University of Mumbai

Website - mu.ac.in
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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/ 250

Date : 24th March, 2025.

CIRCULAR

Sub : B.Sc. (Artificial Intelligence and Sports Analytics) (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. 8.6(N) have been accepted by the Academic Council at its meeting held on 12th July, 2024, vide Item No.8.6(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 Examination, Standard of Passing and Credit Structure along with syllabus of B.Sc (Artificial Intelligence and Sports Analytics) (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 Programme	Ordinance no. for Title	Ordinance no. for Eligibility
A	U.G. Certificate in Artificial Intelligence and Sports Analytics (One year)	O.IMU – 521 A	O.IMU – 522 A
B	U.G. Diploma in Artificial Intelligence and Sports Analytics (Two year)	O.IMU – 521 B	O.IMU – 522 B
C	B.Sc.(Artificial Intelligence and Sports Analytics) (Three year)	O.IMU – 521 C	O.IMU – 522 C
D	B.Sc. (Honors) Artificial Intelligence and Sports Analytics (Four year)	O.IMU – 521 D	O.IMU – 522 D
E	B.Sc.(Honors with Research) Artificial Intelligence and Sports Analytics (Four year)	O.IMU – 521 E	O.IMU – 522 E

2/-

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Regulation Nos	
Duration	R. IMU - 551
Intake Capacity	R. IMU - 552
Scheme of examination	R. IMU - 553
Standard of Passing	R. IMU - 554
Credit Structure	R. IMU - 555 A
	R. IMU - 555 B
	R. IMU - 555 C
	R. IMU - 555 D
	R. IMU - 555 E
	R. IMU - 555 F

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

MUMBAI – 400 032
24th March, 2025

(Dr. Prasad Karande)
REGISTRAR

A.C/8.6 (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
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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. - 8.6 (N)

As Per NEP 2020

University of Mumbai

Title of the program

A- U.G. Certificate in Artificial Intelligence and Sports Analytics
B- U.G. Diploma in Artificial Intelligence and Sports Analytics
C- B.Sc. (Artificial Intelligence and Sports Analytics)
D- B.Sc. (Hons.) in Artificial Intelligence and Sports Analytics
E- B.Sc. (Hons. with Research) in Artificial Intelligence and Sports Analytics

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-521A**	**A**	**U.G. Certificate in Artificial Intelligence and Sports Analytics**
	O: IMU-521B	**B**	**U.G. Diploma in Artificial Intelligence and Sports Analytics**
	O: IMU-521C	**C**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
	O: IMU-521D	**D**	**B.Sc. (Hons.) in Artificial Intelligence andSports Analytics**
	O: IMU-521E	**E**	**B.Sc. (Hons. with Research) in Artificial Intelligence and Sports Analytics**
2	**Eligibility** **O: IMU-522A**	**A**	Passed 10+ 2 standard with 45 %with mathematics As a core /elective subject. Marks scheme of any recognized State/Central/ International Board OR Passed Equivalent Academic Level 4.0
	O: IMU-522B	**B**	Under Graduate Certificate in in Artificial Intelligence and Sports Analytics Academic Level 4.5
	O: IMU-522C	**C**	Under Graduate Diploma in Artificial Intelligence and Sports Analytics Academic Level 5.0
	O: IMU-522D	**D**	Bachelors of Science in Artificial Intelligence and Sports Analytics with minimum CGPA of 7.5 Academic Level 5.5
	O: IMU-522E	**E**	Bachelors of Science in Artificial Intelligence and Sports Analytics with minimum CGPA of 7.5 Academic Level 5.5
3	**Duration of program** **R: IMU-551**	**A**	One Year
		B	Two Years
		C	Three Years
		D	Four Years
		E	Four Years
4	**Intake Capacity** **R: IMU-552**		**60 students**

5	**Scheme of Examination** **R: IMU-553**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	**Standards of Passing** **R**: **IMU-554**	40%	
7	**Credit Structure** **Sem. I - R: IMU-555A** **Sem. II - R: IMU-555B**	Attached herewith	
	Credit Structure **Sem. III - R: IMU-555C** **Sem. IV - R: IMU-555D**		
	Credit Structure **Sem. V - R: IMU-555E** **Sem. VI – R:IMU-555F**		
8	Semesters	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

Introducing a branch focused on "Artificial Intelligence and Sports Analytics" within a BSc (Bachelor of Science). Program is a fascinating endeavor that combines two rapidly evolving fields: artificial intelligence (AI) and sports analytics. This specialized branch would likely cover a range of topics tailored to the intersection of AI and sports analytics, including:

Fundamentals of Artificial Intelligence: Students would learn the foundational concepts, algorithms, and techniques used in AI, including machine learning, neural networks, natural language processing, and computer vision.

