Mahatma Education Society's

Pillai College of Arts, Commerce & Science (Autonomous)

Affiliated to University of Mumbai

'NAAC Accredited 'A' grade (3 cycles)'
'Best College Award' by University of Mumbai
ISO 9001:2015 Certified

SYLLABUS

Program: Master of Science (M. Sc.) in Data Analytics

M.Sc.- Part II Data Analytics

PCACS/PMSDA/SYL/2024-25/PII

As per National Education Policy
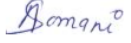Choice Based Credit & Grading System

Academic Year 2024-25
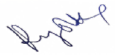
Mahatma Education Society's

Pillai College of Arts, Commerce & Science

(Autonomous)

Affiliated to University of Mumbai

NAAC Accredited 'A' grade (3 cycles)

Best College Award by University of Mumbai

ISO 9001:2015 Certified

Board of Studies in the Department of Computer Science

Sr. No.	Name of the	Details	Sign
1	Prof. Deepika Sharma	Chairperson (Head of Department of Information Technology & Computer Science), Vice Principal	
2	Dr. Gajanan Wader	Principal	
3	Mrs.Munawira Kotyad Founder and CEO Wonderwheel Enterprises, Pillai, Director Pillai Center for Innovation & Research	Faculty Specialization	Absent
4	Dr. Amiya Kumar Tripathy Director Center for GeoAI & ML, Professor, Computer Engineering, Don Bosco Institute of Technology, Mumbai	Subject Expert From Outside Parent University	
5	Dr.Mrs. Anjali Kulkarni CKT College, New Panvel	Vice Chancellor Nominee, University of Mumbai	
6	Mr. Tito Idicula, Director, Programming Hub	Alumni representative	
7	Mr. Anant Baddi, Security Solution Architect, cloud Google	Industry Representative (Industry/Corporate/Allied Sector)	Absent

	Google		
8	Mr. Bhupendra Kesariya Professor,N. M. .College, Vile Parle	Subject Expert in Mathematics From Outside Parent University	
9	Mrs. Anju Somani	Faculty Specialization	
10	Mrs. Shubhangi Pawar	Faculty Specialization	
11	Dr. Kumudini Das	Faculty Specialization	Absent
12	Mrs. Soly Zachariah	Faculty Specialization	
13	Mrs. Ramya S. Kumar	Faculty Specialization	
14	Mrs. Sujata Shahabade	Faculty Specialization	
15	Mrs. Sreevidya T.V.	Faculty Specialization	
16	Mr. Omkar Sherkhane	Faculty Specialization	
17	Mr. Abhijeet Salvi	Faculty Specialization	

Introduction to M.Sc. Data Analytics Program

M.Sc. Data Analytics is a two years post graduate programme that concentrates on creating links between theory and practice. Data Analytics is the process of analyzing sets of data to guide business decisions, plus its business benefits and different types of analytics.

It covers a wide variety of software and hardware technologies and their applications. Students will also gain practical problem solving and program design skills; Students learn how to think more carefully and how to solve real world problems more effectively.

They will not only develop a diverse set of skills to prepare for their curriculum and for employment, but will also be encouraged to launch their own startups or venture into new types of careers using their interdisciplinary training.

Our curriculum exposes students to modern advancements. As we all know M.Sc. degrees in Data Analytics lead to rewarding and lucrative careers, excellent placement and incubation assistance is provided.

Program Outcomes

Sr No	PO Title	POs in brief
PO1	Advanced Knowledge and Expertise	Demonstrate a systematic, extensive and coherent knowledge and understanding of their academic discipline as a whole and its applications, and links to related disciplinary areas/subjects of study; demonstrate a critical understanding of the latest developments in the subject, and an ability to use established techniques of analysis and enquiry within the subject domain with a global perspective.
PO2	Research and Innovation	Acquire comprehensive knowledge about current research and innovation, and acquire techniques and skills required for identifying problems and issues to produce a well-researched written work that engages with various sources employing a range of disciplinary techniques and scientific methods applicable.
PO3	Interdisciplinary Perspective	Commitment to intellectual openness and developing understanding beyond subject domains; answering questions, solving problems and addressing contemporary social issues by synthesizing knowledge from multiple disciplines.
PO4	Leadership Abilities & Entrepreneurial Mindset	Inculcate Leadership skills, including the ability to lead teams, manage projects, and make strategic decisions. innovation and entrepreneurship, business development, technology commercialization, and startup creation
PO5	Communication Competence	Demonstrate effective oral and written communication skills to covey disciplinary knowledge and to communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the subject(s) of study
PO6	Ethical Conduct and Research Integrity	Understanding and adherence to ethical standards and research integrity by developing commitment towards professional ethics and responsibilities as a social endeavor.
PO7	Career development	Demonstrate subject-related knowledge and skills that are relevant to academic, professional, soft skills and employability required for higher education and placements.
PO8	Commitment to the society and to the Nation	Recognise the importance of social, environmental, human and other critical issues faced by humanity at the local, national and international level; appreciate the pluralistic national culture and the importance of national integration.

