining, equipping students with practical skills for
analyzing and interpreting data. Through a mix of theoretical concepts and hands-on exercises, students
will gain the necessary skills to apply data mining techniques effectively.

Unit I	Introduction to Data Mining - Significance of data mining in extracting insights. - Evolution of data mining techniques.Understanding Data Mining - Defining data mining and its purpose. -Need for data mining tools. Data Mining Process and KDD Model - Process of data mining and Knowledge Discovery in Databases(KDD) model. - Research challenges in the KDD process.Types of Data for Mining - Different kinds of data suitable for data mining. - Scenario: Need for databases in data mining.Types of Data Mining Tasks and CRISP-DM - Overview of data mining tasks: descriptive, predictive, etc. - Introduction to CRISP-DM methodology. Components and Techniques in Data Mining - Components of data mining methods. - Various data mining operons and techniques. Applications of Data Mining and Predictive Analytics - Practical applications of data mining across domains. - Predictive analytics and its usage.techniques, Practicalexamples/case studies.	**Hours** 12

Unit II	Data Preparation and Quality - Importance of data preparation in data mining. - Data quality and its significance. • Data Collection Methods andSampling - Techniques for data collection and sampling. - Ensuring data understanding and quality. • Data Exploration and Visualization - Categories of data visualization for exploration. - Verifying data quality through outlier detection. • Data Cleaning and Transformation - Cleaningdata: Acquisition and unified date format. - Handling missing data and categorical variables. • Univariate Data Analysis and Statistics - Performing univariate data analysis. - Analyzing continuous variable distribution, standard deviation, and percentiles. • Analysis of Categorical Data and Discretization - Analyzing observed vs. expected distribution. - Discretization techniques without using classes.	10
Unit III	Data Partitioning and Model Selection - Techniques for data partitioning and model selection. • Linear Regression and Decision Trees - Building a Simple Linear Regression (SLR) model. - Introduction to decision treesand their algorithm. • Clustering, Link Analysis, and Classification - Understanding clustering and link analysis. - Introduction to classificationtechniques. • Decision Trees and Information Theoretic Approach - Decision tree algorithm and key requirements. - Information theoretic approach for decision trees. • Classification Techniques and SVM - Techniques for classification, including Support Vector Machine (SVM)	5
Unit IV	Model Evaluation Methods - Techniques for model evaluation and comparison. • Model Evaluation Metrics - Using evaluation charts for model comparison. - Confusion matrix and measures of accuracy. • Liti Charts, Gain Charts, and ROC - Analyzing liÕ charts, gain charts, and Receiver Operating Characteristic (ROC) curve. • Regression Evaluation and Meta-level Modeling - Evaluating regression models andmeta-level modeling. • Model Deployment and Performance Assessment - Deploying models and assessing their performance. • Model Selection and Assessment - Assessing bias, variance, and modelcomplexity. - Guidelines for model selection using AIC, BIC, and cross- validation. • Model Validation and Data Collection Strategies - Validatingmodels and potential issues in model selection. - Strategies for data collection in regression model building.	5

References:

1.M. Kantardzic, “Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc.
2.M. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson Pieter Adriaans, Dolf Zantinge , “Data Mining”, Pearson Education Asia
3. J. Han, M. Kamber, “Data Mining Concepts and Techniques”, Morgan Kaufmann

Course Title: Big Data Analytics Lab	Duration: 13 Hours
Topics to be covered:	1. Design and Create Cube by identifying measures and dimensions for Star Schema, Snowflake 2. Design and Create Cube by identifying measures and dimensions for Design storage for cube using storage 3. Process Cube and Browse Cube Data 1. By replacing a dimension in the grid, filtering and drilldown using cube browser 2. Browse dimension data and view dimension members, member properties, member property values 4. Create calculated member using arithmetic operators and member property of dimension Member
	5 Design and Create data mining models using Analysis Service of SQL server 2005. 6 Design and Build targeted mailing data mining model using analysis service of SQL server 2005 and compare their predictive capabilities using the Mining Accuracy Chart View and Create predictions using Prediction Query Builder. 7 Perform various steps of Preprocessing on the given relational database / warehouse. 8 To implement Data Mining Extensions (DMX) language and MDX query language 9 Perform various steps of Preprocessing using WEKA software

Semester – V			
Course Code: DSC503	**Course Title: Big Data Analytics**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

1. Demonstrates the basic operation in bigdata
2. Awareness of Architectures use in bigdata
3. Study about Big Data processing language Hadoop
4. Describes about the modern databases
5. Case studies in big data are analysed

Course Description: The subjects the fundamentals and Advanced topics of Big Data Analytics along with use cases.

Unit I	Fundamentals of Big-data analytics, Overview & analytics life cycle, Need, Structured and multi-structured data analysis, Big-data analytics major components, Analytical models and approaches, Relational and non- relational Databases, Application areas, Design and analysis of Analytics model-Analytics design steps, Understanding different data processing models, Statistical models, Predictive models, Descriptive models, Introduction to Data analysisusing R- Basics of R Language, Statistical models in R, Statistical techniques applied using R, Graphical analysis techniques, Practicalexamples/case studies.	**Hours** 20
Unit II	Analytics Using MapReduce, MapReduce design patterns, Clustered Hadoop environment, Advanced HDFS, Graph Algorithms, Searching and Indexing approaches, MapReduce Applications, Introduction to Pig and HIVE- Programming Pig: Engine for executing data flows in parallel on Hadoop, Programming with Hive: Data warehouse system for Hadoop	15
Unit III	Case Studies -Real time stream processing using MapReduce and Rand Text Analytics based on different documents for identifying interesting patterns and correlations	10

References:

1.M. Kantardzic, “Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc.
2. Adriaans, Dolf Zantinge , “Data Mining”, Pearson Education Asia
3. J. Han, M. Kamber, “Data Mining Concepts and Techniques”, Morgan Kaufmann

Semester –V			
Course Code: DSC504	**Course Title: Major Project-1**	**Credits: 3**	**Lectures/Week:3**
	Learning Objective: The object of **Major Project -1** is to enable the student to take up investigative study in the broad field of Computer Science and Engineering , either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. **Course Description:** This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include: **Major Project -1** & Dissertation The object of **Major Project -1** & Dissertation is to enable the student to extend further the investigative ,study either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.		**Hours** 45

Semester –V			
Course Code: DSE5011	**Course Title: Theory of Computation**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

1. Understand Grammar and Languages
2. Learn about Automata theory and its application in Language Design
3. Learn about Turing Machines and Pushdown Automata
4. Understand Linear Bound Automata and its applications

Course Description: To provide the comprehensive insight into theory of computation by understanding grammar, languages and other elements of modern language design. Also to develop capabilities to design and develop formulations for computing models and identify its applications in diverse areas.