Data Collection and Preprocessing: Understanding how to gather and preprocess various types of data relevant to sports, such as player performance statistics, match outcomes, player tracking data (e.g., GPS data), and sensor data.

Machine Learning for Sports Analytics: Exploring how machine learning algorithms can be applied to analyze sports data for insights into player performance, team strategies, injury prevention, and opponent scouting.

Predictive Modeling and Forecasting: Techniques for building predictive models to forecast match outcomes, player performance, and other key metrics in sports using historical data and advanced machine learning methods.

Computer Vision in Sports: Leveraging computer vision techniques to analyze video footage for player tracking, action recognition, event detection, and tactical analysis in various sports.

Natural Language Processing (NLP) for Sports Commentary and Analysis: Understanding how NLP can be applied to analyze sports commentary, social media discussions, and news articles for sentiment analysis, trend identification, and fan engagement.

Ethical and Societal Implications: Discussing the ethical considerations and societal implications of applying AI and data analytics in sports, including issues related to fairness, bias, privacy, and the impact on coaching and scouting practices.

Practical Applications and Case Studies: Hands-on projects and case studies that allow students to apply AI and sports analytics techniques to real-world problems in sports, such as player evaluation, game strategy optimization, and fan engagement.

By offering a specialized branch in Artificial Intelligence and Sports Analytics, students can gain both Theoretical knowledge and practical skills to pursue careers in various areas, including sports technology, data analysis, sports journalism, coaching, and sports management. Additionally, this branch can contribute to advancements in sports performance, coaching methodologies, fan experiences, and the overall understanding of sports dynamics through data-driven insights.

2) Aims and Objectives

The aims and objectives of a BSc program in Artificial Intelligence and Sports Analytics would be designed to provide students with a comprehensive understanding of both artificial intelligence and its applications in the realm of sports analytics. Here are some potential aims and objectives:

Develop a Strong Foundation in Artificial Intelligence: Provide students with a solid understanding of the fundamental concepts, theories, and techniques of artificial intelligence, including machine learning, neural networks, natural language processing, and computer vision.

Integrate Sports Analytics Principles: Introduce students to the principles and methodologies of sports analytics, including data collection, preprocessing, analysis, and interpretation, with a focus on practical applications in various sports contexts.

Foster Interdisciplinary Skills: Cultivate interdisciplinary skills by combining knowledge from computer science, statistics, mathematics, and sports science to address complex challenges in sports analytics using AI-driven approaches.

Promote Critical Thinking and Problem-Solving Abilities: Encourage students to think critically and creatively to solve problems related to sports analytics, including player performance prediction, game strategy optimization, injury prevention, and talent scouting.

Enhance Data Literacy and Analytical Skills: Develop students' ability to work with large and complex datasets commonly found in sports analytics, enabling them to extract meaningful insights and make informed decisions using statistical analysis and machine learning techniques.

Encourage Hands-on Learning and Practical Experience: Provide opportunities for students to engage in hands-on projects, case studies, and internships that allow them to apply AI and sports analytics concepts to real-world sports data and problems.

Address Ethical and Societal Considerations: Foster an understanding of the ethical, legal, and societal implications of using AI and data analytics in sports, and equip students with the knowledge and skills to navigate these issues responsibly.

Prepare Students for Diverse Career Paths: Prepare students for a wide range of career paths in the fields of artificial intelligence, sports analytics, sports technology, coaching, sports management, journalism, and related areas, by providing them with relevant skills and practical experience.

Encourage Research and Innovation: Encourage students to engage in research activities, explore new methodologies, and contribute to the advancement of knowledge and innovation in the field of artificial intelligence and sports analytics through their projects and studies.

By aligning the program's aims and objectives with these principles, students can graduate with a well-rounded education that prepares them to excel in the rapidly evolving fields of artificial intelligence and sports analytics, while also contributing to the advancement of these disciplines through research and innovation.

3) Learning Outcomes

Understanding of Artificial Intelligence Concepts: Students will demonstrate a deep understanding of fundamental concepts, theories, and techniques of artificial intelligence, including machine learning, neural networks, natural language processing, and computer vision.

Application of AI in Sports Analytics: Students will be able to apply AI algorithms and methodologies to analyze sports data for insights into player performance, team strategies, injury prevention, and opponent scouting across various sports domains.