Program Specific Outcomes

Sr. No	PSOs in brief
PSO1	Competence in employing principles, techniques and tools of data analytics for business analytics.
PSO2	Curiosity and readiness to deal with small and big data and ability to engage in exploratory research.
PSO3	Capability to become a successful trainer in data science, data analytics, productive decision maker and therefore well-respected personality at work and in life.
PSO4	Students completing this programme will become full-stack data scientists, well-equipped for a variety of job roles depending on their choices and temperament including Data Scientists, Data Analysts as well as Industrial and Societal Entrepreneurs.

Course Structure

		Semester III				
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures/ Week**
PMSDA301	**Major**	Machine Learning	Theory	100	4	4
PMSDA302	**Major**	Sentiment Analysis	Theory	100	4	4
PMSDA303	**Major**	Internet of Things	Theory	100	4	4
PMSDA304	**Major Elective**	A. Business Analytics B. Digital Footprints: Unraveling Web Analytics C. Computational Social Networks	Theory	50	2	4
PMSDA305P	**Major Practical**	Practicals (PMSDA301 + PMSDA302)	Practical	100	2	4
PMSDA306P	**Major + Elective Practical**	Practicals (PMSDA303 + PMSDA304)	Practical	100	2	4
PMSDA307	**RP**	Research Project	-	100	4	2
Total				650	22	26
All Subjects having Field Project as part of Continuous Assessment-2						

Abbreviations:

RP : Research Project

Semester IV						
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures/ Week**
PMSDA401	**Major**	Artificial Intelligence	Theory	100	4	4
PMSDA402	**Major**	Deep Learning	Theory	100	4	4
PMSDA403	**Major**	Natural Language Processing	Theory	100	2	4
PMSDA404P	**Major Practical**	Practicals (PMSDA401)	Practical	50	2	2
PMSDA405P	**Major Practical**	Practicals (PMSDA402)	Practical	50	2	2
PMSDA406P	**Major Practical**	Practicals (PMSDA403)	Practical	50	2	2
PMSDA407	**RP**	Project Dissertation with Implementation.	-	200	6	4
Total				650	22	22
All Subjects having Field Project as part of Continuous Assessment-2						

Abbreviations:

RP : Research Project

Evaluation Pattern

Marking Code	Marking Scheme
A	60 Marks Final Exam, 20 Marks Internal Exam, 15 Marks Field Project, 5 Marks Attendance
B	100 marks distributed within report /case study/ project/ presentation etc.
C	50 Marks Practical Examination.
D	100 Marks Practical Examination. Subject 1 Practical (50 Marks) + Subject 2 Practical (50 Marks) =100
E	200 Marks distributed within project dissertation & implementation report / internship period / certificate etc.
F	50 Marks Theory Exam.

Semester III				
Course Code	**Course Type**	**Course Title**	**Evaluation Pattern**	**Marks**
PMSDA301	**Major**	Machine Learning	A	100
PMSDA302	**Major**	Sentiment Analysis	A	100
PMSDA303	**Major**	Internet of Things	A	100
PMSDA304	**Major Elective**	a. Business Analytics b. Digital Footprints: Unraveling Web Analytics c. Computational Social Networks	F	50
PMSDA305P	**Major Practical**	Practicals (PMSDA301 + PMSDA302)	D	100
PMSDA306P	**Major + Elective Practical**	Practicals (PMSDA303 + PMSDA304)	D	100
PMSDA307	**RP**	Research Project	B	100
Total				650

Semester IV				
Course Code	**Course Type**	**Course Title**	**Evaluation Pattern**	**Marks**
PMSDA401	**Major**	Artificial Intelligence	A	100
PMSDA402	**Major**	Deep Learning	A	100
PMSDA403	**Major**	Natural Language Processing	A	100
PMSDA404P	**Major Practical**	Practicals (PMSDA401)	C	50
PMSDA405P	**Major Practical**	Practicals (PMSDA402)	C	50
PMSDA406P	**Major Practical**	Practicals (PMSDA403)	C	50
PMSDA407	**RP**	Project Dissertation with Implementation.	E	200
Total				650

SEMESTER - III

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	III
Course Name	Machine Learning
Course Code	PMSDA301
Type of course	Major
Level of the Subject	Advanced
Credit points	4 Theory + 1 Practical

Course Objectives:
1. Understanding Human learning aspects & primitives in the learning process by computer.
2. Understanding the nature of problems solved with Machine Learning.

Unit No	Unit Name	Topic No.	Content	Hours
1	Introduction, ML Models, Features	1.1	**Introduction:** Machine learning, Examples of Machine Learning Problems, Structure of Learning, learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks,	**15**
		1.2	**Machine learning Models:** Geometric Models, Logical Models, and Probabilistic Models. **Features:** Feature types, Feature Construction and Transformation, Feature Selection.	
2	Classification, Regression & Theory of Generalization	2.1	**Classification:** Binary Classification- Assessing Classification performance, Class probability Estimation Assessing class probability Estimates, Multiclass Classification.	**15**
		2.2	**Regression:** Assessing performance of Regression- Error measures, Overfitting- Catalysts for Overfitting, Case study of Polynomial Regression. **Theory of Generalization:** Effective number of hypotheses, Bounding the Growth function, VC Dimensions, Regularization theory.	
3	Linear Model, Logic Based Algebraic Model	3.1	**Linear Models:** Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.	**15**

