University of Mumbai

Website - mu.ac.in
Email id - dr.aams@fort.mu.ac.in
aams3@mu.ac.in

Academic Authorities,
Meetings & Services (AAMS)
Room No. 128, M. G. Road, Fort,
Mumbai – 400 032.
Tel. 022-68320033

Re- accredited with A ++ Grade (CGPA 3.65) by NAAC
Category- I University Status awarded by UGC

No. AAMS_UGS/ICC/2024-25/251 Date :24th March, 2025.

CIRCULAR

Sub : B.Sc. (Data Science and Sports Studies) (Three year) (Sem I & II)

All the Principals of the Affiliated Colleges, Head of the University Departments and Directors of the recognized Institutions under Faculty of Interdisciplinary Studies are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Sports Management at its meeting held on 22nd March, 2024, and subsequently passed by the Board of Deans at its meeting held on 10th July, 2024 vide Item No. 8.7(N) have been accepted by the Academic Council at its meeting held on 12th July, 2024, vide Item No.8.7(N) and subsequently approved by the Management Council at its meeting held on 12th September, 2024, vide Item No.6 and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) the following program with Ordinance for Title of the Program, Eligibility and Regulation numbers for Duration of Program, Intake Capacity, Scheme of Examinations, Standard of Passing and Credit Structure along with syllabus of B.Sc (Data Science and Sports Studies) (Sem I & II) as per appendix have been introduced and the same have been brought into force with effect from the academic year **2024-25**.

Sr. No	Name of the Program me	Ordinance no. for Title	Ordinance no. for Eligibility
A	U.G. Certificate in Data Science and Sports Studies (One year)	O.IMU – 523 A	O.IMU – 524 A
B	U.G. Diploma in Data Science and Sports Studies (Two year)	O.IMU – 523 B	O.IMU – 524 B
C	B.Sc.(Data Science and Sports Studies) (Three year)	O.IMU – 523 C	O.IMU – 524 C
D	B.Sc. (Honors) Data Science and Sports Studies (Four year)	O.IMU – 523 D	O.IMU – 524 D
E	B.Sc.(Honors with Research) Data Science and Sports Studies (Four year)	O.IMU – 523 E	O.IMU – 524 E

2/-

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Regulation Nos	
Duration	R. IMU - 556
Intake Capacity	R. IMU - 557
Scheme of examination	R. IMU - 558
Standard of Passing	R. IMU - 559
Credit Structure	R. IMU - 560 A
	R. IMU - 560 B
	R. IMU - 560 C
	R. IMU - 560 D
	R. IMU - 560 E
	R. IMU - 560 F

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

(Dr. Prasad Karande)
REGISTRAR

MUMBAI – 400 032
24th March, 2024

A.C/8.7 (N)/12/7/2024.
M.C/6/12/09/2024.

****

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 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, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,
8) The Co-ordinator, MKCL

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,** **Dean** 1. Prof.Anil Singh Dranilsingh129@gmail.com **Associate Dean** 2. Dr.Suchitra Naik Naiksuchitra27@gmail.com 3.Prof.Manisha Karne mkarne@economics.mu.ac.in
	Faculty of Commerce & Management, **Dean** 1. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in **Associate Dean** 2. Dr.Ravikant Balkrishna Sangurde Ravikant.s.@somaiya.edu 3. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology **Dean** 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in **Associate Dean** 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, **Dean** 1.Dr. Anil K. Singh aksingh@trcl.org.in **Associate Dean** 2.Prin.Chadrashekhar Ashok Chakradeo cachakradeo@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 – 12/07/2024
Item No. – 8.7 (N)

As Per NEP 2020

University of Mumbai

Title of the program

A- U.G. Certificate in Data Science and Sports Studies
B- U.G. Diploma in Data Science and Sports Studies
C- B.Sc. (Data Science and Sports Studies)
D- B.Sc. (Hons.) in Data Science and Sports Studies
E- B.Sc. (Hons. with Research) in Data Science and Sports Studies

Syllabus for

Semester – Sem I & II

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2024-25 Progressively)

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O: IMU-523A**	**A**	**U.G. Certificate in Data Science and Sports Studies**
	O: IMU-523B	**B**	**U.G. Diploma in Data Science and Sports Studies**
	O: IMU-523C	**C**	**B.Sc. (Data Science and Sports Studies)**
	O: IMU-523D	**D**	**B.Sc. (Hons.) in Data Science and Sports Studies**
	O: IMU-523E	**E**	**B.Sc. (Hons. with Research) in Data Science and Sports Studies**
2	**Eligibility:** **O: IMU-524A**	**A**	Passed 10+2 standard with 45 % with mathematics as a core /elective subject Marks scheme of any recognized State/Central/International Board
	O: IMU-524B	**B**	Under Graduate Certificate in Data Science and Sports Studies Academic Level 4.5
	O: IMU-524C	**C**	Under Graduate Diploma in Data Science and Sports Studies Academic Level 5.0
	O: IMU-524D	**D**	Bachelors of Science in Data Science and Sports Studies with minimum CGPA of 7.5 Academic Level 5.5
	O: IMU-524E	**E**	Bachelors of Science in Data Science and Sports Studies with minimum CGPA of 7.5 Academic Level 5.5
3	**Duration of program** **R: IMU-556**	**A**	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years
4	**Intake Capacity** **R: IMU-557**	**60 (Sixty)**	
5	**Scheme of Examination** **R: IMU-558**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	