Data Collection and Preprocessing Skills: Students will possess the skills to gather, preprocess, and clean diverse types of sports data, including player performance statistics, match outcomes, player tracking data, and sensor data, in preparation for analysis.

Machine Learning and Predictive Modeling: Students will demonstrate proficiency in building and evaluating predictive models using machine learning techniques to forecast match outcomes, player performance, and other key metrics in

sports.

Computer Vision Techniques for Sports Analysis: Students will be able to apply computer vision techniques to analyze video footage for player tracking, action recognition, event detection, and tactical analysis in sports such as soccer, basketball, and tennis.

Natural Language Processing for Sports Commentary Analysis: Students will develop the ability to use natural language processing (NLP) techniques to analyze sports commentary, social media discussions, and news articles for sentiment analysis, trend identification, and fan engagement.

Ethical and Societal Awareness: Students will understand the ethical, legal, and societal implications of using AI and data analytics in sports, and be able to critically evaluate and address issues related to fairness, bias, privacy, and the impact on coaching and scouting practices.

Practical Application and Problem-Solving: Students will be capable of applying AI and sports analytics concepts to real-world sports problems, such as player evaluation, game strategy optimization, injury risk assessment, and talent identification, through hands-on projects and case studies.

Effective Communication and Collaboration: Students will develop strong communication and collaboration skills, enabling them to effectively convey technical concepts and findings to diverse audiences, collaborate with teammates and stakeholders, and work in multidisciplinary teams.

Continuous Learning and Adaptability: Students will recognize the dynamic nature of the fields of AI and sports analytics and demonstrate a commitment to continuous learning, staying updated on emerging technologies, methodologies, and best practices to adapt to evolving challenges and opportunities.

These learning outcomes aim to equip students with the knowledge, skills, and competencies necessary to succeed in careers related to artificial intelligence and sports analytics, as well as to contribute meaningfully to the advancement of these fields through research, innovation, and practical applications.

4) Credit Structure of the Program (Sem I, II, III, IV, V & VI)

UnderGraduate Certificate in BSc Artificial Intelligence and Sport Analytics

Credit Structure (Sem. I & II)

	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(2credits)		-	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 Certificate44**
	R:_____B									
	II	Mathematics II for Intelligent Systems(2 credits), Introduction to Artificial Intelligent and Machine Learning (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	
Exitoption:AwardofUGCertificateinMajorwith40-44creditsandanadditional4creditscoreNSQFcourse/InternshipORContinuewithMajorandMinor										

UnderGraduate Diploma in BSc Artificial Intelligence and Sport Analytics

Credit Structure (Sem. III & IV)

	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	Foundation of AI (4 credits), Machine Learning (4 credits)		4	2	Internet Web and Programming (2 credits)	AEC:2	FP: 2CC:2	22	**UG Diploma88**
	R:_____D									
	IV	Deep Learning (4 credits), Introduction to Data Analytics (4 credits)		4	2	Software Engineering (2 credits)	AEC:2	CEP: 2CC:2	22	
	CumCr.	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 credit score NSQF course/Internship OR Continue with Major and Minor										

BSc. (Artificial Intelligence and Sport Analytics)

Credit Structure (Sem. V & VI)

Level	Semester	Major		Minor	OE	VSC,SEC (VSEC)	AEC, VEC, IKS	OJT, FP,CEP, CC,RP	Cum.Cr. / Sem.	Degree/ Cum.Cr.
		Mandatory	Electives							
	R:_____E									
5.5	V	Pattern Recognition and Anamoly Detection (4 credits), Computational Linguistics and NLP1 (4 credits), Discrete Mathematics (2 credits)	4	4		Distributed Systems (2 credits)		FP/CEP :2	22	**UG Degree132**
	R:_____F									
	VI	Computational Linguistics and NLP2 (4 credits), Application of ML in Industries (4 credits), Data Mining and Warehousing (2 credits)	4	4				OJT:4	22	
	Cum Cr.	48	8	18	12	8+6	8+4+2	8+6+4	132	
Exitoption : 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
BSc. (Artificial Intelligence and Sport Analytics)
(Sem.- I)

Semester I

Sr. No.	Subjects	Subject Type	Code	Credits	Internal	External	Total
1	Python Programming	Major	TIMUAIS1SCE3	4	40	60	100
2	Data Structures and Algorithm	Major	TIMUAIS2SCE5	2	20	30	50
4	Problem Solving through programming	SEC	TIMUDSS1SCE4	2	20	30	50
5	Mathematics I for Intelligent System	VSC	TIMUAIS1C1	2	20	30	50
	Total			**10**			250