Unit I	Automata Theory: Defining Automaton, Finite Automaton, Transitios and Its properties, Acceptability by Finite Automaton, NondeterministicFinite State Machines, DFA and NDFA equivalence, Mealy and MooreMachines, Minimizing Automata. Formal Languges: Defining Grammar, Derivations, Languges generated by Grammar, Comsky Classification of Grammar and Languages, Recursive Enumerable Sets, Operations on Languages, Languages and Automata	15
Unit II	Regular Sets and Regular Grammar: Regular Grammar, RegularExpressions, Finite automata and Regular Expressions, PumpingLemma and its Applications, Closure Properties, Regular Sets and Regular Grammar Context Free Languages: Context-free Languages, Derivation Tree, Ambiguity of Grammar, CFG simplification, Normal Forms,Pumping Lemma for CFG Pushdown Automata: Definitions, Acceptance by PDA, PDA and CFG	15
Unit III	Linear Bound Automata: The Linear Bound Automata Model, Linear Bound Automata and Languages. Turing Machines: Turing Machine Definition, Representations, Acceptability by Turing Machines, Designingand Description of Turing Machines, Turing Machine Construction, Variants of Turing Machine, Undecidability: The Church-Turing thesis, Universal Turing Machine, Halting Problem, Introduction to Unsolvable Problems	15

References:

1) Theory of Computer Science, K. L. P Mishra, Chandrasekharan, PHI,3rd Edition
2) Introduction to Computer Theory, Daniel Cohen, Wiley,2nd Edition
3) Introductory Theory of Computer Science, E.V. Krishnamurthy,Affiliated East-West Press.

Additional Reference(s):

1) Theory of Computation, Kavi Mahesh, Wiley India
2) Elements of The Theory of Computation, Lewis, Papadimitriou, PHI
3) Introduction to Languages and the Theory of Computation, John E Martin, McGraw-Hill Education
4) Introduction to Theory of Computation, Michel Sipser, Thomson

Semester –V			
Course Code: DSE5012	**Course Title: Advanced Machine Learning**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Understand the concepts and characteristics of Big Data. ¬ Explore the Hadoop ecosystem and its components. ¬ Learn query languages such as JAQL and Pig for data processing. ¬ Work with NoSQL databases and analyze data using MongoDB. ¬ Develop data visualization skills for effective analysis. ¬ Use R for scalable analytics and machine learning on Big Data. ¬ Gain practical experience in running MapReduce jobs and managing Hadoop clusters. ¬ Apply Big Data analytics to real-world use cases and scenarios.

Course Description: This course provides a comprehensive introduction to Big Data analytics, focusing on key technologies and tools used for processing, analyzing, and visualizing large datasets. Students will learn the fundamentals of Hadoop, including its components and ecosystem. The course covers query languages such as JAQL and Pig, as well as data visualization techniques for effective analysis. Students will gain practical skills in working with NoSQL databases like MongoDB and using R for scalable analytics. Through a mix of theoretical concepts and hands-on exercises, students will develop the necessary skills to leverage Big Data for informed decision-making and insights.

Unit I	Overview of Big Data Analytics - Introduction to Big Data and its growth story. - Big Data sources and adoption drivers. • Characteristics and Types of Big Data - Defining Big Data and its key characteristics. - Units to measure Big Data and its types. • Benefits and Barriers of Big Data Analytics - Advantages and challenges of Big Data analytics. - Role of Big Data in driving IT industry growth. • Big Data Process and Frameworks - Understanding the Big Data process and frameworks. - Examples of Big Data plaɲorms and applications. • Use Cases and Applications of Big Data - Exploring Big Data use cases across industries. - Big Data in healthcare, transportation, insurance, etc. • IBM's Big Data Success Story - Case study: IBM's utilization of Big Data analytics. - Business drivers and examples of Big Data applications.	**Hours** 10
Unit II	Introdution to Hadoop - Overview of Hadoop and its components. - Hadoop Distributed File System (HDFS) architecture. • MapReduce and MapReduce Jobs - Explaining MapReduce and its components. - Writing and running MapReduce jobs. • HBase and NoSQL Technology - Introducing to HBase and NoSQL databases. - CAP theorem, ACID properties, and HBase features. • Hadoop Ecosystem and Cluster Configuration - Components of the Hadoop ecosystem. - Configuring and managing a Hadoop cluster. • HDFS Commands and Administration - Interacting with HDFS using commands. - Administering HDFS: Health checks, rebalancing, etc. • Introduction to YARN and MapReduce Processing - Understanding YARN architecture and components. - MapReduce job workflow and processing.	15

Unit III	Introduction to JAQL and Pig - Exploring JAQL and Pig for Hadoop analytics. - Executing Pig scripts and basic Pig Latin statements. • JAQL Schema and Data Types - Understanding JAQL schema and data types. - Working with arrays, records, and expressions. • Pig Latin Operators and Functions - Overview of Pig operators and built-in functions. - Using parameter substitution and lazy evaluation. • JAQL I/O Adapters and Data Loading - Working with JAQL I/O adapters for data loading. - Loading data from various sources using adapters. • Hive for Reporting and Analysis - History and components of Hive. - Creating tables, data types, and queries in Hive. • Hive Partitioning, Indexes, and Views - Partitioning, indexing, and creating views in Hive. - Using Hive for reporting and analysis.	10
Unit IV	Introduction to Data Visualization - Importance and value of data visualization in Big Data. - Challenges and considerations in large data visualization. • Types of Data Visualization - Overview of graphs, charts, and network organization. - Selecting appropriate chart types for different data scenarios. • Data Visualization Techniques - Creating various types of visualizations: pie chart, line chart, etc. - Using visualization tools and libraries for Big Data analysis	10

References

1.Hadoop: The Definitive Guide" by Tom White
. 2. "Big Data" by Viktor Mayer-Schönberger and Kenneth Cukier
. 3. "MongoDB: The DefiniΘve Guide" by KrisΘna Chodorow
. 4. "Data Science for Business" by Foster Provost and Tom FawceΣ
. 5. "R in AcΘon: Data Analysis and Graphics with R" by Robert Kabacoff
. 6. "NoSQL DisΘlled:

Semester – V			
Course Code : DSE5013	**Course Title: Cryptography and Cyber Security**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

1. explain the fundamentals of cryptography, such as encryption, digital signatures and secure hashes
2. select appropriate techniques and apply them to solve a given problem
3. design and evaluate security protocols appropriate for a given situation
4. demonstrate an understanding of the mathematical underpinning of cryptography
5. demonstrate an understanding of some legal and socio-ethical issues surrounding cryptography

- **Course Description:** The courses covers the basic terminology, concepts, and standards of cryptography.