6	**Standards of Passing** **R: IMU-559**	40%	
7	**Credit Structure** **Sem. I - R: IMU-560A** **Sem. II - R: IMU-560B**	Attached herewith	
	Credit Structure **Sem. III - R: IMU-560C** **Sem. IV - R: IMU-560D**		
	Credit Structure **Sem. V - R: IMU-560E** **Sem. VI - R: IMU-560F**		
8	**Semesters I & II**	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
		D	Sem VII & VIII
		E	Sem VII & VIII
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5
		D	6.0
		E	6.0
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2024-25	

Sign of the BOS Chairman
Name of the Chairman:-
Name of the BOS :- Sports Science & Management

Sign of the Dean
Name of the Dean :- Dr A.K. Singh
Name of the Faculty:- Faculty of Interdisciplinary Studies

Preamble

1) Introduction

Data Science refers to extraction of knowledge from large volumes of data that are structured or unstructured, which is continuation of data mining and predictive analytics. It involves different categories of analytical approaches for modelling various types of business scenarios and arriving at solution and strategies for optimal decision-making in marketing, finance, operations, organizational behavior and other managerial aspects.

This new field of study breaks down into a number of different areas, from constructing big data infrastructure and configuring the various server tools that sit on top of the hardware, to performing the analysis and developing the right transformations to generate useful results. Data Science is an interdisciplinary field that combines the magic of programming, mathematics and business. Combined with Machine Learning, it helps to identify a future trend which can be used to derive actionable insights for creating future impact. These skills will help for the role of a Data Scientist.

As a Data Science aspirant, learner will be emphasizing of the knowledge to share from the quantitative analysis to programming concept and extended to business intelligence. Data science can add value to any business which can use the data well.

Data Science consists of 3 parts namely:

Machine Learning: Machine Learning involves algorithms and mathematical models, chiefly employed to make machines learn and prepare them to adapt to everyday advancements.

Big Data: Everyday, we are producing so much of data in the form of clicks, orders, videos, images,comments, articles, RSS Feeds etc. These data is generally unstructured and is often called as Big Data. Big Data tools and techniques mainly help in converting this unstructured data into a structured form.

Business Intelligence: Each business has and produces too much data every day. This data when analyzed carefully and then presented in visual reports involving graphs, can bring good decision making to life. This can help the management in taking the best decision after carefully delving into patterns and details the reports bring to life.

What Does a Data Scientist Do?

- Empower the management and controlling officers to make better decisions
- Direct actions based on trends, which in turn help to define new goals
- Identify opportunities
- Making decisions with quantifiable, data-driven evidence
- Test the decisions taken
- Identify and refine the target audiences
- Recruit the right talent for the organization

2) Aims and Objectives:

Below are the some of the Aims and Objectives of Data Science:

- **Extracting Insights**: Uncover valuable patterns, trends, and correlations from data to gain actionable insights.
- **Predictive Modeling**: Develop models to forecast future outcomes based on historical data, aiding in decision-making and planning.
- **Optimizing Processes:** Identify inefficiencies and streamline workflows to improve operational efficiency and productivity.
- **Improving Decision-Making:** Enable data-driven decision-making across various domains and functions within organizations.
- **Personalization:** Create personalized experiences for customers by understanding their preferences and behaviors.
- **Risk Management:** Identify and mitigate risks, fraud, and anomalies within datasets using predictive analytics and anomaly detection techniques.
- **Innovation:** Foster innovation by leveraging data insights for product development, market analysis, and optimization.
- **Business Intelligence:** Transform raw data into actionable intelligence through data visualization, dashboards, and reporting.
- **Continuous Improvement:** Facilitate continuous learning and improvement through iterative data analysis and model refinement.
- **Ethical Data Use:** Ensure ethical data practices, data privacy, transparency, and fairness in decision-making processes.

3) Learning Outcomes:

- Build a strong foundation of statistics for Data Science.
- Use all the features and new updates of Python and R for Data Science.
- Perform scientific and technical computing using the Python SciPy package and its sub packages Integrate, Optimize, Statistics, IO, and Weave.
- Gain expertise in mathematical computing using the NumPy and Scikit-Learn package.
- Gain an in-depth understanding of Data Structure and Data Manipulation
- Understand and use linear and non-linear regression models and classification techniques for data analysis.
- Obtain a comprehensive knowledge of supervised and unsupervised learning models such as linear regression, logistic regression, clustering, dimensionality reduction, K-NN and pipeline.
- Master the concepts recommendation engine, time series modelling, and gain practical mastery over principles, algorithms, and applications of Machine Learning.
- Learn to analyze data using Tableau and Power BI and become proficient in building interactive dashboards.
- Understand deep reinforcement learning techniques applied in Natural Language Processing.
- Understand the different components of the Hadoop ecosystem and learn to work with HBase, its architecture and data storage, learning the difference between HBase and RDBMS, and use Hive and Impala for partitioning.
- Understand Map Reduce and its characteristics and learn how to ingest data using Sqoop and Flume.