		3.2	**Logic Based and Algebraic Model:** **Distance Based Models:** Neighbors and Examples, Nearest Neighbors Classification, Distance based clustering-K means Algorithm, Hierarchical clustering,	
4	Logic Based and Algebraic Model:	4.1	**Logic Based and Algebraic Model:** **Rule Based Models:** Rule learning for subgroup discovery, Association rule mining. Tree Based Models: Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees. **Probabilistic Model:** Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood,	**15**
		4.2	**Probabilistic Model :** Probabilistic Models with Hidden variables: Estimation-Maximization Methods, Gaussian Mixtures, and Compression based Models. **Trends In Machine Learning:** Model and Symbols-Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Data Streams and Active Learning, Deep Learning, Reinforcement Learning.	
Total No. of Lectures				**60**

Course Outcomes:

1. Understand the key issues in Machine Learning and its associated applications in intelligent business and scientific computing.
2. Acquire the knowledge about classification and regression techniques where a learner will be able to explore his skill to generate database knowledge using the prescribed techniques.
3. Understand and implement the techniques for extracting the knowledge using machine learning methods.
4. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.
5. Illustrate the statistical approach related to machine learning.
6. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Books and References:

1. Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge University Press , 2012
2. Introduction to Statistical Machine Learning with Applications in R, Hastie, Tibshirani, Friedman, Springer, 2nd edition, 2012
3. Introduction to Machine Learning, Ethem Alpaydin, PHI, 2nd edition 2013
4. "Machine Learning" by Tom M. Mitchell
5. "Pattern Recognition and Machine Learning" by Christopher Bishop
6. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron

	CASE STUDY

1	Case Study 1: Dell and Persado Partnership
	    Background
	Dell, a global technology leader, faced challenges in their email marketing campaigns. They wanted to improve engagement and response rates by optimizing their email content.
	    The Problem
	Dell's marketing team struggled with crafting effective email content. They needed a data-driven solution to enhance their communication with customers and increase response rates.

2	Case Study 2: Sky UK and Adobe Sensei Integration
	    Background
	Sky UK, a British telecommunication service, aimed to transform customer experiences using machine learning and artificial intelligence.
	    The Problem
	Sky UK wanted to enhance customer experiences by leveraging machine learning algorithms.

Practicals

Practical No	Details
1	Feature Engineering
2	Regression :Simple Linear Regression, Polynomial Linear Regression, Ridge Regression, Lasso Regression
3	Support Vector Machine
4	K- Mean Clustering
5	K- Nearest Neighbor
6	Hierarchical Clustering
7	Apriori Algorithm
8	Information Gain, Naive Bayes
9	Decision Tree
10	Random Forest

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	III
Course Name	Sentiment Analysis
Course Code	PMSDA302
Type of course	Major
Level of the Subject	Advanced
Credit points	4 Theory + 1 Practical

Course Objectives:
1. The main objective of this course is for the students to gain knowledge about sentiment analysis and its applications.
2. Explore the working principles of sentiment analysis, including natural language processing and statistical analysis.

Unit No.	Unit Name	Topic No.	Content	Hours
1	Introduction & Sentiment Analysis Applications	1.1	Sentiment Analysis Applications: Sentiment Analysis Research - Opinion Spam Detection. The Problem of Sentiment Analysis: Problem Definitions - Opinion Summarization – Different Types of Opinions - Subjectivity and Emotion - Author and Reader Standing Point. Document Sentiment	15
		1.2	Classification: Sentiment Classification Using Supervised Learning – Sentiment Classification Using Unsupervised Learning - Sentiment Rating Prediction – Cross-Domain Sentiment Classification- Cross-Language Sentiment Classification.	
2	Sentence Subjectivity and Sentiment Classification:	2.1	Sentence Subjectivity and Sentiment Classification: Subjectivity Classification – Sentence Sentiment Classification - Dealing with Conditional Sentences -	15
		2.2	Dealing with Sarcastic Sentences – Cross language Subjectivity and Sentiment Classification - Using Discourse Information for Sentiment Classification.	
3	Aspect-based Sentiment Analysis	3.1	Aspect-based Sentiment Analysis: Aspect Sentiment Classification - Basic Rules of Opinions and Compositional Semantics - Aspect Extraction - Identifying Resource Usage Aspect	15

		3.2	Simultaneous Opinion Lexicon Expansion and Aspect. Extraction: Grouping Aspects into Categories - Entity, Opinion Holder and Time Extraction - Coreference Resolution and Word Sense Disambiguation.	
4	Sentiment Lexicon Generation & Opinion Search and Retrieval	4.1	Sentiment Lexicon Generation: Dictionary-based Approach - Corpus-based Approach -Desirable and Undesirable Facts. Opinion Summarization: Aspect-based Opinion Summarization - Improvements to Aspect-based Opinion Summarization - Contrastive View Summarization - Traditional Summarization Analysis of Comparative Opinions: Problem Definitions - Identify Comparative Sentences – Identifying Preferred Entities .	15
		4.2	Opinion Search and Retrieval: Web Search vs. Opinion Search - Existing Opinion Retrieval Techniques Opinion Spam Detection: Types of Spam and Spamming - Supervised Spam Detection - Unsupervised Spam Detection - Group Spam Detection.	
Total No. of Lectures				**60**

Course Outcomes:

1. Understand the sentiment analysis using Machine learning algorithms.
2. Understand cross-language subjectivity and deal with complex sentiments like Sarcasm.
3. Understand the concept of Aspect extraction for identifying terms required for building an opinion.
4. Different approaches involved in Sentiment lexicon generation
5. Apply Supervised and Unsupervised Spam detection models and refine the same.
6. Understand the analysis of Comparative opinions to work on Comparative sentences.

