University of Mumbai

वेबसाईट – mu.ac.in
ईमेल - आयडी - dr.aams@fort.mu.ac.in
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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई – ४०० ०३२
टेलिफोन नं. – ०२२ – ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७ दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने **शैक्षणिक वर्ष २०२५-२६** पासून **पदवी व पदव्युत्तर अभ्यासक्रम** विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई – ४०० ०३२
२७ मे, २०२५

(डॉ. प्रसाद कारंडे)
कुलसचिव

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
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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 :-	
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3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

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

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

AC – 20/05/2025
Item No. – 8.50 (N)

As Per NEP 2020

University of Mumbai

Program: B.Sc. (Artificial Intelligence and Sports Analytics)

Semester –III, IV, V, VI

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:_____**	**B.SC.(Artificial Intelligence and Sports Analytics)**
2	**Exit Degree**	**U.G. Diploma in ____**
3	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	**Standards of Passing** **R: _____**	**40%**
5	**Credit Structure** **Sem. III – R. IMU-555C** **Sem. IV – R. IMU-555D** **Sem. V – R. IMU-555E** **Sem. VI – R. IMU-555F**	**Attached herewith**
6	**Semesters**	**Sem. III & IV**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

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

Under Graduate Diploma in <u>Artificial Intelligence and Sports Analytics</u>

Credit Structure (Sem. III & IV)

	R. IMU-555C									
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	Machine Learning (4 credits), Foundation of AI (4 credits)		4 To be picked from University Basket	2 To be picked from University Basket	Internet and Web Programming (2 credits),	AEC:2 To be picked from University Basket	FP: 2 CC:2 To be picked from University Basket	22	**UG Diploma 88**
	R. IMU-555D									
	IV	Deep Learning (4 credits), Data Mining and Warehousing (4 credits)		4 To be picked from University Basket	2 To be picked from University Basket	R Programming (2 credits)	AEC:2 To be picked from University Basket	CEP: 2 CC:2 To be picked from University Basket	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

Under Graduate Diploma in Artificial Intelligence and Sports Analytics

Credit Structure (Sem. V & VI)

	R. IMU-555E								
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	V	Pattern Recognition and Anomaly Detection (4 credits), Analytics for Industries (4 credits) Project 1 (2 credits)		4 To be picked from University Basket	2 To be picked from University Basket	2	AEC:2	FP: 2 CC:2	22	**UG Diploma 88**
	R. IMU-555F									
	VI	Computational Linguistics and NLP 2 (4 credits), Application of ML in Industries (4 credits) Project 2 (2 credits)		4 To be picked from University Basket	2 To be picked from University Basket	2	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										

[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 – Community Engagement Project, CC – Co-Curricular, RP – Research Project]

Sem. - III

Semester III	
Subject Name	**Credit**
Major (Mandatory)	
Machine Learning	4
Foundation of AI	4
Minor	
To be picked from University Basket	2
To be picked from University Basket	2
OE - Open Electives	
To be picked from University Basket	2
VSC - Vocational Skills Course	
Internet and Web Programming	2
AEC - Ability Enhancement Course	
To be picked from University Basket	2
FP - Field Project	
To be picked from University Basket	2
CC - Co-curricular Course	
To be picked from University Basket	2

Syllabus
B.Sc. (Artificial Intelligence and Sports Analytics)
(Sem.- III)

Semester III

Sr. No.	Subjects	Subject Type	Credits	Internal	External	Total
1	Machine Learning	Major	4	40	60	100
2	Foundation of AI	Major	4	40	60	100
3	Internet and Web Programming	VSC	2	20	30	50
4	Pick from University Basket	Minor	2	20	30	50
5	Pick from University Basket	Minor	2	20	30	50
6	Pick from University Basket	OE	2	20	30	50
7	Pick from University Basket	AEC	2	20	30	50
8	Pick from University Basket	FP	2	20	30	50
9	Pick from University Basket	CC	2	20	30	50

BSc (Artificial Intelligence and Sports Analytics)
(Sem.- III)
Title of Paper: Machine Learning

Sr. No.	Heading	Particulars
1	**Description the course :**	• This course provides a comprehensive introduction to the theory and practice of machine learning. • Machine learning is a field of study that focuses on developing algorithms and models that enable computers to learn from data and make predictions or decisions without being explicitly programmed. • This course covers a wide range of machine learning techniques and their applications, equipping students with the skills necessary to understand, implement, and evaluate machine learning models.
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 fundamental concepts and principles of machine learning, including supervised learning, unsupervised learning, and reinforcement learning. • Familiarize with various types of machine learning algorithms, such as decision trees, support vector machines, neural networks, and ensemble methods. • Learn about data preprocessing techniques, including feature selection, feature scaling, and handling missing data. • Gain knowledge of different evaluation metrics and techniques to assess the performance of machine learning models. • Explore model selection and hyperparameter tuning techniques for optimizing machine learning algorithms.	
8	**Course Outcomes**: • Understand the concepts of overfitting, underfitting, and bias-variance tradeoff in machine learning. • Learn about different techniques for handling imbalanced datasets and dealing with class imbalance problems. • Gain practical experience in implementing machine learning algorithms using popular libraries and frameworks such as Scikit-learn and TensorFlow. • Apply machine learning techniques to real-world datasets and solve various prediction, classification, and clustering tasks. • Understand the ethical considerations and implications of machine learning, including fairness, transparency, and interpretability. • Explore advanced topics in machine learning, such as deep learning, natural language processing, and computer vision.	

9	**Modules**:-
	Module 1: 7 Hours Introduction, Motivation for machine learning, Applications, Machine learning, Classification, Regression, The origin of machine learning, Time line of machine learning techniques, Uses and abuses of machine learning, How do machines learn, Abstraction and knowledge representation, Generalization, Assessing the success of learning, Steps to apply machine learning to data, Input data and ML algorithm, Machine learning methods, Unsupervised learning, Semi-supervised learning, Clustering, What are we looking for? Classification of machine learning algorithms, General ML architecture, Reinforcement learning, Supervised learning, Unsupervised learning, Semi-supervised learning, Regularization algorithms, Clustering algorithms, Deep learning algorithms, Ensemble learning, Matching data to an appropriate algorithm.
	Module 2: **7 Hours** Introduction, Supervised learning, Regression, Regression examples, Regression models, Steps in regression analysis, Linear regression, Simple linear regression, Least squares estimation, Least squares regression-Line of best fit, Illustration, Direct regression method, Maximum likelihood estimation, Matrix approach, Regression assumptions and model properties, Coefficient of determination (R-squared), Example, Testing for significance, Testing hypothesis in simple linear regression, Illustration, Checking model adequacy, Over-fitting, Detecting over-fit models: Cross validation, Cross validation: The ideal procedure, Logistic regression.
	Module 3: 6 Hours Introduction, Ordinary least squares estimation for multiple linear regression, Multiple linear regression model building, Partial correlation and regression model building, Multiple linear regression model, Interpretation of multiple linear regression coefficients-Partial regression coefficients, Standardized regression coefficients, Missing data, Validation of multiple regression model, Coefficient of multiple determination (R-Squared), Adjusted R-squared, Statistical significance of individual variables in multiple linear regression: t-Test.
	Module 4: 10 Hours Preamble: Machine learning, To classify faces and expressions, Introduction, ML classifier, Classification and general approach, Classification algorithms, Instance based learning, K-Nearest neighbour, Decision trees, Attribute selection measure: Information gain, ID3 algorithm, Decision tree: weekend example, Converting a tree to rules, Bayesian algorithms, Ensemble, Stories of success, Why ensemble works? Ensemble of classifiers, Bagging, Boosting, Random forests, Neural networks, Activation functions, Feedforward neural network, Multi-layer perceptron, Backprop algorithm, Recurrent or feedback architecture, Perceptron rule, Gradient-descent (training examples, η), Multilayer networks and back propagation algorithm, Support vector machine, Classification model evaluation and selection, ROC curves, Cost Benefit Analysis (CBA).
	Module 5 : 7 Hours Clustering, Clustering algorithms, More common clustering situation, Statistics associated with cluster analysis, General applications of clustering, Clustering as a pre-processing tool, Hard vs. soft clustering, Similarity and dissimilarity between objects, Type of data in clustering analysis, Binary variables, Nominal variables, Ordinal variables, Major clustering approaches, Types of clusters, Cluster centroid and distances, Hierarchical clustering, Hierarchical Agglomerative Clustering (HAC), Hierarchical Agglomerative Clustering: Linkage method, Hierarchical Agglomerative Clustering: Variance and Centroid method, Cluster distance measures, Single link agglomerative clustering, Complete-link clustering, Average-link clustering, Other agglomerative clustering methods, Distance between two