4) Credit Structure of the Program (Sem I, II, III & IV) (Table as per Parishisht 2 with sign of HOD and Dean)

Under Graduate Certificate in Data Science and Sports Studies.

	R:_____A								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
4.5	I	Python Programming (4 credits), Data Structures and Algorithm(2 credits)		-	2+2	Problem Solving through Programming(SEC) (2 credits), Mathematics I for Intelligent Systems (VSC) (2 credits)	AEC:2, VEC:2,IKS:2 Choose from University Basket	CC:2	22	**UG Certificate 44**
	R:_____B									
	II	Mathematics II for Intelligent Systems(2 credits), Introduction to Data Analytics (4 credits)		2	2+2	Database Management System (2 credits) Operating Systems (2 credits)	AEC:2, VEC:2	CC:2	22	
	Cum Cr.	12	-	2	8	4+4	4+4+2	4	44	

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Majorand Minor

Under Graduate Diploma in _____

	R:_____C								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC,RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
5.0	III	Data Warehousing and Multidimensional Modelling (4 credits), Software Engineering (4 credits)		4	2	Discrete Mathematics(2 credits),	AEC:2	FP: 2 CC:2	22	**UG Diploma 88**
	R:_____D									
	IV	Descriptive Analytics (4 credits), Machine Learning (4 credits)		4	2	R Programming (2 credits),	AEC:2	CEP: 2 CC:2	22	
	Cum Cr.	28		10	12	6+6	8+4+2	8+4	88	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continuewith Major and Minor

B.Sc. Data Science and Sports Studies

	R:_____E								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC,RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
5.5	V	Predictive Analytics (4 credits), Big Data Analytics (4 credits) Natural Language Processing (2 credits)	4	4		Distributed Systems (2 credits		FP/CEP:2	22	**UG Degree 132**
	R:_____F									
	VI	Social And Web Analytics (4 credits), Analytics for Industries (4 credits) Design and Analysis of Algorithms(2 credits),	4	4				OJT :4	22	
	Cum Cr.	48	8	18	12	8+6	8+4+2	8+6+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Sem. - I

Syllabus
B.Sc. (Data Science and Sports Studies)
(Sem.- I)

Semester I

Sr. No.	Subjects	Subject Type	Code	Credits	Internal	External	Total
1	Python Programming	Major	TIMUDSS1SCE3	4	40	60	100
2	Data Structures and Algorithm	Major	TIMUDSS2SCE3	2	20	30	50
4	Problem Solving through programming	SEC	TIMUSSS1SCE2	2	20	30	50
5	Mathematics I for Intelligent System	VSC	TIMUDSS1C1	2	20	30	50
	Total			**10**			250

Name of the Course: Python Programming

Sr. No.	Heading	Particulars
1	**Description the course :**	• This introductory course in Python programming provides a solid foundation for beginners who want to learn one of the most popular and versatile programminglanguages. Python is widely used in various fields such as web development, data analysis, machine learning, and scientificcomputing. • The course aims to equip students with essential programming concepts and skills using Python as the primary language.
2	**Vertical :**	Major
3	**Type :**	Theory Practical
4	**Credit**:	4 credits
5	**Hours Allotted :**	75 Hours
6	**Marks Allotted**:	100 Marks
7	**Course Objectives**: • To learn how to use lists, tuples, and dictionaries in Python programs. • To learn how to identify Python object types. • To learn how to use indexing and slicing to access data in Python programs. • To define the structure and components of a Python program. • To learn how to write loops and decision statements in Python.	
8	**Course Outcomes**: • To learn how to write functions and pass arguments in Python. • To learn how to build Python modules for reusability. • To learn how to read and write files in Python. • To learn how to design object-oriented programs with Python classes.	
9	**Unit I: (6 Hours)** Introduction to programming languages, Python as a programming language, History of python, Python versions, Python installation, Environmental variables, Environmental variables in Windows operating system, Add python to Windows path, Executing python from the command line, Invoking python IDLE, Python documentation, Getting help, Dynamic types, Python reserved words, Naming conventions, Character set, Comments, Identifiers, Data types, Operators, Assigning values to variables, Type conversions, String methods, Simple output, Output formatting with “format”, Simple input: Input function, Mutable vs immutable objects in python, Lists: Create and access, Lists: Modify andslice, Lists: Operations, Lists: Methods, Sets: Create and operations, Sets: Operators and methods, Sets: Frozenset, Sets: Methods, Tuples: Create and access, Tuples: Slice and alteration, Dictionaries: Create and access, Dictionaries: Modify and delete, Dictionaries: Methods, Copying collections: Shallow, Copying collections: Deep.	