Books and References:

1.   Sentiment Analysis: Mining Opinions, Sentiments, and Emotions, Bing Liu, Cambridge University Press (2015)
2.   http://nptel.ac.in/courses/106105158/61
3.   Sentiment Analysis: Second Edition, GerardusBlokdyk ,Createspace Independent Publishing Platform (2018)
4.   "Advances in Sentiment Analysis - Techniques, Applications, and Challenges" (Edited by Jinfeng Li)
5.   "Sentiment Analysis in Social Networks" (by Federico Alberto Pozzi, Elisabetta Fersini, Enza Messina, and Bing Liu)
6.   "Multi-Modal Sentiment Analysis" (Edited by Ioannis Kompatsiaris and Guoying Zhao)

CASE STUDY	
CASE STUDY	
1.	**Case Study: Sentiment Analysis for Product Reviews** **Introduction:** In this case study, we'll explore how sentiment analysis can be applied to analyze customer reviews for a popular e-commerce platform. The goal is to understand customer sentiments toward specific products and identify areas for improvement. **Scenario:** Our e-commerce platform sells a wide range of electronic gadgets, including smartphones, laptops, and smartwatches. We have collected a large dataset of customer reviews for these products. Our task is to analyze these reviews and extract valuable insights.
2.	**Case Study: Sentiment Analysis in Banking** **Region:** South Africa **Background:** A bank headquartered in Johannesburg, South Africa, faced a significant churn rate due to cut-throat competition in the banking industry. To retain existing customers and attract new ones, the bank needed to improve its services and address customer concerns promptly. **Objective:** The bank aimed to understand customer sentiments expressed in social media posts, reviews, and comments. By analyzing these sentiments, they hoped to identify areas for improvement and enhance customer satisfaction.

Practical

Practical No	Details
1	Show the use of Sentiment analysis using nltk library.
2	Calculate TF-IDF score of each word in each sentence with sklearn's TFIDVectorizer.
3	Perform Text Length Adaptation in Sentiment Classification.
4	Show cross lingual Sentiment Analysis with an example.
5	Perform Exploratory data analysis on a dataset to decipher insights.
6	With the dataset, perform null value and outlier treatment.
7	Showcase an example of neutral texts classification
8	With an example, showcase the configuration of text classifier for positive or negative review
9	On a dataset, showcase the use of newton-cg on a Logistic regression model for replying to a positive review.
10	Create a sentiment analysis model for classifying an email into Spam and Ham.

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	III
Course Name	Internet of Things
Course Code	PMSDA303
Type of course	Major
Level of the Subject	Advanced
Credit points	4 Theory + 1 Practical

Course Objectives:
1. The objective of the course is aimed to impart knowledge of IoT architecture and their applications with implementations
2. Understand how to set up the Arduino development environment & gain an introduction to Internet of Things (IoT) platforms compatible with Arduino.

Unit No	Unit Name	Topic No.	Content	Hours
1	Introduction to IOT with Arduino	1.1	Introduction, setting up the Arduino development environment, Options for Internet connectivity with Arduino, Interacting with basic sensors,	15
		1.2	Interacting with basic actuators, Configuring your Arduino board for the IoT, Grabbing the content from a web page, Sending data to the cloud.	
2	Cloud Data Monitoring	2.1	Introduction, Internet of Things platforms for Arduino, connecting sensors to your Arduino board, Posting the sensor data online,	15
		2.2	Retrieving your online data, Securing your online data, Monitoring sensor data from a cloud dashboard, Monitoring several Arduino boards at once.	
3	Interacting with Web Services	3.1	Introduction, Discovering the Temboo platform, Tweeting from an Arduino board, Posting updates on Facebook,	15
		3.2	Automation with IFTTT, Sending push notifications, Sending text message notifications, Storing data on Google Drive.	
4	Machine-to-Machine Interaction & Applications of IoT	4.1	**Machine-to-Machine Interaction** Introduction, Types of IoT interaction, Basic local M2M interactions, Cloud M2M with IFTTT, M2M alarm system, Automated light controller, Automated sprinkler controller, Troubleshooting basic M2M issues.	15

		4.2	**Applications of IoT** Controlling machine from the cloud, Cloud smoke detector, Smart cloud thermostat, Assembling a GPS module, Building a simple GPS tracker, designing robotic platform using Arduino.	
Total No. of Lectures				**60**

Course Outcomes:

1. Describe about arduino development and interacting with sensors and actuators
2. Explain cloud data monitoring on Arduino board
3. illustrate different interfaces with web services
4. Identify different types of IOT interactions and M2M interactions
5. Analyze the applications of IOT .
6. Design different platforms using Arduino