Unit I	Introduction to security attacks - services and mechanism - introduction to cryptography -Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion anddiffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.	**Hours** 10
Unit II	Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.	8
Unit III	Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.	6
Unit IV	MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.	8
Unit V	IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.	6

Unit VI	Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems.	7

References:

1. William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI.
2. Wade Trappe, Lawrence CWashington, " Introduction to Cryptography with coding theory", Pearson.

Semester – V			
CourseCode: DSE5021	**Course Title:** Fan Engagement	**Credits: 3**	**Lectures/ Week: 3**

Learning Objectives:

- Students able to learn fan engagement.
- Students able to learn different benefits of fan engagement.

Course Description:

This course will explain the main concepts and best practices of fan engagement, using current methodologies and dealing with examples of real sports institutions.

The environment of the fans and their relationship with sports entities is extremely dynamic and volatile, thecreation of new engagement strategies or the implementation of constant innovations rather than just opportunities is nowadays a must.

To provide the participant with knowledge in the management of the relationship between fans and sportsinstitutions.

This course aims to bring participants closer to the main concepts that are part of fan engagement such as fan identification, fan retention, fan experience, new opportunities for sponsorship or brand image, along with several techniques and best practices to encourage fan engagement both in match day and in non – match day.

- To understand the principles of fan engagement.
- To understand the flow of interests in fan engagement and the consequences in the sport business.
- To know the different benefits of fan engagement.
- To understand the difference and importance between match day & non – match day practices.

Unit 1	Introduction to Fan Engagement. Why fan engagement, principles and rationaleKey Concepts of Fan Engagement. Delivering fan engagement Understanding the Fan. What is a fan, understanding the nature of fandomFan Engagement Strategy. Best practices of Fan Engagement. Leadership: creating and sustaining a culture ofengagement • Actual & Future Trends of Fan Engagement.	10
Unit 2	Sports Marketing Entertainment MarketingCross Country & Cross Industry Innovation in Sports and EntertainmentMarketing	10

Unit 3	Technology to create fan engagementSeroquel: ReliabilityAlertness Attention Certainty TeamQual LEGO Experience Wheel Yoshida Science Article Surveys Censydiam Fan Engagement Scorecard	10
Unit 4	Fan Engagement in Football Factors involved in fan engagementValue of fan engagement Difference in women's events	5
Unit 5	Assess the baseline capacity of the event/organisationIdentify a desired behaviour change Know your audience Understand barriers and benefits Build a behaviour change camping Message development and delivery Capture results – measurement + reportingThe final buzzer Case studies	10

References:

- AI for sports Chris brady, karl tulys, shayegan omid shafei Routledge
- Winning with Data in the business of sports Fiona Green Routledge
- The Use of Applied Technology in Team Sport Jose Pino- Ortega, Markel Rico-González Routledge
- Performance Analysis In Team Sports Pedro Passos, Duarte Araujo, Amma Volossovitch Routledge
- Computer Science in Sport: Arnold Baca Routledge

Semester –V			
Course Code : DSE5022	**Course Title: Consumer Psychology**	**Credits: 3**	**Lectures /Week:3**

Learning Objectives:

- Understand the different frameworks applied to human behavior
- Importance of consumer analysis in developing successful marketing strategies
- Exposure to relevant theories from across the behavioral sciences
- Apply findings to evaluating marketing strategies

Course Description:

- Consumer focus has become an important factor in contemporary business approaches. This makes it even more important for marketing since it is a highly customer-driven function. This course focuses on understanding human behavior – how do they choose, use or evaluate goods and services. The theories in this course are derived to understand human behavior through behavioral sciences.

Unit I	Introduction to Consumer Psychology Motivation and needs of the consumer	**Hours** 3
Unit II	Perception Attention Information Categorization	8
Unit III	Learning and memory Interpersonal influence in marketing and advertising	10
Unit IV	Decision making Consumer decision making Consumption and satisfaction Culture and sub-culture Evaluating marketing strategies and promotions	15
Unit V	Presentations, case studies, live projects	9

References:

- Hoyer, Wayne D., Deborah J. MacInnis, Rick Pieters (2012), Consumer Behavior, 6 th Ed. Houghton Mifflin Co: Boston: MA.
- Cialdini, Robert (2006), Influence: The Psychology of Persuasion, Collins Underhill, Paco (2001)
- Why We Buy: The Science of Shopping, Texere Publishing

Semester – V			
Course Code : DSE5023	**Course Title: Corporate Finance**	**Credits: 3**	**Lectures /Week:3**
Learning Objectives: • Acquire, interpret, and analyze accounting, economic, and financial data to facilitate decision making in corporate and investment environments in both personal and professionalsettings.			
Course Description: This course is designed to critically evaluate corporate finance techniques. It enables the student to be able to take an informed decision in a risky business environment.			
Unit I	Overview of Financial Management Meaning, Objectives, Scope, Role and Functions ofFinancial Management (Financial Decisions) Financial Goal - Profit Maximization versus Shareholders' Wealth Maximization. Time value of Money: (theory andnumerical) Concepts, Compounding, Discounting, Annuities Sources of Long-Term Finance Introduction to Equity Shares, Preference Shares and Debentures, Term loan		**Hours** 10
Unit II	Understanding Dividend Decision Dividend and dividend policy Factors affecting dividend pay-out Dividend payment models: (theory and numerical)		10
Unit III	Cost of Capital: (theory and numerical) Significance, Concept of the Opportunity Cost of Capital Component Costs of Capital - Cost of Debt, Preference Capital and Equity Capital Weighted Average Cost of Capital (WACC) Leverage: (theory and numerical) Types of Leverage - Operating, Financial and Combined Leverage Point of indifference		10

Unit IV	Working Capital Management Concepts of Working Capital Operating Cycle Determinants of Working Capital Estimating Working Capital Needs. (theory and numerical) Working Capital Finance Policies	10
Unit V	Live case studies, presentations, practical assignments	5

References:

- **Prasanna Chandra Financial Management, theory and Practice McGraw - Hill Latest Edition**
- **I M Pandey Financial Management Vikas Latest Edition**
- **M. Y. Khan and P. K. Jain Financial Management McGraw - Hill Latest Edition**

Sem. – VI

BSc. Data Science and Sports Studies
Semester – VI

SEMESTER – VI	CREDITS
COURSE	
CORE	
Social, & Web Analytics	3
Analytics for Industries	3
Distributed Systems	3
Major Project-2	3
SCHOOL ELECTIVES 2/3	
Advanced Statistical Methods	3
Data Mining Techniques	3
Cyber Security	3
SPECIAL ELECTIVES 1/3	
Sports Tourism	3
Sports Entrepreneurship	3
Digital Media and Marketing	3

SEMESTER – VI			
Course Code: DSC601	**Course Title: Social, & Web Analytics**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Understand the importance and impact of social and web analytics in today's digital landscape.
- Learn techniques for collecting, processing, and analyzing social and web data.
- Develop skills in social media monitoring, sentiment analysis, and web traffic analysis.
- Apply social and web analytics techniques to real-world datasets.
- Gain proficiency in using relevant tools and platforms for social and web analytics.