	Unit II (6 Hours) : Indenting requirements, Control statements, Decision making statement: If statement, If statement, If-else statement, Implementation, If-elif-else statement, Implementation, Decision making statement: Nested if-else statement, Nested if-else statement, Implementation, Iteration statements: While loop, While loop, Implementation, Iteration statements: While loop with else, While loop with else, Implementation, Iteration statements: For loop, For loop, Implementation, For loop range function with else, Implementation, For loop with object sequences, Nested for loops, Implementation, Break statement, Implementation, Continue statement, Implementation, Functions, Functions: Built in functions, Functions: User- defined functions, Calling a function, Returning a value from the function, Implementation, Scope or lifetime of variables, Creation and usage of global variables, Creation and usage of nonlocal variables, Passing collections to a function, Variable number of arguments, Implementation, Keyword arguments, Optional parameters, Default parameters, Nested functions, Recursive functions, Advantage and disadvantage, Passing functions to a function, map() function, filter() function, Lambda functions
	Unit III (7 Hours) : Object-oriented programming concepts, Class and object, Abstraction and encapsulation, Inheritance, Polymorphism, Classes in Python, Creating objects: Instance methods, Implementation, Memory management, Constructors, Constructors with parameters, Optional parameters in constructor, Deleting attributes and objects, Special methods, Class variables, Inheritance, Accessing base class element in derived class, Single inheritance, Multi-level inheritance, Multiple inheritance, Method Resolution Order (MRO), Access modifiers, Polymorphism, Operator overloading, Method overloading, Method overriding, Python errors: Syntax errors, Built-in exceptions, Exception handling, Simple exceptions, Multiple exceptions, Using else and finally, Raise an exception, Assert statement, Data streaming and buffering: Serial data, I/O streams and buffers, Access modes, File open, File close, Exceptions in file, Writing to files, Reading from files, seek() and tell() methods, readline() and readlines() methods, Renaming and deleting files.
	Unit IV (10 Hours) : Modules, Modularization, Abstraction versus modularization, Modules in Python, Using modules in Python code, Import statement variances, Module search path, Loading and reloading of modules, dir() function, Python built- in modules: sys, Python built-in modules: math, Methods in module math, Python built-in modules: datetime, Python built-in modules: random, Regular expressions, Special sequences, Character classes in RegEx, Regular expression methods, Implementation, re.split(), Implementation, re.sub(), Implementation, re.subn(), re.search(), re.compile(), Implementation, Match object, Implementation, Raw string with “r” or “R” prefix, RegEx quantifiers, RegEx greedy match, RegEx non- greedy match, Greedy vs non-greedy match, RegEx flags
	Unit V (7 Hours) : Abstract data structures, Primitive data structure, Non-primitive data structures, List comprehensions, Accessing elements, Performing operations, Comprehension using If, Comprehension If-else, Nested list comprehensions, Dictionary comprehensions, Accessing elements, Performing operations, Comprehension using zip(), Comprehension for lambda functions, Nested dictionary comprehensions or dictionaries with compound values, Processing lists in parallel, Time functionality: Big O notation, Case scenarios, Time complexity in python collections, GUI in Python, Components and events, GUI example, Widgets, Attributes for widgets, Label widget, Button widget, Image button, Entry widget, Combo box widget, Check button widget, Radio button widget, Canvas widget,Frame widget, Message box widget, Message widget, Menu widget, Methods, Menu button, Implementation, CGI basics, Configuring CGI, HTML form elements, Form structure, Python and CGI program, CGI scripts, HTTP headers and environment

	variables, GET method, POST method, Complete CGI code, Advantages and disadvantages.
	Unit VI (7 Hours) : OS methods, Environment methods, Directory methods, File methods, Implementation, Implementation, Serialization and deserialization, The pickle module, Pickling and unpickling: Dictionary, Protocol formats, Picklable vs unpicklable types, Serializing attribute connections, Pickle exceptions, Networking fundamentals, Basic communication model, Network topologies, RING topology, STAR topology, MESH topology, TREE topology, Transmission mediums and modes, The client/server model, Client interaction with server, The socket module, The server-side, The client-side, Threaded server, Numpy: Overview, Numpy: Setup, Datatypes, Numpy: Basic operations, Binary operations, NumPy operations, Slicing and indexing, Broadcasting, Matrix operators, Iteration order in multi-dimensional array, Array values modification, External loop in multi- dimensional array, Broadcast iteration, Matplotlib, Plot methods in Matplotlib, Image design functions, Axis functions, Figure functions, Simple plots, Basic plots, Matplotliboptions, Matplotlib: Multi plots, 3D plots, Data processing with pandas, Invalid value,Processing strings, Indexing and selecting data, iloc(): Integer based, Column nameaccess, Group-by operations, Iterating through groups, Aggregation, Transformations, Filtration.
10	**Text Books:**
11	**Reference Books:** 1. Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress 2. Paul Gries, et al., Practical Programming: An Introduction to Computer Science Using Python 3,Pragmatic Bookshelf, 2/E 2014 3. Charles Dierbach, Introduction to Computer Science using Python, Wiley, 2013 4. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction toComputer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014 5. Adesh Pandey, Programming Languages – Principles and Paradigms, Narosa, 2008
	Lab Exercises – (30 Hours) Exercise 1: Pythagorean Triplets Exercise 2: Reverse a Given Number Exercise 3: Check if a Number is an Armstrong Number Exercise 4: Print “n” Natural Numbers Exercise 5: Remove Vowels and Punctuation Exercise 6: Count the number of strings Exercise 7: Tuple Sorting Exercise 8: List Generation Exercise 9: Merge dictionaries Exercise 10: Second lowest grade Exercise 11: Convert a roman numeral to an integer Exercise 12: Parenthesis Validity Exercise 13: Calculate student Grades Exercise 14: Create Address Book Exercise 15: Implement Calculator Exercise 16: Greatest Common Divisor (GCD) Exercise 17: Expression Evaluation Exercise 18: Dictionary Grouping Exercise 19: Machine Value Conversion Exercise 20: GUI using Tk Interface Exercise 21: Calculator - GUI Exercise 22: OS Module – System Services