	clusters, Hierarchical clustering: Time and Space requirements, K - means clustering, Importance of choosing initial centroids, The K-medoids clustering method, PAM (Partitioning Around Medoids), CLARA (Clustering Large Applications), CLARANS (Randomized CLARA), Density based clustering methods, DBSCAN: Density Based Spatial Clustering of Applications with Noise, When DBSCAN Does NOT Work Well, External criteria for clustering quality, Different aspects of cluster validation, Measures of cluster validity, Measuring cluster validity via correlation, Using similarity matrix for cluster validation, Internal measures: SSE, Framework for cluster validity, Internal measures: Cohesion and Separation, Internal measures: Silhouette coefficient.	
	Module 6: 8 Hours Information retrieval: introduction, Information retrieval process, Information retrieval architecture, how do we represent document? Information retrieval models, Similarity metric, Term weighting, Retrieval in vector space model, Constructing inverted index (word counting), Stop words removal, Stemming, Text document clustering, Agglomerative vs. divisive, Impact of cluster distance measure, Buckshot clustering, Issues related to cosine similarity, Validity of document clusters, Text datasets, Experimental evaluation.	
10	**Text Books:** NA	
11	**Reference Books:** 1. The Hundred-Page Machine Learning Book by Andriy Burkov. 2. Machine Learning For Absolute Beginners by Oliver Theobald. 3. Programming Collective Intelligence by Toby Segaran. 4. Machine Learning for Humans by Vishal Maini and Samer Sabri.	
	Lab Exercises –(30 hours) Exercise 1: Linear Regression Exercise 2: Best Fit for LR Exercise 3: Logistic Regression Exercise 4: Logistic Regression - New Product Purchase Dataset Exercise 5: Multiple Linear Regression Exercise 6: Multiple Linear Regression Using Random Data Exercise 7: KNN Accuracy Prediction Exercise 8: KNN algorithm implementation on Breast Cancer Data Exercise 9: KNN algorithm implementation with random value and its power calculation Exercise 10: Implement a Decision Tree using Balance Scale Dataset Exercise 11: Implement Naïve Bayes Classification Using iris data Exercise 12: Implement Support vector machine using random dataset Exercise 13: Implement Principal component analysis with Wine dataset Exercise 14: Implement Bagging using Sonar Dataset Exercise 15: Implement Boosting using Mushroom Dataset and AdaBoost Classifier Exercise 16: DBSCAN with credit card Dataset	
12	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
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)

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- III)
Title of Paper: Foundation of Artificial Intelligence

Sr. No.	Heading	Particulars
1	**Description the course :**	• The objectives of this course are to provide students with comprehensive and in-depth knowledge of AI principles and techniques by introducing AI's fundamental problems, and the state-of-the-art models and algorithms used to undertake these problems. • This course is also designed to expose students to the frontiers of AI-intensive computing and information systems, while providing a sufficiently strong foundation to encourage further research.
2	**Vertical :**	Major
3	**Type :**	Theory & Practical
4	**Credit**:	4 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	100 Marks
7	**Course Objectives**: • Compare AI with human intelligence and traditional information processing and discuss its strengths and limitations as well as its application to complex and human-centred problems. • Discuss the core concepts and algorithms of advanced AI, including informed searching, CSP, logic, uncertain knowledge and reasoning, dynamic Bayesian networks, graphical models, decision making, multiagent, inductive learning, statistical learning, reinforcement learning, deep learning, natural language processing, robotics, and so on.	
8	**Course Outcomes**: • Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems. • Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.	
9	**Module I: (2 Hours)** Introduction Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem.	
	Module II (2 Hours) : Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.	

	Module III (3 Hours) : Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	
	Module IV (10 Hours) : Solving problems by searching : problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies.	
	Module V (10 Hours) : Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems.	
	Module VI (8 Hours) : Adversarial search :Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening. Knowledge & reasoning :Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic :Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction	
	Module VII (5 Hours) : Representing knowledge using rules : Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge. Probabilistic Reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	
	Module VIII (5 Hours) : Expert Systems : Representing and using domain knowledge, expert system shells, knowledge acquisition.	
10	**Text Books: NA**	
11	**Reference Books:** 1. Artificial Intelligence, Ritch & Knight, TMH 2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson 3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI 4. Poole, Computational Intelligence, OUP 5. Logic & Prolog Programming, Saroj Kaushik, New Age International 6. Expert Systems, Giarranto, VIKAS 7. Artificial Intelligence, Russel, Pearson	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 10 Marks Assignments 10 Marks Mid Term Exam 10 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)	

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- III)
Title of Paper: Internet Web and Programming

Sr. No.	Heading	Particulars
1	**Description the course :**	• Knowledge of basic SW engineering methods and practices, and their appropriate application. • Describe software engineering layered technology and Process frame work. • A general understanding of software process models such as the waterfall and evolutionary models.
2	**Vertical :**	VSC
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • On completion of this course, a student will be familiar with client server architecture and able to develop a web application using java technologies. • Students will gain the skills and project based experience needed for entry into web application and development careers.	
8	**Course Outcomes**: • Understand best technologies for solving web client/server problems • Analyze and design real time web applications • Use Java script for dynamic effects and to validate form input entry • Analyze to Use appropriate client-side or Server-side applications	
9	**Module I: (7 Hours)** Internet and WWW: What is Internet?, Introduction to internet and its applications, E- mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, and internet address World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers - internet explorer, netscape navigator, opera, firefox, chrome, mozilla. Search engine, web saver - apache, IIS, proxy server, HTTP protocol.	
	Module II (13 Hours) : HTML and Graphics : HTML Tag Reference, Global Attributes, Event Handlers, Document Structure Tags, Formatting Tags, Text Level formatting, Block Level formatting, List Tags, Hyperlink tags, Image and Image maps, Table tags, Form Tags, Frame Tags, Executable content tags. Imagemaps : What are Imagemaps? Client-side Imagemaps, Server-side Imagemaps, Using Server-side and Client-side Imagempas together, alternative text for Imagemaps, Tables : Introduction to HTML tables and their structure, The table tags, Alignment, Aligning Entire Table, Alignment within a row, Alignment within a cell, Attributes, Content Summary, Background color, Adding a Caption, Setting the width, Adding a border, Spacing within a cell, Spacing between the cells, spanning multiple rows or columns, Elements that can be placed in a table, Table Sections and column properties, Tables as a design tool	