Course Description:

- Social and Web Analytics is a course that focuses on understandingand analyzing data from online sources, including social media platforms and websites.
- The course explores various techniques and tools to extract insights from social and webdata, understand user behavior, and make informed decisions based on the analysis.

Unit I	Social media, Importance of social media, Social media popularity, Benefits of social media, Tools available, Need of using analytics, Social analytics vs web analytics, Web analytics, Terms used by web analytics tools, Types of web analytics, Social and web analytics technical requirements, Social analytics main basic activities, Social media environment, Impact of social media on business, Leverage social media for better services, Current analytics platforms, Open-source vs licensed platforms, Google analytics, IBM social media analytics, Other social and web analytics tools, Choosing right specifications and optimal solution, Measuring variations in user behavior, The diversity of user activities, The origin of the user activity distribution, Long tails everywhere: The 80/20 rule (p/q Rule), User activities on twitter.	**Hours** 10
Unit II	Data collection strategy, Content sharing, Challenges in the social media data collection, Characteristics of people-centric approach, Social graph, Influencers, Community managers, Organizing for social media, Factors that help in applying the model to an organization, Measures to organize the social media for success, Choosing focused data sources and social networks, Collecting and understanding social media data, Social data collection strategy, Facebook social APIs, Best practices for collecting data from social networks, Leverage qualitative data: What, why and how much, How to conduct a lab usability testing, Usability alternatives, Recruiting user research participants with social media, Outsourced online usability, Web-enabled emerging user research options, Online surveys, Types of surveys, Eight tips to choose online survey providers, Types and Properties of Social Networks, Directed Versus Undirected	13

	Graphs, Node and Edge Properties, Visualization Network, The discipline of social media analytics, Collecting data, Performing analysis, Reporting results, Aligning social objectives with business goals, Social media objectives, Developing a waterfall strategy, A SMART methodology, Identify common social business objectives, Developing KPIs, Creating KPI's, Developing KPI's, Basic KPIs, Standard vs critical metrics , Critical web metrics: Bounce rate, Critical web metrics: Exit rate, Critical web metrics: Conversion rate, Critical web metrics: Engagement, Strategically aligned KPIS and tactics to find best web and social metrics, Specific KPIs, Tactics to find the best web and social media metrics, Business goals, Visualizing the social analytics framework, Build scorecards and dashboards to track KPIs, Measuring macro and micro conversions, Quantify economic value, Measuring success for non-ecommerce and B2B websites, Measuring B2B websites.	
Unit III	Managing web and social analytics, Social media analytics, Dashboard, Dashboard: Drill down capabilities, Dashboards in IBM Cognos Consumer Insight (CCI), Types of charts, Drill down to view more details, Sharing insights with dashboards, Relationships, Viewing relationships, Sentiments, Sentiment analysis, Sentiment terms, Evolving topics, Evolving topics: IBM social media analytics, Reports, Social media impact, Segmentation, Discovery, Content creation and tracking, Social media content creation, Issues in content creation, Competitive intelligence analysis, CI data sources and types, Competitor intelligence studies, Website traffic analysis, Analyzing referrals and destinations, Top keywords performance trend, Audience identification and segment analysis, Segmentation analysis, Social media optimization and benefits, Social media enablement audit, Understand signals and potential, Improving social signals, Focus on text and unstructured data, The basics of natural language processing, Modelling: Unsupervised vs supervised.	12

Unit IV	Future of social media analytics and monitoring, , Large volumes of social media, Future of social analytics, Future social media analytics and monitoring, Mashing up data from disparate sources, Integrating customer profile data, True profile, Colliding data sets for big bang ideas, Purchase funnel, Social interactions and web visits, Server response time and help desk tickets, Social media integration and benefits, Integrate solution to share outcome with others, Strategy planning, Benefits of social media integration, Integrating social media into the organization, Integration mode, Social media integration, Goals of integrating social media, Social media integration, Social media services online, Search engines, Content engagement, Interactions: Real world & people, Learning and mapping, Under and over fitting, Regularizing in matrix factorization, Exploratory analysis, Prediction and recommendation.	10

References:

1. The Hundred-Page Machine Learning Book by Andriy Burkov
2. Machine Learning For Absolute Beginners by Oliver Theobald
3. Programming Collective Intelligence by Toby Segaran
4. Machine Learning for Humans by Vishal Maini and Samer Sabri

Lab Exercises –

- Exercise 1. Twitter Data Analysis R
- Exercise 2. What's Happening with 140 Characters R (SHOW WHEN THE TWEETS ARE PUBLISHED)
- Exercise 3. Trend analysis R (SHOW WHEN THE TWEETS ARE PUBLISHED)
- Exercise 4. Sentiment analysis R
- Exercise 5. Follower graph analysis (SHOW THE ACCOUNTS FROM WHICH MOST RETWEETS ORIGINATE)
- Exercise 6. Analyzing Social Networks and Brand Engagements R (SHOW THE MOST FREQUENTLYUSED HASHTAGS)
- Exercise 7. Facebook analyses using R (basis descriptive statistics using own profile)
- Exercise 8. Facebook analyses using R (Finding location and other details of friend's profile)
- Exercise 9. Analyzing English Football Club's brand page engagements
- Exercise 10. Analyzing English Football Club's brand page engagements (Visualizing post counts perpage)
- Exercise 11. Analyzing English Football Club's brand page engagements (Visualizing post counts by post type per page)
- Exercise 12. Analyzing English Football Club's brand page engagements (Visualizing average likes bypost type per page)
- Exercise 13. Analyzing English Football Club's brand page engagements (Visualizing average sharesby post type per page)
- Exercise 14. Analyzing English Football Club's brand page engagements (Visualizing page engagementover time)
- Exercise 15. Analyzing English Football Club's brand page engagements (Visualizing user engagementwith page over time)
- Exercise 16. Analyzing English Football Club's brand page engagements (Trending posts by user likesper page)