Books and References:

1. Internet of Things with Arduino Cookbook Paperback – 1 January 2016 by Marco Schwartz (Author)
2. Internet of Things: A Hands-On Approach Paperback – Import, 9 August 2014 by Arshdeep Bahga (Author), Vijay Madisetti (Author)
3. "IoT Projects with Bluetooth Low Energy" by Madhur Bhargava
4. "Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and Beagle Bone Black" by Donald Norris
5. "Building Arduino Projects for the Internet: Experiments with Real-World Applications" by Adeal Javed
6. "IoT Projects with Arduino and Raspberry Pi" by John C. Shovic

CASE STUDY	
1.	**Case Study: Introduction to IoT with Arduino** A local farmer named Sarah wants to optimize crop growth in her greenhouse. She decides to set up an Arduino-based system to collect data from various sensors placed inside the greenhouse. Here are the key steps:
2.	**Case Study: Machine-to-Machine Interaction** **Scenario** In an industrial setting, machine-to-machine (M2M) communication plays a crucial role in optimizing processes, improving efficiency, and enhancing safety. **Case Study Details** A manufacturing plant produces automotive components. They implement M2M communication to achieve the following: 1. **Basic Local M2M Interactions** 2. **Cloud M2M with IFTTT (If This, Then That)** 3. **M2M Alarm System** 4. **Automated Light Controller** 5. **Troubleshooting Basic M2M Issues**

Practical

Practical No	Details
1	Familiarization with Arduino and perform necessary software installation & interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds
2	To interface digital sensor(IR/LDR)with Arduino and write a program to turn on LED
3	To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings
4	To interface motor using relay with Arduino
5	To interface Bluetooth with Arduino and write a program to send sensor data smartphone using Bluetooth
6	Cloud Data Monitoring
7	Interacting with Web Services
8	Basic local M2M interactions.
9	M2M alarm system
10	Building a simple GPS tracker

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	III
Course Name	Business Analytics
Course Code	PMSDA304
Type of course	Major Elective
Level of the Subject	Advanced
Credit points	2 Theory + 1 Practical

Course Objectives:
1.The main objective of this course is making the students know about various analytics done in business related to consumer behavior and different sectors of business like banking, finance, healthcare etc.
2.Understand how healthcare, telecommunication, retail analysis , banking and finance business analytics fits into data science and business disciplines.

Unit No.	Unit Name	Topic No.	Content	Hours
1	Introduction to Business Analytics	1.1	Introduction: Meaning of Analytics , Evolution of Analytics,Need of Analytics , Business Analysis vs. Business Analytics , Categorization of Analytical Models,	**15**
		1.2	Data Scientist vs. DataEngineer vs. Business Analyst-Business Analytics in Practice-Types of Data-Role of BusinessAnalyst,Scope of Business Analytics,Use cases of Business Analytics	
	Healthcare analytics	2.1	Healthcare analytics,Introduction, Potential contributions,Challenges of healthcare industry	15
		2.2	current and future state of healthcare analytics , top healthcare analytics adaptations	
2	Banking and Finance	3.1	What is Banking Analytics,Challenges Facing Banking Analytics Data and Banking Analytics in the Future Banking and Finance: Systems of Banking, Definition, relevance and scope financial Analytics, recent trends in financial analytics, Concept of Primary Data and Secondary Data, Concept of Supervised and Unsupervised learning.	**15**
		3.2	Types of Products Offered by Commercial Banks,Commercial Banking,New Financial Services:Insurance Services,Types of Insurance, Housing Finance.	

3	Telecomm unication & Concept and Marketing Insight	3.1	Telecommunication: Introduction, End-User Needs and Demands- Telecom Business Telecommunications Industry Overview and Major Trends,Customer Relationship Management,	15
		3.2	Concept of marketing analytics, analytical modeling and metrics in marketing, Marketing Insight: sources of market data, market sizing, porter five forces analysis, STEEPLE model.	
4	Retail analytics	4.1	Retail analytics ,Introduction to Retailing Analytics,Understanding the new consumer,Marketing in a consumer driven era ,	15
		4.2	Managing the brand to drive loyalty,Market Basket Data,Data Storage Basics. Case studies: Walmart, Netflix, Facebook, Uber, Amazon, Kaggle	
Total No. of Lectures				**60**

Course Outcomes :

1. To understand the healthcare domain in detail by going through the challenges, future state of healthcare analytics.
2. To resolve the Banking and finance sector by undergoing detail discussion on Commercial Banking
3. Students will be able to understand the New Financial Services that are provided in the banking sector.
4. To analyze the telecommunication industry by understanding their need and demand.
5. To inculcate domain knowledge in Retail industry with focus on marketing in consumer and managing the brand
6. Students will be able to apply analytics techniques on various real time examples such as Netflix, Facebook, etc.