	Frames : Introduction to Frames, Applications, Frames document, The tag, Nesting tag, Placing content in frames with the tag, Targeting named frames, Creating floating frames, Using Hidden frames. Forms : Creating Forms, The <FORM> tag,Named Input fields, The <INPUT> tag, Multiple lines text windows, Drop down and list boxes, Hidden, Text, Text Area, Password, File Upload, Button, Submit, Reset, Radio, Checkbox, Select, Option, Forms and Scripting, Action Buttons, Labelling input files, Grouping related fields, Disabled and read-only fields, Form field event handlers, Passing form data Style Sheets: What are style sheets?, Why are style sheets valuable? Different approaches to style sheets, Using Multiple approaches, Linking to style information in s separate file, Setting up style information, Using the <LINK> tag, embedded style information, Using <STYLE> tag, Inline style information	
	Module III (10 Hours) : Java Script: Introduction, Client-Side JavaScript, Server-Side JavaScript, JavaScript Objects, JavaScript Security, Operators: Assignment Operators, Comparison Operators, Arithmetic Operators, % (Modulus), ++ (Increment), -- (Decrement), -(Unary Negation), Logical Operators, Short-Circuit Evaluation, String Operators, Special Operators, ? (Conditional operator), ,(Comma operator), delete, new, this, void Statements : Break, comment, continue, delete, do … while, export, for, for…in, function, if…else, import, labelled, return, switch, var, while, with, Core JavaScript (Properties and Methods of Each) : Array, Boolean, Date, Function, Math, Number, Object, String, regExp Document and its associated objects : document, Link, Area, Anchor, Image, Applet, Layer Events and Event Handlers : General Information about Events, Defining Event Handlers, event, onAbort, onBlur, onChange, onClick, onDblClick, onDragDrop, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove, onReset, onResize, onSelect, onSubmit, onUnload	
10	**Text Books: NA**	
11	**Reference Books:** 1. Web Design The complete Reference, Thomas Powell, Tata McGrawHill 2. HTML and XHTML The complete Reference, Thomas Powell, Tata McGrawHill 3. JavaScript 2.0 : The Complete Reference, Second Edition by Thomas Powell and Fritz Schneider	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 5 Marks Presentation 5 Marks Assignments 5 Marks Mid Term Exam 5 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)	

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O: _____A**	**A**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
	O: _____B	**B**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
	O: 6769	**C**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
2	**Eligibility** **O: 6770**	**A**	Passed under 10 + 2 scheme of any recognized State / Central / International Board
	O: _____B	**B**	Under Graduate Certificate in _____ Academic Level 4.5
	O: _____C	**C**	Under Graduate Diploma in _____ Academic Level 5.0
3	**Duration of program** **R: Three Years Program (06 Semesters)**	**A**	One Year
		B	Two Years
		C	Three Years
4	**Intake Capacity** **R: 9512**	**60 (Sixty)**	

5	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
6	**R: 9511 Standards of Passing**	40%
7	**Credit Structure** **Sem. I - R: _____A** **Sem. II - R: _____B**	Attached herewith

	Credit Structure **Sem. III - R: _____C** **Sem. IV - R: _____D**		
	Credit Structure **Sem. V - R: _____E** **Sem. VI - R: _____F**		
8	**Semesters I & II**	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2023-24	

1) 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 <u>Artificial Intelligence and Sports Analytics.</u>

	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	Machine Learning (4 credits), Foundation of AI (4 credits)		4 To be picked from University Basket	2 To be picked from University Basket	Internet and Web Programming (2 credits),	AEC:2 To be picked from University Basket	FP: 2 CC:2 To be picked from University Basket	22	**UG Diploma 88**
	R:_____D									
	IV	Deep Learning (4 credits), Data Mining and Warehousing (4 credits)		4 To be picked from University Basket	2 To be picked from University Basket	R Programming (2 credits)	AEC:2 To be picked from University Basket	CEP: 2 CC:2 To be picked from University Basket	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										

Sem. - IV

Semester IV	
Subject Name	**Credit**
Major (Mandatory)	
Deep Learning	4
Data Mining and Warehousing	4
Minor	
To be picked from University Basket	2
To be picked from University Basket	2
OE - Open Electives	
To be picked from University Basket	2
SEC - Skill Enhancement Course	
R-Programming	2
AEC - Ability Enhancement Course	
To be picked from University Basket	2
CEP - Continuing Education Program	
To be picked from University Basket	2
CC - Co-curricular Course	
To be picked from University Basket	2

Syllabus
B.Sc. (Artificial Intelligence and Sports Analytics)
(Sem.- IV)

Semester IV

Sr. No.	Subjects	Subject Type	Credits	Internal	External	Total
1	Deep Learning	Major	4	40	60	100
2	Data Mining and Warehousing	Major	4	40	60	100
3	R-Programming	SEC	2	20	30	50
4	Pick from University Basket	Minor	2	20	30	50
5	Pick from University Basket	Minor	2	20	30	50
6	Pick from University Basket	OE	2	20	30	50
7	Pick from University Basket	AEC	2	20	30	50
8	Pick from University Basket	CEP	2	20	30	50
9	Pick from University Basket	CC	2	20	30	50

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- IV)
Title of Paper: Deep Learning

Sr. No.	Heading	Particulars
1	**Description the course :**	• This course provides a comprehensive introduction to the field of deep learning, which focuses on developing and training neural networks with multiple layers to solve complex problems. • Deep learning has revolutionized various domains, including computer vision, natural language processing, and speech recognition. • This course covers the fundamental concepts, architectures, and techniques of deep learning, enabling students to understand, implement, and apply deep learning models effectively..
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 fundamental concepts and principles of deep learning, including neural networks, activation functions, and backpropagation. • Familiarize with various deep learning architectures, such as feedforward neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), and generative adversarial networks (GANs). • Learn about different types of layers and their functionalities in deep learning models, including fully connected layers, convolutional layers, and recurrent layers. • Gain knowledge of different activation functions and their impact on the performance of deep learning models. • Explore optimization algorithms and techniques for training deep neural networks, including stochastic gradient descent (SGD), Adam optimizer, and learning rate schedules. • Understand techniques for regularization and handling overfitting in deep learning, such as dropout, batch normalization, and early stopping.	
8	**Course Outcomes**: • Learn about transfer learning and pre-trained models for leveraging existing deep learning architectures and weights. • Gain practical experience in implementing deep learning models using popular deep learning libraries and frameworks such as TensorFlow and PyTorch. • Apply deep learning techniques to real-world problems in computer vision, natural language processing, and other relevant domains.	

	• Explore advanced topics in deep learning, such as deep reinforcement learning, attention mechanisms, and generative models. • Understand the ethical considerations and implications of deep learning, including bias, fairness, and interpretability.
9	**Module I: (4 Hours)** How is deep learning different from other machine learning, AI vs ML vs DL, Deep learning capabilities, Other approaches to artificial intelligence, what is special about deep learning? Relevance of deep learning.
	Module II: (6 Hours) Supervised learning, Unsupervised learning, Memory based learning, Memory based learning techniques, Hebbian learning, Hebbian learning modifications: Mathematical models, Competitive learning, Error- correction learning, Boltzmann learning, Learning tasks: Pattern association, Learning tasks: Pattern recognition and function approximation, Learning tasks: Control and filtering, Learning tasks: Beamforming, Memory, Adaptations, Statistical nature of the learning process, Statistical learning theory, Probably approximately correct model of learning, Adaptive filtering problems, Unconstrained optimization techniques, Linear least-squares filters, Least-mean-square algorithms, Learning curves, Learning rate annealing techniques, Perceptron, Perceptron convergence theorem, MLP concepts, Backpropagation algorithm, XOR problem, Heuristics for making backpropagation algorithm perform better, Output representation and decision rules, Feature detection, Backpropagation and differentiation, Hessian matrix, Generalization, Approximations of functions, Cross- validations, Network pruning techniques, Virtues and limitations of backpropagation learning, Accelerated convergence of backpropagation learning, Supervised learning viewed as optimization problem, Cover's theorem on the separability of patterns, Interpolation problem, Regularization theory and regularization networks, Generalized radial- basis function networks, Estimation of the regularization parameter, Approximation properties of RBF networks, Comparison of RBF networks and multilayer perceptron, Kernel regression and its relation to RBF networks, Learning strategies in RBF networks, Simulated annealing, Boltzmann machines, Deterministic Boltzmann machine.
	Module III: (5 Hours) How does a neural network look like? The matrix magic, Visualizing deep learning, The elephant in the room, Programmatic expression of deep learning's math constructs, Operations with the tensors, Array broadcasting, Scalar product/Inner product of tensors, Morphing shapes of tensors, Gradient calculation.
	Module IV: (5 Hours) Deep learning depths, Model: The molecules of DL, Loss functions in neural networks, Optimizers in neural networks, Activation functions, Finding the perfect fit, Running deep learning algorithms: The frameworks, Real examples and actual schematics of building neural nets, Data preparation and label preparation, Examples of neural networks at work, Readying data for neural nets, Constructing the network, ReLU, Constructing the network, Approach validation, Plotting the loss from validation & training, What experiments do we run next? An example in regression: Guess the price of the house, Processing the data, Building the network, K-fold approach for validating algorithm, K-fold approach: In code.