- Exercise 17. Google analytics setup
- Exercise 18. Google Analytics - Real-time Operations Google Analytics
- Exercise 19. Google Analytics - Audience Analysis Google Analytics
- Exercise 20. Google Analytics - Acquisition analysis Google Analytics
- Exercise 21. LinkedIn data analysis using R

SEMESTER – VI			
Course Code: DSC602	**Course Title:** Analytics for Industries	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Comprehend the fundamental concepts of Business Analytics and its applications in different
- industry contexts.
- Differentiate between Descriptive, Predictive, Prescriptive, and Cognitive analytics and their
- significance.
- Analyze challenges posed by data volume, variety, and speed in industries, and propose
- effective solutions.
- Appraise the importance of enterprise analytics capabilities and data infrastructure for
- decision-making.
- Apply the IBM Business Analytics Maturity Model to assess an organization's analytics
- readiness.
- Evaluate the role of optimization in enhancing business outcomes within industries.
- Understand the IBM Technology Porŋolio for Business Analytics and its relevance to specific
- industries.

Course Description: This course provides a comprehensive exploration of Business Analytics (BA) across diverse industries, including Banking, Insurance, Telecom, and Healthcare. Through a combination of theoretical insights and practical examples, students will gain a deep understanding of the role of Analytics in addressing industryspecific challenges, Optimizing decision-making processes, and fostering business growth. The course delves into various types of Analytics , thesignificance of a fact-based decision-making culture, and the technologies that drive Analytics -driven transformations in industries.

Unit I	Overview of Business Analytics - Introduction to business Analytics and its significance. - Types of Analytics : Descriptive, Predictive , Prescriptive, Cognitive. • Business Analytics Capabilities and Technologies - Enterprise Analytics capabilities and technologies. - Predictive Analytics , prescriptive Analytics , cognitive Analytics . • Business Analytics Challenges and Approaches - Addressing challenges: Volume, Variety, Speed of Data. - Building a fact-based decision-making culture. - Importance of data infrastructure and analytical tools. • Business Analytics Maturity Model and Optimization - IBM Business Analytics Maturity Model. - Key concepts and importance of optimization. • IBM Technology Porŋolio for Business Analytics - IBM technologies for business Analytics and optimization..	**Hours** 10
Unit II	Banking Industry Overview - Challenges and priorities in the banking industry. • Business Analytics Capabilities for Banking - Enhancing competitiveness using business Analytics . - Examples of actionable insights in banking. • Business Analytics Applications in Banking - Operational efficiency, integrated risk management, customer care. - Payments and securities: Real-world examples. • Business Analytics Maturity Model for Banking - Applying the IBM Business Analytics Maturity Model to banking. • IBM Technology Porŋolio for Banking - IBM solutions and technologies for business Analytics in banking.	13

Unit III	Changes in the Insurance Industry - Evolving challenges and opportunities in insurance. • Business Analytics for Customer Focus - Creating a customer-focused enterprise. - Leveraging customer insight for retention and growth. • Business Analytics for Risk Management - Integrated risk management using Analytics . • Business Analytics for Sales and Claims - Optimizing sales performance and claims process. • IBM Technology Porɳolio for Insurance - IBM solutions and technologies for business Analytics in insurance.	12
Unit IV	Challenges in the Telecom Industry - Addressing challenges in a connected world. • Smarter Analytics for Telecom - Leveraging Analytics for compeӨӨve advantage. • Business Analytics Applications in Telecom - Customer Analytics , marketing optimization, and social media. - Network Analytics for insights and performance. • IBM Technology Porɳolio for Telecom - IBM solutions and technologies for business Analytics in telecom.	10

References:

1. "Analytics in a Big Data World: The EssenӨal Guide to Data Science and its Applications " by Bart Baesens
2. "Big Data Analytics in Banking and Finance" by Gloria Phillips-Wren and Stephanie Teufel2. "Business Analytics for Managers" by Gert H. N. Laursen and Jesper Thorlund
3. "Predictive Analytics : The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel
4. "Big Data Analytics : Turning Big Data into Big Money" by Frank J. Ohlhorst
5. "Predictive Analytics for Insurance" by Eric Siegel
6. "Business Analytics for Telecoms: Building a BeΣer Customer Experience" by Tony Costa and Yves de Montcheuil
7. "Healthcare Analytics for Quality and Performance Improvement" by Trevor L. Strome
8. "Healthcare Analytics : From Data to Knowledge to Healthcare Improvement" by Hui Yang and Walter W. Piegorsch

Lab Exercises –

Exercise 1. Twitter Data Analysis R
Exercise 2. What's Happening with 140 Characters R (SHOW WHEN THE TWEETS ARE PUBLISHED)Exercise 3. Trend analysis R (SHOW WHEN THE TWEETS ARE PUBLISHED)
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Exercise 12. Analyzing English Football Club's brand page engagements (Visualizing average likes by post type per page)
Exercise 13. Analyzing English Football Club's brand page engagements (Visualizing average shares by post type per page)
Exercise 14. Analyzing English Football Club's brand page engagements (Visualizing page engagement over time)
Exercise 15. Analyzing English Football Club's brand page engagements (Visualizing user engagement with page over time)

Exercise 16. Analyzing English Football Club's brand page engagements (Trending posts by user likes per page)
Exercise 17. Google analytics setup
Exercise 18. Google Analytics - Real-time Operations Google AnalyticsExercise 19. Google Analytics - Audience Analysis Google Analytics Exercise 20. Google Analytics - Acquisition analysis
Google Analytics Exercise 21. LinkedIn data analysis using R

<table>
<tr><td colspan="4">Semester – VI</td></tr>
<tr><td>Course Code:
DSC603</td><td>Course Title: Distributed Systems</td><td>Credits: 3</td><td>Lectures/Week:3</td></tr>
<tr><td colspan="4">Learning Objectives:
Upon Completion of the course, the students will be able to
• List the principles of distributed systems and describe the problems and challenges associated with these principles.
• Understand Distributed Computing techniques, Synchronous and Processes.
• Apply Shared Data access and Files concepts.
• Design a distributed system that fulfills requirements with regards to key distributed systems properties.
• Understand Distributed File Systems and Distributed Shared Memory.
• Apply Distributed web-based system.
• Understand the importance of security in distributed systems</td></tr>
<tr><td colspan="4">Course Description:
• This course provides an introduction to the fundamentals ofdistributed computer systems, assuming the availability of facilities for data transmission.</td></tr>
<tr><td>Unit I</td><td colspan="2">Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges. System Models: Introduction, Architectural Models, Fundamental Models.