	Exercise 23: OS Module – File Services Exercise 24: Socket programming Exercise 25: Array operations – Numpy Exercise 26: Charts – Matplotlib Exercise 27: File Operation on Excel	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 05 Marks Assignments 05 Marks Practical Exam 20 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 20 Marks Question 2-7 each of 10 Marks (Attempt any 4)	

Name of the Course: Data Structure and Algorithms

Sr. No.	Heading	Particulars
1	**Description the course :**	• In this course students will be learn different types of searching method. • Stack and different types of queue. In syllabus include linked list and trees methodology.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To understand data organization, deletion, traversal and other relatedterminologies • To understand linear and non-linear data structures like stacks, queues, linkedlists, trees • To understand searching and sorting techniques.	
8	**Course Outcomes**: • To understand different types of data structures available in programming language. • To understand the use and working of different types data structures.	
9	**Unit I: (6 Hours)** Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	
	Unit II (6 Hours) : Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications ofStacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	
	Unit III (6 Hours) : Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.	
	Unit IV (5 Hours) : Trees: Basic Tree Terminologies, Different types of Trees:Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms andanalysis.	

	Unit V (7 Hours) : Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	
10	**Text Books: NA**	
11	**Reference Books:** 1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung. 2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, and Susan Anderson-freed. 3. "Data Structures in C" by Aaron M. Tenenbaum. 4. "Data Structures" by S. Lipschutz. 5. "Data Structures Using C" by ReemaThareja. 6. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev. 7. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 05 Marks Assignment 05 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 10 Marks Question 2-7 each of 5 Marks (Attempt any 4)	

Name of the Course: Problem Solving through Programming

Sr. No.	Heading	Particulars
1	**Description the course :**	• The objective of this courses to provide the students a knowledge of c programming environment to create, implement and debug programs.
2	**Vertical :**	SEC
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • Develop efficient algorithms for solving a problem. • Use the various constructs of a programming language viz. conditional, iteration and Recursion. • Implement the algorithms in "C" language. • Use simple data structures like arrays, stacks and linked list in solving problems. • Handling File in "C"	
8	**Course Outcomes**: • Understand basics of programming. • Develop logic and programming skills in students.	
9	**Unit I: (2 Hours)** Introduction to Programming : How to develop a program, Algorithms, Flow-charts, Types of Programming Languages, Compiler and Linker, Testing and Debugging a program, Documentation, Constants, Variables & Data Types : Character set, C Tokens, Identifiers and Keywords, Constants, Variables, Data types, Declaration of variables, declaration of storage class, assigning values to variables, defining symbolic constants, declaring a variable as constant, declaring a variable as volatile, overflow and underflow of data.	
	Unit II (2 Hours) : Operators and Expressions: Arithmetic operators, Relational, Logical operators, Assignment, increment and decrement operators, conditional operators, bitwise operators, special operators, arithmetic expressions, evaluation of arithmetic expressions, precedence of arithmetic expressions, some computational problems, type conversion in expressions, operator precedence and associativity, mathematical functions.	
	Unit III (4 Hours) : Managing Input & output operations: Reading a character, writing a character, formatted input, formatted output. Decision Making – Branching & Looping Hrs. Decision making with IF statement, switch statement,? : Operator, goto statement. While statement, do-while statement, for statement, Jumps in loops	

	Unit IV (5 Hours) : Arrays and Strings: One dimensional array: Array Manipulation, Different operations on one dimensional arrays, two dimensional array, operations on two dimensional arrays, multi-dimensional array, dynamic arrays Declaring and initializing string variables, reading string from terminal, writing string to screen, putting strings together, comparison of two strings, string handling functions, table of strings	
	Unit V (6 Hours) : Functions: Top down approach of problem solving, standard library functions, passingvalues between functions, scope rules of functions, calling convention, return type of functions, call by value and call by reference, recursive functions. Storage Classes Scope and extent, Storage Classes in a single source file: auto, extern and static, register.	
	Unit VI (6 Hours) : Structures and Unions: Defining a structure, Declaring Structure variables, accessing structure members, structure initialization, copying and comparing structure variables, operation on individual members, arrays of structures, arrays within structures, structuresand functions, union, size of structure, bit fields.	
	Unit VII (5 Hours) : Understanding pointers, accessing the address of a variable, declaring pointer variables, initialization of pointer variables, accessing a variable through its pointer, chain of pointers, pointer expression, pointer increment and scale factor, pointer and arrays, pointers and character strings, array of pointers, pointers as function arguments, functions returning pointers, pointers to functions, pointers and structures.	
10	**Text Books: NA**	
11	**Reference Books:** 1. "E. Balagurusamy, "Programming with ANSI-C", Fourth Edition,2008, Tata McGraw Hill. 2. R.G. Dromey, "How to solve it by Computer", Pearson Education, 2008. 3. Kanetkar Y, "Let us C", BPB Publications, 2007. 4. Hanly J R &Koffman E.B, "Problem Solving and Program design in C", PearsonEducation, 2009	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 05 Marks Assignment 05 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 10 Marks Question 2-7 each of 05 Marks (Attempt any 4)	