	Module V (5 Hours) : Convolutional neural networks, What and how of ConvNets, Example 1, Example 2, Convolution effectiveness, what is this convolution and why is it effective? Visualization of 2D convolution, Visualization of 3D convolution, Building a model without any max-pooling layers, How to train a CNN on a dataset from ground-up, Importance of deep learning when data is limited, Downloading Datasets, Working on it, Building a CNN, one layer at a time, Data preprocessing: Preparing the data, Accuracy & loss: Data processing, Making the most of what's available: Data Augmentation, Accuracy & loss: Data augmentation, Using a trained CNN, How about extracting features without augmenting data? Accuracy & loss: Without data augmentation, how about extracting features with augmenting data? Accuracy & loss: With augmenting data, Tuning the CNN, what do Convolutional Neural Network (CNN, or ConvNet) see? Seeing the intermediate, Points to ponder, Visualizing the filters themselves, looking at heat maps of how filters seek details.
	Module VI (7 Hours) : Recurrent Neural Network (RNN), Why recurrent networks? RNN explained, Deep RNNs, Recursive neural networks, Step function, Tanh function, RNN in memory, LSTMs and GRUs, Long Short Term Memory (LSTM), Working components of LSTMs, Core idea behind LSTMs, LSTM: A simple walk through, Gated Recurrent Unit (GRU), GRU design steps, Fully gated vs minimal gated architecture of GRU, Working of RNN's, Recurrent neural networks, Backpropagation through timeline in RNN, Backpropagation through Computational graphs, Problem Statement 1, Problem Statement 2, Complex recurrent neural networks, Over-fitting and under-fitting, Detect and avoid overfitting, Prevent of overfitting an approach on model and data, Multi-layered RNNs, Stacked LSTM, Stacked LSTM architecture, Multi-directional RNNs, Difference between LSTM and BI-LSTM, One-dimensional sequence processing, CNN and RNN.
	Module VII (4 Hours) : Generative deep learning, Using LSTMs to synthesize text, Text synthetization procedures, Neural style transfer and applications, NST working principle, Content and style management in NST, NST implementation, Image synthesis with variational auto encoders, Need for image synthesis, Working models, Variational Auto Encoders (VAE), Latent space, Generative Adversarial Networks (GAN's), Generative and discriminative algorithms, Applications using GAN, GAN working principle, Generator and discriminator, Training GAN, Implementing GAN: 1st generation.
	Module VIII (5 Hours) : MIMO deep learning models, Concept in MIMO, Auto-Encoder with SISO modelling, Supervised learning in wireless communications, Un- Supervised learning in wireless communications, Reinforcement learning in wireless communications, Q learning in wireless communications, Multi armed bandits in D2D networks in wireless communications, Layers graphs: Acyclic and directional, Directed acyclic graphs, Introducing cyclic graphs in neural networks, Creating matrices from graphs, Multi-scale CNN, Can layers share weights?, Hyperparameter tuning, Process and features, Hyperparameter categories, Hyperparameter specification approaches, Hyperparameter tuning process, Algorithms, Hyperparameter working and optimization, Hyperparameter value flow, Ensemble modeling: Bag of tricks, Ensemble techniques: Simple level, Ensemble techniques: Advanced level, Bagging vs boosting, Advantages and disadvantages of ensemble, Algorithms using bagging and boostingt
	Module VIII (5 Hours) : Information-theoretic machine learning, Basic concepts of information theory, Information processing in analog channels, Some common terminologies, Deep neural networks: Information theoretical perspective, Information bottleneck methodology, Concepts to remember, Capacity modelling theorems, Characteristics of deep neural network layers, Phases in double optimization, Encoder and decoder in DNN, Learning theory, Stochastic relation and hidden layers, Applying information gain, Hebbian learning, Implementation of Hebbian learning in a perceptron, Limitations of Hebbian learning, Competitive learning,

	What is competition in neural networks? Characteristics of competitive learning, Criteria for competitive learning, Architecture and implementation, Mathematical representation, Competitive learning, Competitive learning rule, Hebbian learning and competitive learning, Boltzmann learning, Boltzmann machines, Energy-Based Models (EBMs), Restricted Boltzmann machines, Restricted Boltzmann machines- working, Radial-basis function networks, RBF network architecture, RBF neuron activation function, RBFN as a neural network, Advantages of using RBNN than the MLP.
	Module IX (4 Hours) : Information-theoretic machine learning, Basic concepts of information theory, Information processing in analog channels, Some common terminologies, Deep neural networks: Information theoretical perspective, Information bottleneck methodology, Concepts to remember, Capacity modelling theorems, Characteristics of deep neural network layers, Phases in double optimization, Encoder and decoder in DNN, Learning theory, Stochastic relation and hidden layers, Applying information gain, Hebbian learning, Implementation of Hebbian learning in a perceptron, Limitations of Hebbian learning, Competitive learning, What is competition in neural networks? Characteristics of competitive learning, Criteria for competitive learning, Architecture and implementation, Mathematical representation, Competitive learning, Competitive learning rule, Hebbian learning and competitive learning, Boltzmann learning, Boltzmann machines, Energy-Based Models (EBMs), Restricted Boltzmann machines, Restricted Boltzmann machines- working, Radial-basis function networks, RBF network architecture, RBF neuron activation function, RBFN as a neural network, Advantages of using RBNN than the MLP.
10	**Text Books: NA**
11	**Reference Books:** *1. Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.* *2. "Deep Learning with Python" by François Chollet.* *3. "Deep Learning for Computer Vision" by Adrian Rosebrock.* *4. "Deep Reinforcement Learning" by Pieter Abbeel and John Schulman. 5."Generative Deep Learning" by David Foster.* 5. *6."Deep Learning with PyTorch" by Eli Stevens, Luca Antiga, and Thomas Viehmann.*
	Lab Exercises –(30 hours) Exercise 1: Print Dimensions of dataset Exercise 2: Calculation of accuracy values Exercise 3: Compose Matrix Shape and Tensor Shape Exercise 4: LMS Implementation Exercise 5: Back-Propagation Implementation Exercise 6: Accessing and manipulation of tensors Exercise 7: Training a binary classifier Exercise 8: Access and manipulation of tensors Exercise 9: Regression Data Sampling Exercise 10: Combatting Overfitting Problem in NN Exercise 11: Training a CNN Exercise 12: Model Reusability Exercise 13: Model accuracy comparison and cleaning Exercise 14: Stages of the convnet Exercise 15: Sequence Classification Problem Exercise 16: Text-to-Speech synthesis Exercise 17: Text Generation Exercise 18: Automatic Image Captioning Exercise 19: Automatic Image Captioning with Keras Exercise 20: Facial Recognition Exercise 21: Digit Recognition