MAJOR (MANDATORY)

Name of the Course: **Python Programming**		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	This introductory course in Python programming provides a solid foundation for beginners who want to learn one of the most popular and versatile programming languages. Python is widely used in various fields such as web development, data analysis, machine learning, and scientific computing. The course aims to equip students with essential programming concepts and Skills using Python as the primary language.
2	**Vertical :**	**Major (Mandatory)**
3	**Type :**	Theory and Practical
4	**Credit**:	4 credits (1 credit = 15 Hours for Theory, 1 credit = 30 hours practical)
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. • 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. • To practice data processing, analysis and visualization with python.	
8	**Course Outcomes**: The students should be able to: • Examine Python syntax and semantics and be fluent in the use of various Operators of Python. • Make use of flow control statements and Input / Output functions of Python. • Demonstrate proficiency in handling Strings and File Systems. • Create, run and manipulate Python Programs using core data structures like Lists and Tuples. • Apply the core data structures like Sets and Dictionaries in Python Programming.	

	• Demonstrate the use of functions, modules and Regular Expressions in Python.
9	**Modules**:-
	Unit I: Introduction to Python (7 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, Gettinghelp, 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 and slice, Lists: Operations, Lists: Methods, Sets: Create and operations, Sets: Operators and methods, Sets: Frozen set, Sets: Methods, Tuples: Create andaccess,Tuples:Sliceandalteration,Dictionaries:Createandaccess, Dictionaries: Modify and delete, Dictionaries: Methods, Copying collections: Shallow, Copying collections: Deep.
	Unit II: Program flow Control (5 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-definedfunctions,Callingafunction,Returning a value from the function, Implementation, Scope or lifetime of variables, Creation and usage of global variables, Creation and usage of nonlocal variables,Passingcollectionstoafunction,Variablenumberofarguments, 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: Object –Oriented in python (9 Hours)
	Object-orientedprogrammingconcepts,Classandobject,Abstractionand 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,Accessingbaseclasselementinderivedclass,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,Accessmodes,Fileopen,Fileclose,Exceptionsinfile,Writingto files, Reading from files, seek() and tell() methods, readline() and readlines() methods, Renaming and deleting files.
	Unit IV: Modules (7 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 modulemath,Pythonbuilt-inmodules:datetime,Pythonbuilt-inmodules: 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, Reg Exquantifiers, RegExgreedymatch, RegExnon-Greedy match, Greedy vsnon-greedymatch, RegExflags
	Unit V: Dictionaryand GUI (9 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: File method and topology (5 Hours)
	OS methods, Environment methods, Directory methods, File methods, Implementation,Implementation,Serializationanddeserialization,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
	Unit VII: Numpy (3 Hours)
	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,Imagedesignfunctions,Axisfunctions,Figurefunctions,Simple plots, Basic plots, Matplot lib options, Matplot lib: Multi plots, 3D plots, Data processing with pandas, Invalid value, Processing strings, Indexing and selecting data, iloc(): Integer based, Column name access, Group-by operations, Iterating through groups, Aggregation, Transformations, Filtration.	
	Lab Exercises– (30 hours) Exercise 1: Lab Exercises Exercise1:PythagoreanTriplets Exercise2: Reverse a Given Number Exercise3:CheckifaNumberisanArmstrongNumber Exercise 4: Print "n" Natural Numbers Exercise5:RemoveVowelsandPunctuation Exercise 6: Count the number of strings Exercise 7: Tuple Sorting Exercise 8: List Generation Exercise 9: Merge dictionaries Exercise10:Secondlowestgrade Exercise11:Convertaromannumeraltoaninteger Exercise 12: Parenthesis Validity Exercise13:CalculatestudentGrades Exercise 14: Create Address Book Exercise 15: Implement Calculator Exercise16:GreatestCommonDivisor(GCD) Exercise17:ExpressionEvaluation 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	
10	**References:** 1. MagnusLieHetland,BeginningPython:FromNovicetoProfessional,Apress 2. Paul Gries, et al., Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014 3. CharlesDierbach,IntroductiontoComputerScienceusingPython,Wiley,2013 4. PaulGries,JenniferCampbell,JasonMontojo,PracticalProgramming:AnIntroductiontoComputer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014 AdeshPandey,ProgrammingLanguages–PrinciplesandParadigms,Narosa,2008	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**

13	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)