Time and Global States: Introduction, Clocks Events and Process States, Synchronizing Physical Clocks, Logical Time andLogical Clocks, Global States, Distributed Debugging. Coordination and Agreement: Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication, Consensus and Related Problems.</td><td>Hours

10</td></tr>
<tr><td>Unit II</td><td colspan="2">Inter Process Communication: Introduction, The API for the Internet Protocols, External Data Representation and Marshalling,Client-Server Communication, Group Communication, Case Study: IPC in UNIX. Distributed Objects and Remote Invocation: Introduction,Communication between Distributed Objects, Remote ProcedureCall, Events and Notifications, Case Study: JAVA RMI.</td><td>10</td></tr>
</table>

Unit III	Distributed File Systems: Introduction, File Service Architecture, Case Study 1: Sun Network File System, Case Study 2: The Andrew File System. Name Services: Introduction, Name Services and the Domain Name System, Directory Services, Case Study of the Global Name Services. Distributed Shared Memory: Introduction, Design and Implementation Issues, Sequential Consistency and IVY case study, Release Consistency, Munin Case Study, Other Consistency Models.	14
Unit IV	Transactions and Concurrency Control: Introduction, Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison of Methods for Concurrency Control. Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery.	11

References:

1. Distributed Systems, Concepts and Design, George Coulouris, J Dollimore and Tim Kindberg, Pearson Education, Edition. 2009.
2. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.
3. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor & Fransis Group, 2007.

Semester – VI			
Course Code: DSC604	**Course Title: Major Project -2**	**Credits: 3**	**Lectures/Week:3**

Learning Objective: The object of **Major Project -2** is to enable the student to take up investigative study in the broad field of Computer Science and Engineering , either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include: **Course Description:** **Major Project -2** & Dissertation The object of **Major Project -2** & Dissertation is to enable the student to extend further the investigative ,study either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. **Major Project -2 might be a continuation to Major Project -1 or a fresh separate project for the fulfilment of the degree of Bachelor of Science.**	**Hours** 45

Semester – VI			
Course Code: DSE6011	**Course Title: Advanced Statistical Method**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- To understand the concept of distribution.
- To understand the mean, variance, moment generation functions.
- To understand the concept of distribution, Estimation-Unbiasedness

Course Description: The course covers the topics of advanced statistical methods.

Unit I	Theoretical distributions, Discrete distribution, Uniform-mean, variance, moment generating functions	Hours 5
Unit II	Binomial-mean, variance, moment generating functions and fitting of data.	6
Unit III	Poisson-mean, variance, moment generating functions and fitting of data, Continuous distribution. Normal distribution-important properties (without proof) of the distribution, mean, variance, moments, mgf. M.D. and Q.D Area under the normal curve-related problems. Definition, Statistic, Parameter, Standard Error	9
Unit IV	Sampling Distributions of Mean of the sample from Normal population and distribution of Variance(form alone)	7
Unit –V	$\chi 2$ distribution(without derivation), properties, Interrelationships. t distribution(without derivation), properties, Interrelationships. F distribution(without derivation),properties.Interrelationship of$\chi 2$,t, F distributions, Estimation of parameters, Point Estimation	9
Unit -VI	Properties of Estimation-Unbiasedness, Properties of Estimation-Efficiency, Properties of Estimation- Consistency, Properties of Estimation- Sufficiency, Interval estimation for mean, variance of normal population and proportion of binomial population	9

Reference

1. Understanding Advanced Statistical Methods (Chapman & Hall/CRC Texts in Statistical Science)

Semester – VI			
Course Code: DSE6012	**Course Title: Data Mining Techniques**	**Credits: 3**	**Lectures/Week:3**

Learning Objectives:

- Be familiar with mathematical foundations of data mining tools.
- Understand and implement classical models and algorithms in data warehouses and data mining
- Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

Course Description: This course will introduce the concepts of data ware house and data mining, which gives a complete description about the principles, used, architectures, applications, design and implementation of data mining and data ware housing concepts**.**

Unit I	Overview of Data warehousing Strategic information and the need for Data warehousing, Defining a Data warehouse, Evolution of Data warehousing, Data warehousing and Business Intelligence	**Hours** 4
Unit II	The Building Blocks of Data warehouse Defining features - Subject- oriented data, Integrated data, Time-variant data, Nonvolatile data, Data granularity Data warehouses and Data marts Architectural Types - Centralized, Independent data marts, Federated, Hub-and-Spoke, Data mart bus Overview of components - Source Data, Data Staging, Data Storage, Information Delivery, Metadata, and Management and Control components	6
Unit III	Business Requirements and Data warehouse Dimensional nature of Business data and Dimensional Analysis, Dimension hierarchies and categories, Key Business Metrics (Facts), Requirement Gathering methods and Requirements Definition Document (contents) Business Requirements and Data Design - Structure for Business Dimensions and Key Measurements, Levels of detail Business Requirements and the Architecture plan Business Requirements and Data Storage Specifications Business Requirements and Information Delivery Strategy	5
Unit IV	Data warehouse Architecture and Infrastructure Architectural components Concepts of Data warehouse architecture - Definition and architecture in the areas of Data acquisition, Data storage, and Information delivery Distinguishing characteristics - Different objectives and scope, Data content, Complex analysis for faster response, Flexible and Dynamic, Metadata-driven etc Architectural Framework - supporting flow of data, and the Management and Control module Technical architecture - Data acquisition, Data storage, and Information delivery Overview of the components of Architectural	5