	Exercise 22: Hand Movement Recognition Exercise 23: Implementing a Recurrent Neural Network Exercise 24: RNN generating "Flower" names	
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)	

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- IV)
Title of Paper: Data Mining and Warehousing

Sr. No.	Heading	Particulars
1	**Description the course :**	• Students will identify the core concepts of distributed systems: the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	4 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	100 Marks
7	**Course Objectives**: • This course is an introduction to the design of distributed systems and algorithms that support distributed computing.	
8	**Course Outcomes**: • Students will learn the concepts of Data Mining and Warehousing.	
9	**Module I: (8 Hours)** • Introduction to Data Mining • Basic Data Mining Tasks • DM versus Knowledge Discovery in Databases • Data Mining Issues • Data Mining Metrics • Social Implications of Data Mining • Overview of Applications of Data Mining	

	Module II (8 Hours) • Introduction to Data Warehousing • Architecture of DW • OLAP and Data Cubes • Dimensional Data Modeling-star, snowflake schemas • Data Preprocessing – Need, Data Cleaning, Data Integration & Transformation, Data Reduction • Machine Learning • Pattern Matching	
	Module III (8 Hours) • Data Mining Techniques • Frequent item-sets and Association rule mining: Apriori algorithm, Use of sampling for frequent item-set, FP tree algorithm • Graph Mining: Frequent sub-graph mining, Tree mining, Sequence Mining.	
	Module IV (20 Hours) • Classification & Prediction • Decision tree learning: Construction, performance, attribute selection Issues: Over-fitting, tree pruning methods, missing values, continuous classes Classification and Regression Trees (CART) • Linear classifiers • Least squares, logistic, perceptron and SVM classifiers • Prediction • Linear regression • Non-linear regression	
	Module V (8 Hours) Accuracy Measures Precision, recall, F-measure, confusion matrix, cross-validation, bootstrap.	
	Module VI (8 Hours) Software for data mining and applications of data mining R, Weka, Sample applications of data mining	
10	**Text Books: NA**	
11	**Reference Books:** 1. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India 2. Data Warehousing, Data Mining, & OLAP - Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill Education 3. Data warehouse Toolkit by Ralph Kimball, Wiley India	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 05 Marks Presentation 05 Marks Assignments 05 Marks Practical Exam 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)	

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- IV)
Title of Paper: R Programming

Sr. No.	Heading	Particulars
1	**Description the course :**	• In this course students will learn how to program in R and how to use R for effective data analysis. • You will learn how to install and configure software necessary for a statisticalprogramming environment, discuss generic programming language concepts as they are implemented in a high-level statistical language.
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 basic concept of R programming • To learn basic and advanced data structure in R Programming • To learn and implement advanced concept of data visualization techniques using R	
8	**Course Outcomes**: • The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions, debugging, and organizing and commenting R code.	
9	**Module I: (4 Hours)** Introduction to R – Help Functions in R – Vectors – Vectorized Operations –Functions in R – Packages in R.	
	Module II (8 Hours) : Matrices, Arrays and Lists Matrix Operations – Adding and Deleting Rows and Columns – Higher Dimensional Arrays – Lists – General List Operations – Accessing List Components and Values – Applying functions to Lists	
	Module III (6 Hours) : Data Frames Creating Data Frames – Matrix-like Operations on a Data Frame – Merging Data Frames – Applying functions to Data Frames – Factors and Tables – Common Functions used with Factors – Working withTables.	

	Module IV (6 Hours) : OOP S3 Classes – S4 Classes – Managing the Objects – Input / Output – Accessing Keyboard and Monitor – Reading and Writing Files – accessing the Internet – String Manipulation.	
	Module V (4 Hours) : Data Visualization Introduction to GGPlot2 – Factors – Aesthetics – Plotting with Layers – Overriding Aesthetics – Mapping vs Setting – Histograms – Density Charts – Statistical Transformation – Facets – Coordinates – Themes.	
10	**Text Books: NA**	
11	**Reference Books:** 1. Norman Matloff , "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011. 2. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013. 3. Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013 4. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.	
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)	

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Title of program** **O: _____A**	**A**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
	O: _____B	**B**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
	O: 6769	**C**	**B.Sc. (Artificial Intelligence and Sports Analytics)**
2	**Eligibility** **O: 6770**	**A**	Passed under 10 + 2 scheme of any recognized State / Central / International Board
	O: _____B	**B**	Under Graduate Certificate in _____ Academic Level 4.5
	O: _____C	**C**	Under Graduate Diploma in _____ Academic Level 5.0
3	**Duration of program** **R: Three Years Program (06 Semesters)**	**A**	One Year
		B	Two Years
		C	Three Years
4	**Intake Capacity** **R: 9512**	**60 (Sixty)**	

5	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
6	**R: 9511 Standards of Passing**	40%
7	**Credit Structure** **Sem. I - R: _____A** **Sem. II - R: _____B**	Attached herewith

	Credit Structure **Sem. III - R: _____C** **Sem. IV - R: _____D**		
	Credit Structure **Sem. V - R: _____E** **Sem. VI - R: _____F**		
8	**Semesters I & II**	A	Sem I & II
		B	Sem III & IV
		C	Sem V & VI
9	**Program Academic Level**	A	4.5
		B	5.0
		C	5.5
10	**Pattern**	Semester	
11	**Status**	New	
12	**To be implemented from Academic Year Progressively**	From Academic Year: 2023-24	

2) 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 Artificial Intelligence and Sports Analytics.

	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	Machine Learning (4 credits), Foundation of AI (4 credits)		4 To be picked from University Basket	2 To be picked from University Basket	Internet and Web Programming (2 credits),	AEC:2 To be picked from University Basket	FP: 2 CC:2 To be picked from University Basket	22	**UG Diploma 88**
	R:_____D									
	IV	Deep Learning (4 credits), Data Mining and Warehousing (4 credits)		4 To be picked from University Basket	2 To be picked from University Basket	R Programming (2 credits)	AEC:2 To be picked from University Basket	CEP: 2 CC:2 To be picked from University Basket	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

Sem. - V

Semester V	
Subject Name	**Credit**
Major (Mandatory)	
Pattern Recognition and Anomaly Detection	4
Computational Linguistics and NLP-1	4
Project 1	2
Minor	
To be picked from University Basket	2

To be picked from University Basket	2
OE - Open Electives	
To be picked from University Basket	2
SEC - Skill Enhancement Course	
To be picked from University Basket	2
AEC - Ability Enhancement Course	
To be picked from University Basket	2
FP - Field Project	
To be picked from University Basket	2

Syllabus
B.Sc. (Artificial Intelligence and Sports Analytics)
(Sem.- V)

Semester V

Sr. No.	Subjects	Subject Type	Credits	Internal	External	Total
1	Pattern Recognition and Anomaly Detection	Major	4	40	60	100
2	Computational Linguistics and NLP-1	Major	4	40	60	100
3	Project 1	Major	2	20	30	50

4	Pick from University Basket	VSC	2	20	30	50
5	Pick from University Basket	Minor	4	40	60	100
6	Pick from University Basket	FP	2	20	30	50
7	Pick from University Basket	CEP	2	20	30	50

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- V)
Title of Paper: Pattern Recognition and Anomaly Detection