Name of the Course: Data Structure and Algorithm		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	The objective of this courses to provide the students a in depth Idea of storing and organizing data including linear and non–linear data strutures
2	**Vertical :**	**Major (Mandatory)**
3	**Type :**	Theory and Practical
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To understand data organization, deletion, travers a land other related terminologies • To understand linear and non-linear data structures like stacks, queues, linked lists, trees • To understand searching and sorting techniques	
8	**Course Outcomes**: The students should be able to: • Ability to select the data structures that efficiently model the information in a problem. • Ability to assess efficiency trade-offs among different data structure implementations or combinations. • Implement and know the application of algorithms for sorting and pattern matching. • Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.	
9	**Modules**:-	
	Unit I: Introduction: Basic Terminologies (5 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: Stacks and Queues (5 Hours)	
	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: 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: Linked List (5 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: Trees (7 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 and analysis.	
	Unit V : Sorting and Hashing (8 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	**References:** 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, Susan Anderson-freed. 3. "Data Structures in C" by Aaron M. Tenenbaum. 4. "Data Structures" by S. Lipschutz. 5. "Data Structures Using C" by Reema Thareja. 6. "Data Structure Using C", 2/eby A.K.Rath, A.K.Jagadev. 7. "Introduction to Algorithms" by Thomas H. Cormen, Charles E .Leiserson, Ronald 8. L. Rivest, Clifford Stein.	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**

12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)

Name of the Course: Problem Solving Through Programming		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	The objective of this courses to provide the students a in depth Idea of storing and organizing data including linear and non–linear data strutures
2	**Vertical :**	**SEC**
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • The objective of this courses to provide the students a knowledge of c programming environment to create, implement and debug programs.	
8	**Course Outcomes**: The students should be able to: • Develop efficient algorithms for solving a problem. • Use the various constructs of a programming language viz. conditional, iteration and recursion. • Implement the algorithmsin "C" language. • Uses implement data structures like arrays, stacks and linked list in solving problems. • Handling File in "C"	
9	**Modules**:-	
	Unit I: Introduction to Programming **(3 Hours)**	
	: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: Operators and Expressions **(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 line expressions, operator precedence and associativity, mathematical functions
	Unit III: Managing Input & output operations (3 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. Whilestatement, do-while statement, for statement, Jumps in loops,
	Unit IV: Arrays and Strings (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 : Functions (6 Hours)
	Functions: Top down approach of problem solving, standard library functions, passing values 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: Structures and Unions (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, structures and functions, union, size of structure, bit fields.
	Unit–VII: Pointer (5 Hours)
	Understanding pointers, accessing the address of a variable, declaring pointervariables,initializationofpointervariables,accessingavariable 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	**References:** 1. E. Balagurusamy, " Programming with ANSI-C",FourthEdition,2008, Tata Mc Graw Hill. 2. R.G. Dromey," How to solve itbyComputer",PearsonEducation,2008. 3. Kanetkar Y,"Letus C", BPB Publications, 2007. 4. Hanly JR & Koffman E. B, "Problem Solving and Program design in C", Pearson Education,2009.	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Name of the Course: Problem Solving Through Programming		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	The objective of this courses to provide the students a in depth Idea of storing and organizing data including linear and non–linear data strutures
2	**Vertical :**	**SEC**
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • The objective of this courses to provide the students a knowledge of c programming environment to create , implement and debug programs.	
8	**Course Outcomes**: The students should be able to: • Develop efficient algorithms for solving a problem. • Use the various constructs of a programming language viz. conditional, iteration and recursion. • Implement the algorithmsin "C" language. • Uses implement data structures like arrays, stacks and linked list in solving problems. • Handling File in "C"	
9	**Modules**:-	
	Unit I: Introduction to Programming **(3 Hours)**	
	: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: Operators and Expressions **(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 line expressions, operator precedence and associativity, mathematical functions
	Unit III: Managing Input & output operations (3 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. Whilestatement, do-while statement, for statement, Jumps in loops,
	Unit IV: Arrays and Strings (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 : Functions (6 Hours)
	Functions: Top down approach of problem solving, standard library functions, passing values 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: Structures and Unions (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, structures and functions, union, size of structure, bit fields.
	Unit–VII: Pointer (5 Hours)
	Understanding pointers, accessing the address of a variable, declaring pointervariables,initializationofpointervariables,accessingavariable 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	**References:** 5. E.Balagurusamy,"ProgrammingwithANSI-C",FourthEdition,2008,TataMcGrawHill. 6. R.G.Dromey,"Howtosolve itbyComputer",PearsonEducation,2008. 7. Kanetkar Y,"LetusC",BPBPublications,2007. 8. HanlyJR&KoffmanE.B,"ProblemSolvingandProgrammdesigninC",PearsonEducation,2009.	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Name of the Course: Mathematics I for Intelligent System		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	This objective of this course is to provide a focus on Matrix Theory and Vector Spaces
2	**Vertical :**	**VSC**
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • The objective of this courses to provide the students a knowledge of c programming environment to create , implement and debug programs.	
8	**Course Outcomes**: The students should be able to: • To develop an understanding of the basic concepts and techniques of linear algebra as applied to signal processing. • To provide an appreciation of these disciplines within the scientific field. • To provide connection between the concepts of linear algebra, differential equation and probability theory.	
9	**Modules**:-	
	Unit I: Basics of Linear Algebra (15 Hours)	
	Skew symmetric and orthogonal matrices, Determinants, Inverse and rank of a matrix, solving system of linear equation using matrices. Eigen values and Eigen vectors, diagonalization of matrices, Cayley- Hamilton theorem.	
	Unit II : Vector Spaces (15 Hours)	
	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	**References:** 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	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Sem. – II