Name of the Course: Mathematics I for Intelligent System

Sr. No.	Heading	Particulars
1	**Description the course :**	• The objective of this courses to provide the students a knowledge of c programming environment to create, implement and debug programs.
2	**Vertical :**	VSC
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To develop an understanding of the basic concepts and techniques of linear algebra • To appreciate the employment of these concepts in AI and Data Science	
8	**Course Outcomes**: • Understand basics of mathematics.	
9	**Unit I: (15 Hours)** Basics of Linear Algebra: Symmetric, skew symmetric and orthogonal matrices, Determinants, Inverse and rank of a matrix, solving system of linear equations using matrices, Eigenvalues and Eigenvectors, diagonalization of matrices, Cayley-Hamilton theorem.	
	Unit II (15 Hours) : Vector Spaces: Definition and examples, Linear dependence of vectors, Basis and dimension, Linear transformations and matrix associated with linear transformations, composition of linear transformation with examples, Inverse of linear transformation, Rank- Nullity theorem.	
10	**Text Books: NA**	
11	**Reference Books:** 1. "*Erwin Kreyszig*: Advanced Engineering Mathematics, John Wiley & Sons. 2. *David C Lay*: Linear Algebra and it's Applications, Addison Wesley Publishing Company 3. *Gilbert Strang*: Linear Algebra and it's Applications, Fourth Edition	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Quizzes 05 Marks Assignment 05 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 10 Marks Question 2-7 each of 5 Marks (Attempt any 4)	

Sem. – II

Syllabus
B.Sc. (Data Science and Sports Studies)
(Sem.- II)

Semester II

Sr. No.	Subjects	Subject Type	Subject Code	Credits	Internal	External	Total
1	Mathematics II for Intelligent System	Major	TIMUDSS1C1	2	20	30	50
2	Introduction to Data Analytics	Major	TIMUDSS2SCE2	4	40	60	100
4	Database Management System	VSEC	TIMUDSS2C2	2	20	30	50
5	Operating System	VSC	TIMUDSS3SCE4	2	20	30	50
	Total			**10**			250

Name of the Course: Mathematics II for Intelligent System

Sr. No.	Heading	Particulars
1	**Description the course :**	• The course includes the concepts of limits, continuity differentiability and integration of functions. It also includes methods of differentiation and application of differentiation in finding the maximum/minimum value of a function.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To develop an understanding of the basic concepts and techniques of linear algebra • To appreciate the employment of these concepts in AI and Data Science	
8	**Course Outcomes**: • Understand basics of mathematics.	
9	**Unit I: (15 Hours)** Continuity and Derivatives: Limits at Infinity; Horizontal Asymptotes, Derivatives and Rates of Change Differentiation rules: The Product and Quotient Rules, The Chain Rule, Implicit Differentiation, Rates of Change in the Natural and Social Sciences, Exponential Growth and Decay, Related Rates, Linear Approximations and Differentials Integrals: Areas and distances, The Definite Integral, Fundamental Theorem of Calculus, Indefinite Integrals and the Net Change Theorem	
	Unit II (15 Hours) : Multivariate calculus: Multivariate functions, Graph of functions of two variables, shifting and scaling of graphs, visualizing different surfaces, Vector and Scalar Functions, Partial Derivatives, Curves, Tangents, Maxima, minima and saddle points, method of Lagrange's multipliers	
10	**Text Books: NA**	
11	**Reference Books:** 1. *James Stewart*: Calculus Early Transcendental, Thomson, 6th Edition, 2008. 2. *George B Thomas Jr, Ross L., Finney Maurice, D Weir*: Calculus and Analytical Geometry, Addison Wesley Publishing Company, 1998. 3. *Silvanus P Thomson, Martin Gardner*: Calculus Made Easy, PALGRAVE, 1998	

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Quizzes 05 Marks Assignment 05 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 10 Marks Question 2-7 each of 5 Marks (Attempt any 4)	

Name of the Course: Introduction to Data Analytics

Sr. No.	Heading	Particulars
1	**Description the course :**	• This course provides an introduction to the field of data analytics, focusing on the tools, techniques, and processes used to extract insights and make informed decisions from data. • Data analytics plays a crucial role in various domains, including business, healthcare, finance, and marketing. • This course covers the fundamental concepts of data analytics, data exploration and visualization, statistical analysis, and introduces students to popular tools and methodologies used in the field.
2	**Vertical :**	Major
3	**Type :**	Theory Practical
4	**Credit**:	4 credits
5	**Hours Allotted :**	75 Hours
6	**Marks Allotted**:	100 Marks
7	**Course Objectives**: • Understand the fundamentals of data analytics and its significance in different domains. • Familiarize with the various types of data (structured, unstructured, and semi-structured) and their characteristics. • Learn about data preprocessing techniques, including data cleaning, data integration, and data transformation. • Explore data exploration and visualization techniques to gain insights and communicate findings effectively. • Gain knowledge of statistical analysis techniques, such as hypothesis testing, regression analysis, and analysis of variance (ANOVA).	
8	**Course Outcomes**: • Understand the concepts and techniques of data mining and predictive analytics. • Learn about machine learning algorithms and their application in data analytics. • Familiarize with data analytics tools and technologies, such as Python, R, and SQL. • Gain practical experience in applying data analytics techniques through hands-on exercises and projects. • Learn how to interpret and communicate data analytics results to stakeholders effectively.	