Sr. No.	Heading	Particulars
1	**Description the course :**	• This course focuses on the theory, algorithms, and applications of pattern recognition and anomaly detection. Pattern recognition involves identifying and classifying patterns in data, while anomaly detection focuses on identifying abnormal or unusual instances in datasets. • These techniques find applications in various domains, including fraud detection, cybersecurity, quality control, and medical diagnostics. This course explores the fundamental concepts,

		methods, and tools used in pattern recognition and anomaly detection, providing • students with the knowledge and skills to effectively analyze and interpret complex datasets.
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 concepts and principles of pattern recognition and anomaly detection. • Explore different types of pattern recognition techniques, such as statistical methods, machine learning algorithms, and neural networks. • Learn about feature extraction and selection methods for representing patterns in data. • Familiarize with classification and clustering algorithms commonly used in pattern recognition and anomaly detection tasks. • Gain knowledge of evaluation metrics and techniques to assess the performance of pattern recognition and anomaly detection models. • Understand the challenges and considerations in applying pattern recognition and anomaly detection in real-world scenarios. • Learn about various applications of pattern recognition and anomaly detection, including fraud detection, image and speech recognition, network intrusion detection, and medical diagnosis.	
8	**Course Outcomes**: • Gain hands-on experience in implementing pattern recognition and anomaly detection techniques using relevant software tools and libraries. • Explore advanced topics in pattern recognition and anomaly detection, such as deep learning approaches and ensemble methods. • Understand the ethical considerations and privacy implications in pattern recognition and anomaly detection. • Learn how to interpret and communicate the results of pattern recognition and anomaly detection analyses effectively. • Learn about natural language processing (NLP) and computer vision techniques in AI.	
9	**Unit I: (7 Hours)** What is pattern? What is pattern recognition? Pattern recognition techniques, Training and learning in pattern recognition, Pattern recognition applications, Pattern recognition use cases, what is anomaly detection? What are some other practical uses for anomaly detection? How is anomaly detection calculated over time? Key point for AI and ML- anomaly detection, Tasks for artificial intelligence, AI system learning process, Test to geometric requirements for curves algebraic, Curves matched to data points, Case study: Anomaly detection with IBM Watson, Probability theory, Maximum likelihood theory and estimation, Model selection, Matrices of uncertainty (confusion matrices), Loss of logging (log-loss), Rate for F1 (F1 score), Metric selection, Hyperparameter selection, The problem with high dimensionality, Information theory.	

	Unit II (10 Hours) Understanding statistics, T-test, Z-test, Z-test and t-test difference, P-value, Descriptive statistics, Type I error, Type II error, Differences between type I and type II errors, Null hypothesis, Statistical significance, Hypothesis testing, Four steps of hypothesis testing, Real-world example of hypothesis testing, Bonferroni test, Check of one-tailed, Probability distributions, Types of distributions, Regression models, Types of regression, How to select the best model for regression? Common questions, Linear models for classification, Example of positive linear regression.
	Unit III (9 Hours) Neural networks, how neural networks learn? Neural networks examples, Neural networks use cases, Kernel methods, Sparse kernel machines use cases, Graphical models, Mixture models and EM, Bayesian networks: Directed graphical models, Conditional probability distributions, Potential functions, Conditional independences, Sampling methods for pattern recognition, Continuous latent variables, Combining models for pattern recognition, Markov chain Monte Carlo, The K-means algorithm, Applications of K-means.
	Unit IV (10 Hours) What are anomalies? Applications of anomaly detection, Related use cases, Types of input data, Types of anomalies, Evaluation of an anomaly detector, Taxonomy of approaches, Classification based, Classification use cases, Supervised classification techniques, Nearest neighbour based techniques, Others model techniques, Information theory, Contextual anomaly based, Collective anomaly detection, On-line based model, Distributed anomaly detection, IDS analysis strategy..
	Unit V (9 Hours) Network intrusion detection, Understanding of IDS core operation, How an IDS works? Types of intrusion detection systems, Fundamental concerns of intrusion detection systems, Intrusion detection vs. intrusion prevention, The future of IDS, Anomaly detection in big data, Key attributes of advanced anomaly detection, The real-world impact of anomaly detection, Anomaly detection on 5G: Possibilities and opportunities, Real time anomaly detection in docker, Hadoop cluster, Anomaly detection in IoT, Detection of deviations in deep learning time series results, Anomaly detection use cases, Anomaly detection with time series forecasting, What is time series analysis? Time series data models, how to find anomaly in time series data? Anomaly detection using machine learning, Anomaly detection using deep learning, Anomaly detection for an e-commerce pricing system, IBM's Watson AIOps automates IT anomaly detection and remediation.
10	**Text Books:**
11	**Reference Books:** 5. Pattern Recognition and Machine Learning" by Christopher M. Bishop. 6. Anomaly Detection: Principles and Algorithms" by Chandola, Varun, Arindam Banerjee, and Vipin Kumar. 7. Pattern Classification" by Richard O. Duda, Peter E. Hart, and David G. Stork. 8. Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy. 9. Introduction to Statistical Pattern Recognition" by Keinosuke Fukunaga. 10. Data Mining: Concepts and Techniques" by Jiawei Han, Micheline Kamber, and Jian Pei. 11. Pattern Recognition: Statistical, Structural and Neural Approaches" by Robert J. Schalkoff.
	Lab Exercises- (30 Hours) Exercise 1: Polynomial Curve Fitting Exercise 2: Probability and Distribution Exercise 3: Simple Linear regression Exercise 4: Multiple Linear regression Exercise 5: Logistic regression Model Exercise 6: Polynomial regression for classification

	Exercise 7: Neural Networks Exercise 8: Sparse Kernel Machines Exercise 9: Sampling Methods for Pattern Recognition Exercise 10: Decision Tree Exercise 11: Random Forest Exercise 12: SVM – Support vector Machine Exercise 13: Local Outlier Factor (LOF) Exercise 14: Cluster based Local Outlier Factor (CBLOF) Exercise 15: Local Density Cluster based Outlier Factor (LDCOF) Exercise 16: Local Correlation Integral (LOCI) Exercise 17: Influenced Outlierness (INFLO) Exercise 18. Local Outlier Probability (LoOP) Exercise 19: Connectivity based Outlier Factor (COF) Exercise 20: OpenCV - Object Detection with CAM Exercise 21: OpenCV - Object Detection with Video Exercise 22: OpenCV - Color Filtering Exercise 23: OpenCV - Object Detection with Haar cascade Exercise 24: Graph Theory Exercise 25: GUI for pattern detection	
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)	

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- V)
Title of Paper: Computational Linguistics and NLP 1

Sr. No.	Heading	Particulars

1	**Description the course :**	• This course introduces Science undergraduate learners to the fundamental concepts and practical applications of Natural Language Processing (NLP).
2	**Vertical :**	Major
3	**Type :**	Theory & Practical
4	**Credit**:	4 credits
5	**Hours Allotted :**	75 Hours
6	**Marks Allotted**:	100 Marks
7	**Course Objectives**: • Develop a foundational understanding of Natural Language Processing and its significance in language analysis.	
8	**Course Outcomes**: • Learn about different techniques for handling imbalanced datasets and dealing with class imbalance problems. • Gain practical experience in implementing machine learning algorithms using popular libraries and frameworks such as Scikit-learn and TensorFlow. • Apply machine learning techniques to real-world datasets and solve various prediction, classification, and clustering tasks. • Understand the ethical considerations and implications of machine learning, including fairness, transparency, and interpretability. • Explore advanced topics in machine learning, such as deep learning, natural language processing, and computer vision.	
9	**Module I: (9 Hours)** Introduction to Natural Language Processing (NLP) and its importance in understanding human language. Overview of linguistic levels: Morphology (word structure), Syntax (sentence structure), Semantics (meaning), Pragmatics (context usage).	
	Module II (9 Hours) Traditional text processing methods and tools, including statistical methods and text classification. Scope and significance of text analysis and processing in various domains. Evaluation methods for text classification and extraction processes.	