Syllabus
BSc (Artificial Intelligence and Sport Analytics)
(Sem.- II)

Semester II

Sr. No.	Subjects	Subject Type	Code	Credits	Internal	External	Total
1	Mathematics II for Intelligent System	Major	TIMUAIS2C1	2	20	30	50
2	Introduction to Artificial Intelligence & Machine Learning	Major	TIMUAIS2SCE2	4	40	60	100
4	Database Management System	SEC	TIMUAIS2C2	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 :** **Including but Not limited to :**	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 (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: Develop an understanding of the concepts of Univariate and Multivariate Calculus • To appreciate the application so these concepts in AI and Data Science	
8	**Course Outcomes**: The students should be able to: • To develop an understanding of the basic concepts and techniques of linear algebra as applied to signal processing. • To provide an appreciation of these disciplines within the scientific field. • To provide connection between the concepts of linear algebra, differential equation and probability theory.	
9	**Modules**:-	
	Unit I: Continuity and Derivatives (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	
	Unit II: Multivariate calculus (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	**References:** 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. *Silvanus P Thomson, Martin Gardner*: Calculus Made Easy, PALGRAVE, 1998	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Name of the Course: Introduction to Artificial Intelligence & Machine Learning		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	This course provides an introduction to the fundamental concepts and techniques of Artificial Intelligence (AI) and Machine Learning (ML). It covers the principles, algorithms, and applications of AI and ML, focusing on building a solid foundation for understanding and applying these technologies in various domains. The course combines theoretical knowledge with hands-on practical exercises to reinforce the concepts learned.
2	**Vertical :**	**Major**
3	**Type :**	Theory
4	**Credit**:	4 credits (1 credit = 15 Hours for Theory)
5	**Hours Allotted :**	75 Hours
6	**Marks Allotted**:	100 Marks
7	**Course Objectives**: • Understand the basic concepts, principles, and history of Artificial Intelligence and Machine Learning. • Familiarize with different types of machine learning algorithms, including supervised learning, unsupervised learning, and reinforcement learning. • Learn about data preprocessing, feature engineering, and data visualization techniques for machine learning tasks. • Gain knowledge of different evaluation metrics and techniques to assess the performance of machine learning models.	
8	**Course Outcomes**: The students should be able to: • Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning. • Acquire the knowledge of real world Knowledge representation.	
9	**Modules**:-	
	Unit I: History of artificial intelligence (6 Hours)	