Books and References:

1. Gomez Clifford(2011). Banking and Finance Theory Law and practice, PHI Learning
2. Anders Olsson(2004). Understanding Changing Telecommunications, Wiley Publications
3. Jennifer LeClaire, Danielle Dahlstrom, Vivian Braun. Business analytics in Retail for dummies, 2 nd IBM Limited edition
4. Alistair Croll (2013) Lean analytics: Use Data to Build a Better Startup faster, O Reilly Publishers
5. Bernard Marr (2016). Big Data in Practice – How 45 successful companies used big data

CASE STUDY	
1.	Case Study(Finance) The finance industry within Australia has to rapidly innovate using technology to improve efficiency and competitiveness. The client, a large organization with a market capitalization of $4.7 billion, briefed Business Analysis (BAPL) to integrate financial systems. The organization saw an opportunity to significantly improve their market share and also improve efficiencies across the organization.
2.	Case Study(Cyber Security) Recent cyber attacks have highlighted a global trend towards cyber terrorists targeting utility providers. While the client had plans to deal with malicious acts such as viruses and malware attacks, they required additional plans and capabilities to deal with the ever-evolving threat and sophistication of cyber attacks. Our client, a Government–owned water utility with over 700 permanent staff and approximately $1 billion in annual turnover, approached Business Analysis (BAPL) to assist them in starting a holistic program of cyber security improvement work streams for the 2018/19 financial year. The programs relate to improving their resilience against cyber attacks that could potentially affect the information and communications technology (ICT) and operational technology (OT) functions of the utility

Practical

Practical No	Details
1	Create Advance Formatting and Conditional Formatting using Excel
2	Create Different Lookup and Reference Functions by using different types of data.
3	Performing Table Calculations using Tableau.
4	Performing Graphs representation using Tableau.
5	Show the implementation and visualization of HR Analytics.
6	Show the implementation and visualization of Healthcare Analytics.
7	Show the implementation and visualization of Financial Analytics.
8	Show the implementation and visualization of Telecommunication Analytics.
9	Show the implementation and visualization of marketing analytics
10	Performing Data Analytics using different Python Libraries

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	III
Course Name	Digital Footprints: Unraveling Web Analytics
Course Code	PMSDA304
Type of course	Major Elective
Level of the Subject	Advanced
Credit points	2 Theory + 1 Practical

Course Objectives :

1 .By the end of the course, students will be able to demonstrate a comprehensive understanding of web analytics concepts, including key metrics, terminology, and the historical evolution of web analytics tools.

2 .Throughout the course, students will develop practical skills in implementing and utilizing web analytics tools such as Google Analytics and Tag Manager to collect and analyze data effectively, track user behavior, and optimize digital marketing strategies for improved conversion rates and user experiences.

Unit no.	Unit Name	Topic No.	Content	Hours
1	Foundation of Web Analytics	1.1	**Introduction to Web Analytics:** Understanding the significance of web analytics in the digital landscape, Key metrics and terminology (e.g., sessions, pageviews, bounce rate) , Historical context and evolution of web analytics tools **Data Collection and Tracking :** Implementing tracking codes (e.g., Google Analytics, Tag Manager) , Setting up goals, events, and e-commerce tracking , Privacy considerations and compliance (e.g., GDPR, CCPA).	15
		1.2	**User BehaviorAnalysis :**Analyzing user journeys and paths , Heatmaps, session recordings, and clickstream analysis , Identifying user segments and personas.	
2	Advanced Analytics Techniques	2.1	**Conversion Rate Optimization (CRO) :** A/B testing and multivariate testing , Funnel analysis and conversion funnels , Landing page optimization. **Segmentation and Custom Reports :** Creating custom segments based on user attributes , Building personalized reports and dashboards , Cross-device and cross-channel analysis.	15

		2.2	**Attribution Modeling :** Understanding attribution models (first touch, last touch, linear, etc.) , Multi-channel attribution and its impact on marketing decisions	
3	Business Insights and Decision Making	3.1	**Business KPIs and Metrics:** Aligning web analytics with organizational goals , Defining relevant KPIs (e.g., ROI, customer lifetime value) , Measuring marketing campaign effectiveness.	15
		3.2	**Data Visualization and Storytelling :** Creating compelling visualizations (charts, graphs, infographics) , Communicating insights effectively to stakeholders , Case studies and real-world examples.	
4	Emerging Trends and Ethical Considerations	4.1	**Mobile and App Analytics :** Tracking mobile app usage and engagement , Mobile-specific metrics (e.g., app installs, retention) , Challenges and opportunities in mobile analytics.	15
		4.2	**Ethics in Web Analytics :** Balancing data collection with user privacy , Transparency and informed consent , Responsible use of analytics data.	
			Total Lectures :	60

Course Outcome :-
1 . Understanding the significance of Web Analytics.
2 . Apply key matrices and terminology.
3 . Implement effective data collection and tracking strategies.
4 .Analyze user behavior and segmentation.
5 . Optimize convention rates and funnel analysis.
6 . Align Web Analytics with business KPIs and matrices.