	Module III (9 Hours) Creating text corpora and the role of annotations in NLP tasks. Basic understanding of statistical techniques and their relevance in NLP. Hidden Markov Models for Part-of-Speech (POS) tagging and word sense disambiguation.	
	Module IV (9 Hours) Introduction to speech recognition and machine translation technologies. Challenges and limitations in statistical machine translation	
	Module V (9 Hours) Exploring statistical parsing techniques and their application in understanding sentence structure. Word similarity and text similarity methods for measuring semantic relationships	
10	**Text Books: NA**	
11	**Reference Books:** 4. The Handbook of Computational Linguistics and Natural Language Processing Editor(s): Alexander Clark PhD,, Dr Chris Fox, Shalom Lappin First published:29 June 2010 5. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper 6. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin 7. "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and Hinrich Schütze.	
	Lab Practical(30 hours): Different case study.	
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)	

(Sem.- V)

Title of Paper: Project 1

Sr. No.	Heading	Particulars
1	**Description the course :**	• The Project Implementation course in Analytics builds upon the knowledge and skills acquired

		in previous semesters, focusing on the practical implementation of data science projects. • Students will work on real-world projects, applying data science methodologies and techniques to solve complex problems. • They will gain hands-on experience in data collection, preprocessing, feature engineering, and model development.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To enable students to apply the knowledge and skills acquired during the B.Sc Data Science program in the implementation of a data science project. • To provide students with hands-on experience in implementing data science methodologies and techniques to solve real-world problems.	
8	**Course Outcomes**: • To develop students' project management skills by planning, executing, and monitoring a data science project. • To enhance students' collaboration and teamwork abilities by working in groups to implement a data science project. • To foster students' critical thinking and problem-solving skills by addressing challenges and making informed decisions during the project implementation phase.	
9	**Unit I: (30 Hours)** Students can undertake industrial project.	
10	**Text Books: NA**	
11	**Reference Books:**	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 10 Marks Assignment 10 Marks Oral Test 10 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)	

Sem. - VI

Semester V	
Subject Name	**Credit**
Major (Mandatory)	
Computational Linguistics and NLP 2	4
Application of ML in Industries	4
Project 2	2
Minor	
To be picked from University Basket	2
To be picked from University Basket	2
OE - Open Electives	
To be picked from University Basket	2
SEC - Skill Enhancement Course	
To be picked from University Basket	2
AEC - Ability Enhancement Course	
To be picked from University Basket	2

FP - Field Project	
To be picked from University Basket	2

Syllabus
B.Sc. (Artificial Intelligence and Sports Analytics)
(Sem.- VI)

Semester VI

Sr. No.	Subjects	Subject Type	Credits	Internal	External	Total
1	Computational Linguistics and NLP 2	Major	4	40	60	100
2	Application of ML in Industries	Major	4	40	60	100
3	Project 2	Major	2	20	30	50
4	Pick from University Basket	VSC	2	20	30	50
5	Pick from University Basket	Minor	4	40	60	100
6	Pick from University Basket	FP	2	20	30	50

8	Pick from University Basket	CEP	2	20	30	50

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- VI)
Title of Paper: Computational Linguistics and NLP 2

Sr. No.	Heading	Particulars
1	**Description the course :**	• Students will explore linguistic levels, traditional text processing methods, statistical techniques, parsing, information retrieval, and various NLP applications. The course aims • to equip students with essential skills to analyze and process text data, understand language structures, and apply NLP techniques in real-world contexts.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	4 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted**:	100 Marks

7	**Course Objectives**: • Understand parsing techniques for analyzing sentence structures and word relationships. • Learn about information retrieval using NLP and its applications in question answering and information extraction.	
8	**Course Outcomes**: • Explore emerging applications of NLP, including multimedia presentations, education, and healthcare. • Develop practical skills to evaluate and apply NLP techniques for text analysis and processing.	
9	**Unit I: (15 Hours)** Applications of NLP in various domains: Information extraction, report generation, and ontology construction. Introduction to multimedia presentation generation: Integrating multimedia elements with NLP.	
	Unit II (15 Hours) : Data collection strategy, Content sharing, Challenges in the social media data collection, Characteristics of people-centric approach, Social graph, Influencers, Community managers, Scripted dialogue and language interfaces in intelligent tutoring systems. Introduction to argumentation techniques for healthcare information dissemination. Basics of sentiment analysis and its role in understanding opinions. Defocus, Construction of 3D model from images	
	Unit III (10 Hours) : Exploration of emerging NLP applications: Multimedia presentations, education, and healthcare. NLP models in healthcare and their contributions to medical data analysis	
	Unit IV (5 Hours) : Document-level and sentence-level sentiment analysis: Understanding and categorizing sentiment in text. Introduction to opinion summarization: Condensing opinions and reviews for efficient analysis., Medial representations, Multiresolution Analysis	
	Practical (30 hours) : 10 Different Case Study	
10	**Text Books: NA**	
11	**Reference Books:** *6. "Introduction to Information Retrieval" by Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze* *7. "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data" by Dipanjan Sarkar* 8. *"Natural Language Processing for Computational Linguistics and Artificial Intelligence" by Roberto Garigliano*	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**

13	**Continuous Evaluation through:** Class Tests 10 Marks Presentations 10 Marks Assignment 10 Marks Oral Exam 10 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)	

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- VI)
Title of Paper: Application of Machine Learning in Industries

Sr. No.	Heading	Particulars
1	**Description the course :**	• The Application of Machine Learning in Industries course provides students with an in-depth understanding of how machine learning techniques are applied across various industries to solve real-world problems and drive business outcomes. • The course focuses on practical applications, case studies, and hands-on experience to demonstrate the potential and impact of machine learning in different sectors.
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 principles and fundamentals of machine learning. • Explore the diverse applications of machine learning across industries. • Gain knowledge of industry-specific challenges and considerations in applying machine learning.
8	**Course Outcomes**: • Develop skills in selecting and implementing machine learning algorithms for specific industry use cases. • Apply machine learning techniques to real-world datasets in different industries.
9	**Unit I: (4 Hours)** Why machine learning in banking sector, Use of AI in banking and finance, Fraud detection, Tough competition in banking industry, Risk modeling and investment banks, Customer data management, Decreased customer experience and loyalty, Personalized marketing, Role of machine learning: Challenges of banking sector and securities, Widely used machine learning algorithm in banking and security, Fraud prevention and detection systems, Rule based and machine learning based approach in fraud detection, Anomaly detection: Ways to expose suspicious transactions in banks, Advanced fraud detection systems, Risk management systems, Case study: Application of machine learning for financial risk management, Credit risk analysis using machine learning classifier, Investment prediction systems, Portfolio management systems, Objectives of portfolio management, Algorithmic trading, Deep learning for customer services, Chatbot: Deep learning approach, AI powered marketing systems, Deep learning in cyber security, Types of cyber- attacks in banks, Deep learning methods used in cyber security, Deep learning v/s restricted Boltzmann machines, Convolution Neural Networks (CNNs), Recurrent neural networks, Machine learning techniques: Loan underwriting & sentiment/news analysis, Sentiment or news analysis, Current challenges and opportunities: Banking and security domain.
	Unit II (5 Hours) Machine learning in communication, media and entertainment, Usage of machine learning in media and entertainment industry, Machine learning techniques for customer sentiment analysis, World embedding's, Sentiment analysis with long short term memory networks, Real-time analytics in communication, media and entertainment industries, Real time analytics and social media, Deep learning for social media analytics, Recommendations engines, Collaborative filtering, Memory based collaborative filtering, Model based collaborative filtering, Content based filtering, Hybrid recommendation systems, Summary of recommendation systems, Deep learning techniques on recommender systems
	Unit III (4 Hours) Applications of machine learning in health and life sciences, The most important applications of machine learning in healthcare, Role of machine learning in drug discovery, Machine learning approaches in drug discovery, Medical image analysis, Why deep learning for medical image analysis, Neural network and deep learning architecture, Comparisons between architecture of different types of deep learning models, Machine learning in genetics and genomics, Genomics and AI background, Two category of genomics, How to use deep learning effectively, Interpreting deep learning models, Predictive medicine: Prognosis and diagnostics accuracy, Predictive medicine: Examples, ML applications in breast cancer diagnosis and prognosis.