Unit V	Infrastructure for Data warehousing Distinction between architecture and infrastructure, Understanding of how data warehouse infrastructure supports its architecture Components of physical infrastructure, Hardware and Operating systems for data warehouse, Database Software, Collection of Tools, Data warehouse Appliances - evolution and benefits	5
Unit VI	The role of Metadata Understanding the importance of Metadata Metadata types by functional areas - Data acquisition, Data storage, and Information delivery Business Metadata - overview of content and examples Technical Metadata - overview of content and examples Metadata Requirements, Sources of Metadata, Metadata management - challenges, Metadata Repository, Metadata integration and standards	5
Unit VII	Principles of Dimensional Modeling Data Design - Design decisions, Basics of Dimensional modeling, E-R modeling versus Dimensional modeling The STAR schema - illustration, Dimension Table, Fact Table, Factless Fact Table, Data granularity STAR schema keys - Primary, Surrogate, and Foreign Advantages of the STAR schema, STAR schema Examples	5
Unit VIII	Data Quality Importance of data quality, Challenges for data quality, Data quality tools, Data cleansing and purification, Master Data Management . Matching information to classes of users Information from Data warehouse versus Operational systems, Users of information - their needs and how to provide information Information delivery - queries, reports, analysis, and applications Information delivery tools - Desktop environment, Methodology and criteria for tool selection, Information delivery framework, Business Activity Monitoring, Dashboards and Scorecards	5
Unit IX	OLAP in Data warehouse Overall concept of Online Analytical Processing (OLAP), OLAP definitions and rules, OLAP characteristics Major features and functions of OLAP - General features, Dimensional analysis, Hypercubes, Drill Down and Roll Up, Slice and Dice, Rotation, Uses and Benefits Familiarity with OLAP models - Overview of variations, MOLAP, ROLAP, HOLAP, DOLAP, Database OLAP, Web OLAP Data Mining Overview of Data mining - Definition, Knowledge Discovery Process (Relationships, Patterns, Phases of the process), OLAP versus Data mining Some aspects of Data mining - Association rules, Outlier analysis, Predictive analytics etc) Concepts of Data mining in a Data warehouse environment Major Data Mining techniques - Cluster Detection, Decision Trees, Memory-based Reasoning, Link Analysis, Neural Networks, Genetic Algorithms etc Data Mining Applications in industry - Benefits of Data mining, Discussion on applications in Customer Relationship Management (CRM), Retail, Telecommunication, Biotechnology, Banking and Finance etc	5

References:

1. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India

Semester – VI			
Course Code: DSE6013	**Course Title: Cyber Security**	**Credits: 3**	**Lectures/Week: 3**
Learning Objectives: • To understand the concept of attacks, encryptions • To understand the concept of threats, threat management • To understand authorization and authentication			
Course Description: The course covers the concept of cyber security including threat, threat management and authentication and authorization.			
Unit I	Introduction: Security threats - Sources of security threats- Motives - Target Assets and vulnerabilities – Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers, Insider threats, Cyber crimes. Network Threats: Active/ Passive – Interference – Interception –Impersonation – Worms –Virus – Spam's – Ad ware - Spy ware – Trojans and covert channels – Backdoors – Bots – IP, Spoofing - ARP spoofing - Session Hijacking - Sabotage-Internal treats Environmental threats - Threats to Server security.	**Hours** 10
Unit II	Security Threat Management: Risk Assessment - Forensic Analysis - Security threat correlation –Threat awareness - Vulnerability sources and assessment- Vulnerability assessment tools – Threatidentification - Threat Analysis - Threat Modeling - Model for Information Security Planning.	15
Unit III	Security Elements: Authorization and Authentication - types, policies and techniques – Securitycertification - Security monitoring and Auditing - Security Requirements Specifications – Security Policies and Procedures, Firewalls, IDS, Log Files, Honey Pots	15
Unit IV	Access control, Trusted Computing and multilevel security - Security models, Trusted Systems,Software security issues, Physical and infrastructure security, Human factors – Security awareness,training , Email and Internet use policies.	5

References:

1. Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press, 2004.
2. William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”,Prentice Hall, 2008.
3. Joseph M Kizza, “Computer Network Security”, Springer Verlag, 2005
4. Thomas Calabres and Tom Calabrese, “Information Security Intelligence: Cryptographic Principles & Application”, Thomson Delmar Learning, 2004.

Semester – VI			
Course Code: DSE6021	**Course Title:** Sports Tourism	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

Define sports tourism and differentiate it from traditional tourism models.

1. Analyze the motivations and characteristics of sports tourists, including participants, spectators, and event enthusiasts.
2. Evaluate the various forms of sports tourism, such as attending major sporting events, participating in recreational activities at a destination, or visiting sports heritage sites.
3. Critically assess the economic impact of sports tourism on host destinations, including job creation, infrastructure development, and revenue generation.
4. Develop strategies for promoting sports tourism destinations, utilizing effective marketing and communication channels.
5. Analyze the social and cultural impact of sports tourism, considering its potential to foster cultural exchange, build community spirit, and promote healthy lifestyles.
6. Evaluate the environmental impact of sports tourism events and infrastructure, exploring strategies for sustainable practices and responsible resource management.
7. Assess the role of technology in facilitating sports tourism experiences, including travel booking, event ticketing, and information dissemination.
8. Develop a comprehensive marketing plan for attracting a specific sports tourism segment to a chosen destination.
9. Critically analyze case studies of successful (and unsuccessful) sports tourism initiatives.

Course Description:

This course explores the dynamic intersection of sports and tourism, examining how these two powerful industries interact and influence each other. Students will delve into the motivations of sports tourists, the various types of sports tourism experiences, and the economic, social, and environmental impacts of this growing phenomenon. The course will equip students with the knowledge and skills to develop innovative strategies for marketing destinations, managing sporting events, and fostering sustainable growth within the sports tourism sector.

Unit I	Introduction to Sports Tourism Tour Operations Management Event and Logistics Psychosocial Aspects of Sports and Exercise Economic Scale of the Sports Industry Foreign Language Destination Management	**Hours**
Unit II	Tourism Marketing Cultural Tourism Tourism Transportation Itinerary Preparation and Tour Packaging Forex Management - Financial Management	

Unit III	Recreational Tourism Tourist Behaviour and Cross-Cultural Management Tour Leadership and Management Technology Integration in Tourism Sports Tours, Sports Theme Parks, Sports Museums Sports Hall of Fame	
Unit IV	Study Tour Reports Summer Training Reports Computer and Management Information Systems Integration Ticketing and Packages – Olympics, Wimbledon, Football	
Unit V	Practicals Itinerary Drafting - Prepare the itenerary for FIFA U-17 Womens world cup to be held in India. The itenerary should be for one of the visiting teams. Essay Writing - Write an essay on the impact of sports on the tourism of a country. Use the example of Sri Lanka as a country. Guest Lecture - Sports Tourism Marketing Study Tour - The students will visit 2 different sports associations and study how a state level / national level tournament preparation is done.	
References: 1.Sport Tourism: Interrelationships, Impacts and Issues by James Higham and Tom Hinch 2. Understanding Sport Tourism: Concepts, Theory and Practice by Heather J. Gibson and Daniel C. Funk		

Semester – VI			
Course Code: DSE6022	**Course Title:** Sports Entrepreneurship	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

- Identify the skills and knowledge base needed to foster entrepreneurial activity for individuals based on the experiences of successful sports entrepreneurs as well as assess and discuss the challenges they have faced.
- Critically discuss ways in which entrepreneurial-minded individuals can thrive in large sports organisations despite the tendency of such organisations to resist innovation and to favour the status quo or only seek marginal gains.
- Demonstrate an understanding of, and identify, new opportunities and translate them into viable business solutions or opportunities.