	History of artificial intelligence, The birth of artificial intelligence, AI Winters, Todays'AI, Historical milestones in the development of AI, Great contributors, People who have influenced AI, Differences between strong AI and weak AI, Artificial Intelligence definitions, Emergence of AI – Technological advances, Machine Learning ---> Deep Learning --->AI, Functions of AI, Characteristics of artificial intelligence, Applications of AI, AIinhealthcare,Industry4.0,AIinmanufacturing,AIineducationsector, AI in business, AI in Finance Sector, AI in Law, AI in society, Cognitive science and AI, Cognition andprocessofCognition,DisciplinesinCognitivescience,Multidisciplinary subject, Linguistics, Artificial intelligence as Cognitive science, Methods in Cognitive science, Watson.
	Unit II: Knowledge representation systems (6 Hours)
	Introduction to knowledge representation systems, Knowledge representation using logic, Propositional logic, Semantics of propositional logic, Properties of propositional logic statements, Tautologies and logical implication, Resolution, Conjunctive normal form, Resolution is valid, Resolution algorithm, Knowledgebase systems, Structure of a knowledge based system, Recap of artificial intelligence, Components of expert systems, Expert systems development, Wumpus world, Logic, A simple knowledge base, Exploring the Wumpus world, Semantic net, Inference in semantic networks, Semantic networks: Types and components, Types of relationships in semantic network, Frames, Frames: Some examples, Non-Monotonic logic, Circumscription, Default logic.
	Unit III: Probability (8 Hours)
	Probability, Basic concepts, Probability of an event, Example on Sample Space, counting rules, Event relations, Conditional Probabilities, Defining Independence, The Law of Total Probability, Bayes' Rule, Examples. Random Variables, Discrete Random Variable, Probability Distributions, Probability Mass Function, Probability Density Function, Expectations of Random Variables, Medians of Random Variables, The variance of a RandomVariable,Chebyshev'sInequality,QuantilesofRandomVariables, Jointly Distributed Random Variables, Marginal Probability Distributions, Independence and Covariance, Bayesian Networks, Merits of Bayesian Networks, Construction of a Bayesian Network, Representation in Bayesian Networks, Benefits of Bayesian Networks, Why learn Bayesian networks? Constructing Bayesian networks, Example from medical diagnostics, Software for Bayesian networks, Gaussian Bayesian Networks, Linear Gaussian B N to joint Gaussian, Theorem: From Gaussian to Bayesian networks, Noisy OR-Gate model, Promed as: A clinical diagnostic decision support system, Organization of PROMEDAS development.
	Unit IV: Biological background (7 Hours)
	Biological background - The cell, Chromosome, genes and genomes, Reproduction, Natural selection, Inspiration-Evolution,Classesofsearchtechniques,Introduction-Genetic algorithm,Vocabulary,Pseudocode-GeneticAlgorithm,RouletteWheel's Selection Pseudo Code, Population/Representation, Representation example, Crossover, Mutation, Evaluation and deletion, The traveling sales man problem, Representation, cross over and mutation, TSPExample - 30 cities, Ant colony and artificial ants for TSP, Pheromone trails, Ant colony optimization algorithms, Particle swarm optimization – Introduction, Kenne dyand Eberhart's(1995) refined algorithm, A(partial) example in two dimensions, Algorithm termination, Financial applications,

	Anautomatic stock trading system using Particle Swarm Optimization,PSO based methodology, Trading decision, Considering the GA technology, Some GA application types.
	Unit V: Artificial Neural Network (8 Hours)
	Introduction, Artificial Neural Network, Appropriate problems for neural network learning, Characteristics of the problems, Basic understanding of neural networks, A single neuron, Activation Functions, Architectures of neural networks, Feedforward neural network, Single-Layer feedforward architecture, Multiple-Layer feedforward architecture, Types of feed forward networks, Multi-layer perceptron, Training MLP: The back- propagation algorithm, Step 1: Forward propagation, Step 2: Back propagation and weight updation, Process of learning in neural network, Recurrent or feedback architecture, Mesh Architectures, GRADIENT- DESCENT (training examples, η), Stochastic GRADIENTDESCENT(training examples, η), Multilayer networks and Backpropagation algorithm, The Backpropagation algorithm, Natural language processing, Classical NLP, Feed-forward networks, Recurrent neural networks and recursive networks, Features for NLP problems, Framenet Vs. Wordnet, Features for text, Features for word relations, NGRAM features, Some terminologies.
	Unit VI: Machine Learning (5 Hours)
	Motivation for Machine Learning, Applications, Machine Learning, Learning associations, Classification, Regression, The Origin of machine learning, Uses and abuses of machine learning, Success cases, How do machines learn, Abstraction and knowledge representation, Generalization, Factors to be considered, Assessing the success of learning, Metrics for evaluation of classification method, Steps to apply machine learning to data, Machine learning process, Input data and ML algorithm, Classification of machine learning algorithms, General ML architecture, Group of algorithms, Reinforcement learning, Supervised learning, Unsupervised learning, Semi-Supervised learning, Algorithms, Ensemble learning, Matching data to an appropriate algorithm.
	Unit VII : Regression (5 Hours)
	Supervised Learning, Regression, Linear regression, Multiple linear regression, A multiple regression analysis, The analysis of variance for multiple regression, Examples for multiple regression, Overfitting, Detecting overfit models: Cross validation, Cross validation: The ideal procedure, Parameter estimation, Logistic regression, Decision trees: Background, Decision trees, Decision trees for credit card promotion, An algorithm for building decision trees, Attribute selection measure: Information gain, Entropy, Decision Tree: Weekend example, Occam's Razor, Converting a tree to rules, Unsupervised learning, Semi-Supervised learning, Clustering, K – means clustering, Automated discovery, Reinforcement learning, Multi-Armed Bandit algorithms, Influence diagrams, Risk modelling, Sensitivity analysis, Casual learning.
	Lab Exercise (30 Hours) 1. Normal Distribution 2. Chi Square Distribution 3. Binomial Distribution 4. Poisson Distribution 5. Analyzing one sample 6. Linear Regression