	Unit IV (5 Hours) Machine learning in education, Advantages of machine learning in education, learning analytics, Academic analytics, Action research, Educational data mining, Recommender system, Personalized adaptive learning, Learning analytics process, Data environment: What? Stakeholders: Who? Methods: How? Case study: Sentimental analysis for student's feedback using ML, Recommender systems in education, Domain model, Learner model, Students classification algorithm, Recommendation model, Case study: Application of ML in predicting students' performance, Proposed methodology, Data description, Sample data sets, Visualization, Selection of machine learning technique.
	Unit V (4 Hours) Introduction, Applications of machine learning in manufacturing industry, Deep learning for smart manufacturing, Machine learning for quality control in manufacturing, Case study, Construction of CNN, Experimental results, Efficiency of CNN for defect detection, Comparative experiments, Machine learning for fault assessment, Time frequency methods, Spectrograms: Short-Time Fourier Transform (STFT), Scalograms: Wavelet transform, Hilbert-Huang transform, Proposed CNN architecture for fault classification based on vibration signals, Case study, Machinery failure prevention technology, Conclusion.
	Unit VI (5 Hours) Importance of machine learning in insurance, Potential use cases of machine leaning in insurance industry, Case study on insurance climb analysis using machine learning algorithms, Case study on using machine learning for insurance pricing optimization, Personalized marketing in insurance industry, Predictive model for insurance underwriting, Case study: Risk prediction in life insurance industry.
	Unit VII (4 Hours) Importance of machine learning in insurance, Potential use cases of machine leaning in insurance industry, Case study on insurance climb analysis using machine learning algorithms, Case study on using machine learning for insurance pricing optimization, Personalized marketing in insurance industry, Predictive model for insurance underwriting, Case study: Risk prediction in life insurance industry.
	Unit VIII (5 Hours) Introduction, Inventory management, Few use case examples, Benefits of predictive analytics to retailers, Robots-seeing to customer satisfaction, IoT: Prevention first, Predictive analytics: Weathering demand, Analysing buying patterns, Analysing traffic patterns, Assortment planning, Eliminate guess work, Feed the right stores, Get better information, Assortment planning to drive supply chain, Retail analytics, Domestic forecasting, Case study: Forecasting seasonal footwear demand using ML, Demand forecasting methods, Predictor variables in demand forecasting, Traditional techniques v/s machine learning techniques, Methodology, Machine learning techniques used, List of attributes from the aggregated data by month at the style level, Feature selection and engineering, List of attributes for feature selection, Dataset partitioning, Model building, Three step model, K-means clustering, Three steps followed in classification, Three sub-steps in prediction, Performance measurement, Results, Three step model, Machine learning for supply chain management, Recommended architecture for machine learning models, Machine learning models use case.

	Unit IX (4 Hours) Introduction, Applications of ML and artificial intelligence in transportation, Applications of machine learning in transport, Incident detection, Predictive models, Application of AI in aviation and public transportation, Aviation, Shared mobility, Buses, Intelligent urban mobility, Autonomous vehicles, Autonomous transportation, Artificial intelligence use cases in logistics, Back office AI, Cognitive customs, Predictive logistics, Predictive risk management, Seeing thinking and speaking logistics operations, ML powered customer experience, Limitations of AI techniques in transportation, Computation complexity of AI algorithms.	
	Unit X (5 Hours) Introduction, Smart grid, Smart grid technologies, Key characteristics of smart grid, Machine learning applications in smart grid, Machine learning techniques for renewable energy generation, Forecasting renewable energy generation, Wind power generation, Solar energy generation, Hydro power generation, Determining plant location, size and configuration, Managing renewable energy-integrated smart grid, Machine learning applications in wind energy forecasting, Case study: Wind power forecasting based on daily wind speed data, Wind energy output calculations based on hourly wind speed, Machine learning techniques used, LASSO regression, KNN regression, xGBoost regression, Random forest regression, Support vector regression, Wind power forecasting method using machine learning algorithm, About data set, Case studies, Case 1: Wind power forecasting based on daily mean wind speed and standard deviation, Forecasting accuracy of algorithms, Case 2: Wind power forecasting based on only daily mean wind speed, Case 3: Wind power forecasting for a different region.	
10	**Text Books: NA**	
11	**Reference Books:** 8. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron. 9. Applied Predictive Modeling" by Max Kuhn and Kjell Johnson. 10. Machine Learning for Healthcare" by Pradeep Chowriappa. 11. Machine Learning in Action" by Peter Harrington. 12. Machine Learning for Dummies" by John Paul Mueller and Luca Massaro. 13. Big Data: A Revolution That Will Transform How We Live, Work, and Think" by Viktor Mayer- Schönberger and Kenneth Cukier.	
	Lab Exercises (30 hours)– Exercise 1 - Wine Quality Prediction Exercise 2 - Housing Price Prediction Exercise 3 - Air Quality Prediction Exercise 4 - Bank Marketing Campaign Exercise 5 - Liver Disease Prediction Exercise 6 - Heart Disease Prediction Exercise 7 - Credit Default Prediction Exercise 8 - Car Price Prediction Exercise 9 - Media Content Problem Exercise 10 - Online Retail Case Study Exercise 11 - Airline Passengers Prediction Exercise 12 - Energy Efficiency Analysis Exercise 13 - Stock Price Prediction Exercise 14 - Car Evaluation Exercise 15 - Movie Sentiment 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)

Syllabus
BSc. (Artificial Intelligence and Sports Analytics)
(Sem.- VI)
Title of Paper: Project 2

Sr. No.	Heading	Particulars
1	**Description the course :**	• The Project Implementation course in Analytics builds upon the knowledge and skills acquired in previous semesters, focusing on the practical implementation of data science projects. • Students will work on real-world projects, applying data science methodologies and techniques to solve complex problems. • They will gain hands-on experience in data collection, preprocessing, feature engineering, and model development.
2	**Vertical :**	Major
3	**Type :**	Theory
4	**Credit**:	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted**:	50 Marks
7	**Course Objectives**: • To enable students to apply the knowledge and skills acquired during the B.Sc Data Science program in the implementation of a data science project. • To provide students with hands-on experience in implementing data science methodologies and techniques to solve real-world problems.	
8	**Course Outcomes**: • To develop students' project management skills by planning, executing, and monitoring a data science project. • To enhance students' collaboration and teamwork abilities by working in groups to implement a data science project. • To foster students' critical thinking and problem-solving skills by addressing	

	challenges and making informed decisions during the project implementation phase.	
9	**Unit I: (30 Hours)** Students can undertake industrial project.	
10	**Text Books: NA**	
11	**Reference Books:**	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class Tests 10 Marks Presentation 10 Marks Assignment 10 Marks Oral Test 10 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)	

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

Sd/-
Sign of the BOS Chairman
Dr. Manoj N. Reddy
Ad-hoc Board of Studies in Sports Science and Management

Sd/-
Sign of the Offg. Associate Dean
Dr. C.A.Chakradeo
Faculty of Interdisciplinary Studies

Sd/-
Sign of the Offg. Associate Dean
Dr. Kunal Ingle
Faculty of Interdisciplinary Studies

Sd/-
Sign of the Offg. Dean
Prof. A. K. Singh
Faculty of Interdisciplinary Studies