Course Description:

This module aims to develop, evaluate and critique entrepreneurial skills within the context of launching new products or services in the sport industry. It will also be of benefit for entrepreneurs who are looking to flourish within existing organisations.

Unit I	Nature and Importance of Entrepreneurship and mind set, intentions of corporate entrepreneurship. Types of Entrepreneurships Sport as a catalyst for Entrepreneurs in Sport Characteristics of individual entrepreneurs in sport Entrepreneurialism within large sporting Organisations	**Hours**
Unit II	Identifying opportunities for innovation in sport Structuring the sports start-up Funding and resourcing a sports start-up	
Unit III	Managing growth and existing within the sports industry Generating and exploiting new entries, and creativity and the business idea Domestic and International opportunities and legal issues Business Plan, and Marketing plan Organizational Plan, Financial Plan Sources of Capital, and informal risk capital, venture capital and going public Strategies for growth and accessing resources for growth from external sources Succession planning and strategies for harvesting and ending the Venture	

Unit IV	Business Plan Online Sports Entrepreneurship Magazine	
Unit V	Practical Guest Lecture - Identifying opportunities for innovation in sport Movie Review - 22 Yards, Million Dollar Arm Preparation of business plan - Prepare a business plan for a new business start up idea in the field of sports. Presentation - Present any one successful business model in the e-sports industry.	

Semester – VI			
Course Code: **DSE6023**	**Course Title:** Digital Media and Marketing	**Credits: 3**	**Lectures/Week: 3**

Learning Objectives:

On successful completion of the module, the student should be able to:

- Evaluate the theory pertaining to issues in sports promotion and sponsorship and formulate appropriate communication strategies within a sport industry setting, for a team or product.
- Explain the fundamental concepts and processes of marketing promotion and communication in sport and evaluate the role of social media in the promotion of sports.
- Explain and evaluate different types of sports promotion and communication strategies with emphasis on sport sponsorship and social media and the targets they are relevant for.

Course Description:

Sports promotion, through sports sponsorship and marketing communications, has increased in importance over the last few years due to the need to create revenues and to disconnect from state funded sources. The module concentrates primarily on the objectives of marketing communication of brands (that can refer to products, teams, venues and athletes) that invest in sport promotion and the strategies and tools to achieve these objectives. The approach combines the advancement of new methods of promotion through traditional offline methods and digital methods with emphasis to social media to attract participants (athletes), buyers (fans) and sponsors.

Unit I	Overview of principles of marketing and communication as they relate to the sports industry - Target audiences (consumers, athletes, businesses) - Sports integrated communication - Sports Sponsorship - Sports web marketing - Social media marketing - Design and implementation of campaigns What is sports marketing? Sports Marketing: differences and similarities with other marketing	**Hours**

Unit II	Fundamentals of Digital Marketing and Advanced SEO - Pay-per-click (PPC) - Web Analytics - Digital Marketing Capstone Project Social Media Marketing - Facebook - YouTube - Website - Instagram - Snap chat/Tiktok/Takatak - Weibo - LinkedIn Affiliate and Influencer Marketing Email Marketing	
Unit III	Value: sponsorship, partnership and dynamic ticket pricing Sports Communication: Press Releases, Media Relations, Public Relations - SEO Optimization - Introduction to CRM - Competitor and Website Analysis - Market Research and Niche Potential - Content Creation, Management and Promotion - Introduction to Web Analytics - Mobile Marketing - Social Media Marketing - Digital Marketing Budgeting, Planning and Forecast - Digital Marketing Project Management - Product Marketing (Facebook, Instagram, Google Ads) - Website Data Analytics - Paid Ads Optimization Strategies - Neuro-Marketing Fundamentals	

References:

MATERIAL

- Lagae, W. (2005) Sports Sponsorship and Marketing Communications: A European Perspective. Essex, UK: Pearson Education Limited.
- Newman, T., Peck, J. & Harris C. (2013) Social Media in Sport Marketing, Scottsdale, AZ: Holcomb HathawayPublishers.

RECOMMENDED READING :

A. Books

- Pelsmacker, P., Geuens, M. & van den Bergh, J. (2007) Marketing Communications: A European perspective, 4th Edition, Essex, UK: Pearson Education Limited.
- Shank, M. (2008) Sports Marketing: A Strategic Perspective, 4th Edition, Upper
  Saddle River, NJ: Pearson.
- Shilbury, D., Westerbeek, H., Quick, S. & Funk, D. (2009) Strategic Sport Marketing,Crows Nest, AU: Allen and Unwin.

B. Articles

An
- Ferrier, S., Waite, K. & Harrison, T.(2013) “Sports sponsorship perceptions: exploration”, Journal of Financial Services Marketing, 18(2), 78-90.
- Farrelly, F.(2010)“Not PlayingtheGame: WhySportSponsorship Relationships Break Down”, Journal of Sport Management, 24(3), 319-337.
- Hutchins, B.& Rowe, D.(2010) “Reconfiguring Media Sport for the Online World: An Inquiry Into "Sports News and Digital Media"”, International Journal of Communication, 4, 696-718.
- Moore, A. J. (2011) “Go for the goal: How pro sports teams score with social media”, Public Relations Tactics, 18(3), 11.
- Pronschinske, M., Groza, M. & Walker, M. (2012) “Attracting Facebook Fans': The Importance of Authenticity and Engagement as a Social Networking Strategy for Professional Sport Teams”, Sport Marketing Quarterly, 21(4), 221- 231.
- Price, J., Farrington, N. & Hall, L. (2013) “Changingthe game? The impact of Twitter on relationships between football clubs, supporters and the sports media”, Soccer & Society, 14(4), 446-461.
- Schultz, B. & Sheffer, M. (2011) “Factors Influencing Sports Consumption in the Era of New Media”, Web Journal Of Mass Communication Research, 37. Retrieved from http://www.scripps.ohiou.edu/wjmcr/vol37/.

C. Web Resources

- Journal of Sports Management www.nassm.com
- Journal of Sports Management and Marketing www.inderscience.com
- Journal of Sports Marketing and Sponsorship www.imrpublicorshipations.com
- North American Association of Sports Management www.nassm.com
- Sport Marketing Quarterly www.marketingpower.com
- European Association of Sport Management www.easm.net
- Sport Marketing Association www.sportmarketingassociation.net

Evaluation Scheme

Continuous Assessment (C.A.) -
C.A. – I: Test – Rubric to assess
C.A. – II:

Organization and Development of Ideas	Analysis and Evaluation

Semester End Examination (SEE) -
Passing marks shall be 45% for all subjects compulsorily.

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