9	**Unit I: (10 Hours)** Introduction to Business Analytics and Optimization, Challenges of data creation, Approaches to help maximize profitability and returns, what are Business Analytics? Business Analytics capabilities, Enterprise Analytics capabilities, Business Analytics technologies, Predictive Analytics, Prescriptive Analytics, A fact-based decision-making culture, A strong data infrastructure, the right analytical tools, New tools and architectures may be needed, Analytics workforce, Knowledge requirements, Business Analyst, Data Scientist, where to put the Analytics team? IBM Business Analytics maturity model, Optimization, Key BAO concepts, The need for BAO now, Essential capabilities in BAO, BAO capabilities: Business performance management, BAO capabilities: Predictive analysis and mining, Value of BAO to business organization, Impact of BAO on diverse industries, Advantages to implementing BAO solutions, BAO capabilities: real-time Analytics: Data in motion, BAO support for decision-making, High level architecture of BAO, Importance of reference architecture, BAO reference architecture, BAO reference architecture to BAO architects, IBM technology portfolio for BAO.
	Unit II (8 Hours) : Decision support, Three-tier decision support systems, Exploring and analyzing data, what is a data warehouse? Data warehouse architecture choices, Enterprise data warehouse, Independent data mart architecture, Dependent data mart architecture, Data warehouse, Multidimensional data, Conceptual modeling of data warehouses, Data warehouse design process, Single-layer architecture, Two-layer architecture, Three-tier data warehouse architecture, Data warehouse development, Multi-tiered architecture, Information pyramid, BI reporting tool architectures, Multidimensional analysis techniques, Data analysis and OLAP, OLAP server architectures, Data cube, OLTP vs OLAP, Business query, Dashboards and scorecards development, Metadata model, Automated tasks and events, Mobile BI, Software development kit (SDK), Setting up data for BI, Making BI easy to consume
	Unit III (10 Hours): What is business intelligence? Definitions of business intelligence, Sample BI architecture, Things are getting more complex, BI components and architecture, Scope and fit of BI solutions within existing infrastructure, High level BI process, A single or a few applications, Benefits of BI, Maximize value from BI systems, Strategy and business intelligence, Business transformation projects, Business role of BI (TWDI), ASUG business intelligence maturity model, Why act? BI effectiveness scorecard, BI value scorecard, five key areas of strategy, Planning a BI project, Pre-engagement activities, Engagement activities and process, BI design and development, Business environment, Project tasks, Task 1: Knowledge capture goals Discuss business objectives & prior learning, Interview key stakeholders, Project planning Task 2: Consolidate Findings Create logical design Task 3: Map the customer situation Current environment, Business / functional requirements sample diagram, Logical BI diagram Task 4: Methodology & approach Task 5: Standards & governance Task 6: Sections, milestones, and tasks Task 7: Proof of Concept (POC) Task 8: Table creation Task 9: OLAP creation Task 10: Final Deliverables Risk management and mitigation, Cost justification and measuring success

	Unit IV (8 Hours) : What is Data Mining? Evolution of Data Mining, Why Data Mining and data Analytics? Knowledge based system, Data Mining process, Phasesof Data Mining process, Data Mining process, KDD process model, CRISP – DM, CRISP DM, CRISP-DM elaborate view, Data Mining on what kinds of data? DM tasks and components of DM methods, Data Mining operations, Data Mining techniques, Data Mining techniques, Industry examples of application of DM, Challenges of Data Mining, why machine should "learn"? What is machine learning?Growth of machine learning, Machine learning types, Unsupervised learning, Reinforcement learning.
	Unit V (8 Hours) : Definition of dashboard, Dashboard types, Layers of information, Evolution of dashboards, Dashboard design, Dashboard design principles, Chart overview, Singular components, Metrics, Kaplan-Norton balanced scorecard, The Ray port-Jaworski performance dashboard and strategy framework, Introducing the R-J performance dashboard, Blueprint to the R-J performance dashboard, Building reports, List report, Data group, sort and filters, Add calculations to report, Conditions and aggregations in report, Drilling in report, Run report: On demand or schedule, Charts, Chart type: Bar chart, What is data visualization? Data visualization tools, what is tableau? Tableau features, Tableau products, Tableau architecture, an introduction to tableau workspace, Tableau charts, How to post tableau service dashboards? Table in tableau computation, Basic table calculation functions, Quick filters.
	Unit VI (8 Hours) : What is Big Data? Intrinsic property of data it grows, A growing interconnected and instrumental world, Need for Big Data, Characteristics of Big Data, Structure of Big Data and need for standards, Big Data Analytics adoption, Benefits & barrier of Big Data Analytics, Trends for Big Data Analytics,Commoditization of hardware enabling new Analytics, The 5 key Big Data use cases, More ways wide ranging Analytics and techniques, Big Data platform and application frameworks, A Big Data platform manifesto, Use cases for a Big Data platform, Data science.
	Unit VI (8 Hours) : Descriptive statistics, Inferential statistics, Univariate analysis, Factor analysis, Cluster analysis, Density-based clustering, Variance analysis, Discriminatory analysis, Multidimensional scaling, Collaboration methods, K-means grouping, Redundancy analysis, Market basket analysis, Introduction to RFM and Capstone project, Recency, frequency, and monetary analysis.
10	**Text Books: NA**
11	**Reference Books:** 1. Data Science for Business" by Foster Provost and Tom Fawcett. 2. Python for Data Analysis" by Wes McKinney. 3. Storytelling with Data" by Cole Nussbaumer Knaflic. 4. Big Data: A Revolution That Will Transform We Live, Work, and Think" by Viktor Mayer-Schönberger and Kenneth Cukier. 5. Data Analytics Made Accessible" by Anil Maheshwari. 6. The Data Science Handbook" edited by Field Cady. 7. Data Analysis for Business Decisions" by Gareth M. James, G. Peter Zhang, David J. Eckles, andJeffrey M. Camm.
	Lab Exercises – Exercise 1: Creating matrix and manipulating matrix Exercise 2: Operations on data frames Exercise 3: Exploratory data analysis Exercise 4: Graphics in R