Books and References :-
1. "Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity" by Avinash Kaushik
2. "Google Analytics Breakthrough: From Zero to Business Impact" by FerasAlhlou, Shiraz Asif, and Eric Fettman
3. "Web Analytics For Dummies" by Jennifer LeClaire
4. "Digital Analytics Primer" by Judah Phillips
5. "Unveiling Digital Footprints: The Power of Web Analytics in Data Analysis"

CASE STUDY	
1	**Background:** A leading e-commerce platform aimed to enhance its digital footprint and improve online sales through effective web analytics strategies. **The Problem:**

		The company faced challenges with high bounce rates, low conversion rates, and a lack of understanding of customer behavior on its website. This hindered their ability to optimize marketing efforts and maximize revenue.
2		**Background:** A hospitality management company sought to enhance its online presence and improve guest experiences through effective web analytics strategies. **The Problem:** The company faced challenges with low direct bookings through its website, limited understanding of guest behavior online, and a lack of personalization in marketing efforts.

Practical

Practical No	Details

1	**A/B Testing and Multivariate Testing:**
	   - Design and conduct an A/B test on two different versions of a landing page to determine which one leads to higher conversion rates.
	   - Perform a multivariate test on multiple elements of a webpage (e.g., headline, call-to-action button) to identify the combination that maximizes conversion rates.

2	**Funnel Analysis and Conversion Funnels:**
	   - Use web analytics tools to analyze the conversion funnel of an e-commerce website and identify stages with high drop-off rates.
	   - Implement changes to key steps in the conversion funnel and track the impact on overall conversion rates over time.

3	**Landing Page Optimization:**
	   - Evaluate the performance of landing pages using web analytics data and identify opportunities for optimization.
	   - Implement changes to landing page elements (e.g., layout, content) based on insights from A/B testing and monitor the effects on conversion rates.

4	**Segmentation and Custom Reports:**
	   - Create custom segments based on user attributes (e.g., age, location, device type) using web analytics tools.
	   - Build personalized reports and dashboards tailored to specific stakeholder needs, incorporating custom segments for deeper insights into user behavior.

5	**Attribution Modeling:**
	   - Compare different attribution models (e.g., first touch, last touch, linear) to understand their impact on marketing decisions and budget allocation.
	   - Implement a multi-channel attribution model to attribute conversions accurately across various marketing channels and assess the effectiveness of each channel.

6	**Business KPIs and Metrics:**
	   - Define relevant KPIs aligned with organizational goals (e.g., ROI, customer acquisition cost) and track them using web analytics platforms.
	   - Analyze the performance of marketing campaigns by measuring KPIs and assessing their contribution to overall business objectives.

7	**Data Visualization and Storytelling:** - Create compelling visualizations (e.g., charts, graphs, infographics) to represent

	web analytics data and communicate key insights effectively to stakeholders. - Develop a storytelling narrative around the data, highlighting trends, patterns, and actionable recommendations for business decision-makers.

8	**Mobile and App Analytics:**
	    - Track mobile app usage and engagement metrics (e.g., app installs, session duration, retention rate) using app analytics tools.
	    - Identify challenges and opportunities in mobile analytics, such as cross-device tracking and optimizing user experiences across different platforms.

9	**Ethics in Web Analytics:**
	    - Evaluate the ethical considerations of data collection practices in web analytics, including user privacy concerns and data transparency.
	    - Develop guidelines for responsible data collection and use, ensuring compliance with regulations (e.g., GDPR) and maintaining user trust.

10	**Real-World Case Studies:**
	        - Analyze real-world examples and case studies of successful conversion rate optimization strategies, attribution modeling approaches, and ethical considerations in web analytics.
	        - Apply learnings from case studies to develop actionable recommendations for optimizing web analytics practices in various business contexts.

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	III
Course Name	Computational Social Networks
Course Code	PMSDA304
Type of course	Major Elective
Level of the Subject	Advanced
Credit points	2 Theory + 1 Practical

Course Objectives :

6. Understand the fundamental concepts of social network analysis & Apply computational techniques to analyze and model social networks.
7. Evaluate the impact of network structures on information diffusion, influence, and behavior & Critically assess ethical considerations related to computational social science.

Unit no.	Unit Name	Topic No.	Content	Hours
1	Introduction to Computational Social Science	1.1	Overview of Computational Social Science (CSS) : Definition of CSS , scope , historical development . Data Collection and Preprocessing : sources of social data , data cleaning , preprocessing techniques.	15
		1.2	Network Representation : Basics of network theory , visualization tools and techniques Social Influence and Contagion Models :Diffusion models , contagion process in social networks	
2	Social Network Analysis	2.1	Centrality measures : degree centrality, closeness centrality , betweenness centrality. Community Detection Algorithm : Modularity – based methods , hierarchical clustering Structural Balance Theory : Triadic closure , Balance and imbalance in social relationships.	15
		2.2	Homophily and Assortativity : Similarity based network formation , Assortative mixing patterns . Temporal Network Analysis : Dynamic network metrics , Temporal motifs and patterns	
3	Text Analysis in Social	3.1	Natural Language Processing (NLP) for Social Media data :Text preprocessing , feature extraction . Sentiment Analysis :Sentiment Lexicons , classifiers ,application in social media analysis	15

	networks	3.2	Topic Modeling :Latent Dirichlet Allocation (LDA), Dynamic Topic Modelling Influence of Textual Content on network dynamics :Information diffusion in text-based networks , opinion dynamics models	
4	Agent based modeling and simulation	4.1	Introduction to Agent-based-modeling (ABM): What is ABM ,Basic concepts of ABM, principles of ABM , application in social science ABM for Social Networks :Modeling individual behavior and interactions , network formation and evolution .	15
		4.2	Emergent behavior and collective phenomena : Self – organization in complex systems , emergence of macroscopic patterns form local interactions Calibration and Validation of ABMs : Parameter estimation techniques , validation strategies for ABM. Case study using NetLogo or Other ABM platforms	
			Total Lectures :	**60**