	7. Logistic Regression 8. Support Vector Machine 9. Web Scrapping 10. Random Forests 11. Decision Trees 12. Naïve Bayes Classifier	
10	**References:** 1. Artificial Intelligence: A Modern Approach. Latest Edition: 3rd edition. 2. Artificial Intelligence Engines: A Tutorial Introduction. Latest Edition: 1st edition. 3. Data Science from Scratch: First Principles. Latest Edition: 2nd edition. 4. Applied Artificial Intelligence. Latest Edition:1st edition.	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Name of the Course: Operating Systems		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	In this course students learn os system. And students analyse how to process work. Students learn Unix, windows OS.
2	**Vertical :**	**VSC**
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
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. • Togainknowledgeondistributedoperatingsystemconceptsthatincludesarchitecture Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols • To know the components and management aspects of concurrency management.	
8	**Course Outcomes**: The students should be able to: • Will be able to control access to a computer and the files that may be shared. • Demonstrate the knowledge of the components of computer and their respective roles in computing.	
9	**Modules**:-	
	Unit I: Operating Systems (4 Hours)	
	Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Micro kernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	
	Unit II: Processes , Thread, Process Scheduling (6 Hours)	

	Processes: Definition,ProcessRelationship,DifferentstatesofaProcess, Process Statetransitions, 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-emptiveand Nonpre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.
	Unit III: Inter-process Communication (5 Hours)
	Critical Section, Race Conditions, Mutual Exclusion,HardwareSolution,StrictAlternation,Peterson'sSolution,The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IP C Problems: Reader's & Writer Problem, Dinning Philosopher Problematic.
	Unit IV: Deadlocks (5 Hours)
	Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.
	Unit V: Memory Management (5 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 VI: I/O Hardware (5 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	**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, William Stallings, Prentice Hall of India. 3. Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018) 4. OperatingSystem:ADesign-orientedApproach,1stEditionbyCharles Crowley, Irwin Publishing 5. OperatingSystems:AModernPerspective,2ndEditionbyGaryJ.Nutt,Addison-Wesley 6. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India.	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Name of the Course: Database Management Systems		
Sr. No.	**Heading**	**Particulars**
1	**Description the course :** **Including but Not limited to :**	The objective of this course is to introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide in sight into related research problems
2	**Vertical :**	**SEC**
3	**Type :**	Theory
4	**Credit**:	2 credits (1 credit = 15 Hours for Theory)
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 • 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.	
8	**Course Outcomes**: The students should be able to: • Will be able to control access to a computer and the files that may be shared. • Demonstrate the knowledge of the components of computer and their respective roles in computing.	
9	**Modules**:-	

	Unit I Database system architecture (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: Relational query languages (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 the need for indentation, Working at the command linear in the IDE.	
	Unit III: Storage strategies (6 Hours)	
	Storage strategies: Indices, B-trees, Hashing	
	Unit IV: Transaction (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: Database Security (4 Hours)	
	Database Security: Authentication, Authorization And access control, DAC, MAC and RBAC models, Intrusion detection, SQLinjection.	
10	**References:** 1. DatabaseSystemConcepts",6th Edition by A Braham 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. 3. Database Management Systems, R.P.Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook–2018)	
11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

QUESTION PAPER PATTERN
(External and Internal)

Question paper pattern

Continuous External Evaluation (Marks 60)
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.

Continuous Internal Evaluation (Marks 40)

Sr. No	Particulars	Marks
1	Assignments	10
2	Classroom Presentations	5
3	Internal Test	10
4	Lab Exercise/ Mini Project	15

For 2 Credit Courses
External/Semester End Examination (Marks 30) Time 1 Hr

1. Q1 is Compulsory (10 marks)
2. Solve any 4 out of 6 question

Continuous Internal Evaluation (20 Marks)

Sr. No	Particulars	Marks
1	Classroom Presentation	5
2	Internal Test	10
3	Assignments /Essay Submission/Field visit report/Educationalactivity report	5

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

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

Appendix B

Justification for B.Sc. (Artificial Intelligence and Sports Analytics)

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