	Exercise 5: Ggplot2 operations with datasets Exercise 6: Summary statistics Exercise 7: Predictive analytics Exercise 8: Prescriptive analytics Exercise 9: Linear models Exercise 10: Tableau - Connect to your data Exercise 11: Tableau - Drag and drop to take a first look Exercise 12: Tableau – Focus your results Exercise 13: Tableau - Explore data geographically Exercise 14: Tableau - Drill down into the details Exercise 15: Tableau - Build a dashboard to show your insights Exercise 16: Tableau - Build a story to present Exercise 17: Tableau - Share findings Exercise 18: Credit risk analytics Exercise 19: Click analytics Exercise 20: Descriptive statistics Exercise 21: Inferential statistics Exercise 22: Market basket analysis Exercise 23: Text mining Exercise 24: Decision trees Exercise 25: Sentimental analysis	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 05 Marks Assignments 05 Marks Practical Exam 20 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 20 Marks Question 2-7 each of 10 Marks (Attempt any 4)	

Name of the Course: Database Management System

Sr. No.	Heading	Particulars
1	**Description the course :**	• The objective of this courses to provide the students a knowledge of c programming environment to create, implement and debug programs.
2	**Vertical :**	VSEC
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To understand the different issues involved in the design and implementation of a database system. • To study the physical and logical database designs, database modeling, relational, hierarchical, and network models • To understand and use data manipulation language to query, update, and manage a database	
8	**Course Outcomes**: • To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing. • To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS. • To understand the different issues involved in the design and implementation of a database system.	
9	**Unit I: (6 Hours)** Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations	
	Unit II (8 Hours) : Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS-MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms	

	Unit III (6 Hours) : Storage strategies: Indices, B-trees, Hashing	
	Unit IV (6 Hours) : Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multiversion and optimistic Concurrency Control schemes, Database Recovery	
	Unit V (4 Hours) : Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	
10	**Text Books: NA**	
11	**Reference Books:** 1. Database System Concepts" , 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan,McGraw-Hill. 2. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 05 Marks Assignment 05 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 10 Marks Question 2-7 each of 05 Marks (Attempt any 4)	

Name of the Course: Operating Systems

Sr. No.	Heading	Particulars
1	**Description the course :**	• This course examines the important problems in operating system design and implementation. • The operating system provides an established, convenient, and efficient interface between user programs and the bare hardware of the computer on which they run.
2	**Vertical :**	VSEC
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course 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.	
8	**Course Outcomes**: • 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.	
9	**Unit I: (4 Hours)** Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	
	Unit II (4 Hours) : 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.	
	Unit III (4 Hours) : 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.	

	Unit IV (6 Hours) : Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	
	Unit V (6 Hours) : 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/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently.	
	Unit V (6 Hours) : 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	
10	**Text Books: NA**	
11	**Reference Books:** 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.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 05 Marks Assignment 05 Marks	
14	**Format of Question Paper:** for the final examination (Semester End Examination) Question 1 Compulsory 10 Marks Question 2-7 each of 05 Marks (Attempt any 4)	

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Appendix B

Justification for B.Sc. (Data Science and Sports Studies)

1.	Necessity for starting the course:	There is a need for a course that is blended with other imperative industries to IT and sport, along globally acclaimed universities and yet taught locally with academics and practical frameworks.
2.	Whether the UGC has recommended the course:	Yes it has been recommended, given the rapid growth of administration in sports industry
3.	Whether all the courses have commenced from the academic year 2023-24	Yes
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?	Yes the courses are self-financed and faculties are available. They are a combination of academic 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 nuances of the sports industry.
6.	The intake capacity of each course and no. of admissions given in the current academic year:	The proposed batch size in 60 students. However, if there is increase in demand, can increase the batch size up to 120 students.
7.	Opportunities of Employability / Employment available after undertaking these courses:	There is enough employment opportunities post the completion of this course.

Sign of the BOS Chairman
Name of the Chairman:-
Name of the BOS :- Sports Science & Management

Sign of the Dean
Name of the Dean :- Dr A.K. Singh
Name of the Faculty:- Faculty of Interdisciplinary Studies