Course Outcome :-
1. Understand the foundation and evolution of computational social science.
2. Master data collection, preprocessing, and network representation techniques.
3. Analyze social influence and contagion process.
4. Evaluate network structures using centrality measures and community detection algorithms.
5. Explore structural balance homophily and assortativity in social relationships.
6. Utilize text analysis techniques for social media data.

Books and References :-
1 . Easley, D., & Kleinberg, J. (2010). *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*. Cambridge University Press.
2 .Barabási, A.-L. (2016). *Network Science*. Cambridge University Press.
3 . Social Network Analysis by Stanley Wasserman and Katherine Faust
4 . Agent Based and Individual Based Modelling : A practical Introduction by Steven F. Railsback and Volker Grimm.
5. "Computational Social Networks: Tools, Perspectives, and Challenges" Author : Mrutyunjaya Panda, Nashwa El-Bendary, Mostafa A. Salama, Aboul Ella Hassanien, Ajith Abraham
6. Computational Social Networks: Mining and Visualization.

CASE STUDY	
1	**Background:** A research team aimed to simulate the spread of a contagious disease within a social network to understand the impact of different intervention strategies on disease transmission dynamics. **The Problem:**

	The research team faced challenges in modeling the complex interactions between individuals within the network and assessing the effectiveness of various intervention measures, such as vaccination campaigns and social distancing policies, in controlling the spread of the disease.
2	**Background:** A social media platform aimed to enhance user engagement and content dissemination through effective network analysis and modeling. **The Problem:** The platform experienced challenges in understanding the dynamics of information diffusion and identifying influential users within its network. This hindered their ability to optimize algorithms for content recommendation and improve overall user experience.

Practical

Sr. No	Details
1	Data Collection and Preprocessing: - Question: How does data cleaning affect the accuracy and reliability of social data analysis? Analyze a dataset collected from social media platforms and perform data cleaning techniques to prepare it for analysis.
2	Network Representation: - Question: Visualize a social network dataset using network theory principles. Compare and contrast different visualization tools and techniques for representing social networks.
3	Social Influence and Contagion Models: - Question: Implement a diffusion model to simulate the spread of information or behavior in a social network. Analyze the impact of different parameters on the contagion process.
4	Centrality Measures: - Question: Calculate degree, closeness, and betweenness centrality measures for nodes in a given social network dataset. Identify key influencers or central nodes and analyze their impact on network dynamics.
5	Community Detection Algorithm: - Question: Apply modularity-based methods or hierarchical clustering algorithms to identify communities within a social network dataset. Evaluate the effectiveness of different algorithms in detecting communities.
6	Structural Balance Theory: - Question:Analyze triadic closure and balance theory in a social network dataset. Identify balanced and imbalanced triads and explore their implications on social relationships.
7	Homophily and Assortativity: - Question: Investigate assortative mixing patterns in a social network dataset based on homophily principles. Analyze the degree of similarity-based network formation and its impact on network structure.
8	Temporal Network Analysis: - Question: Explore dynamic network metrics and temporal motifs/patterns in a

	time-varying social network dataset. Identify temporal dynamics and patterns of interaction over time.
9	Natural Language Processing (NLP) for Social Media Data: - Question: Perform text preprocessing and feature extraction on social media data using NLP techniques. Analyze sentiment trends and topics discussed in the dataset.
10	Agent-based Modeling (ABM) for Social Networks: - Question: Develop an ABM to simulate individual behavior and interactions in a social network context. Explore how network formation and evolution emerge from local interactions.

BOS	Computer Science
Class	M.Sc. Data Analytics Part - I
Semester	I
Course Name	Research Project
Course Code	PMSDA107
Type of course	Research Project
Level of the Subject	Advanced
Credit points	4

Students have to build a software regarding web application / analysis by using various technologies with documentation as per given following direction.

1. **Project Proposal**:

   ○ Start with a **project proposal** that outlines the purpose, objectives, and scope of your research. Include the following sections:

      i.   **Introduction**: Briefly describe the problem or topic you're addressing.

      ii. **Objectives**: Clearly state what you aim to achieve.

      iii. **Methodology**: Explain the research methods you plan to use.

      iv. **Expected Outcomes**: Mention the expected results or contributions.

      v.   **Timeline**: Provide a project schedule.

2. **Literature Review**:

   a. Conduct a thorough **literature review** to understand existing work related to your topic.

   b. Summarize relevant research papers, articles, and studies.

   c. Highlight gaps in the existing literature that your project aims to address.

3. **Methodology Section**:

   a. Describe the **data collection process**:

      i.   Specify data sources (datasets, APIs, surveys, etc.).

      ii. Explain how you'll preprocess and clean the data.

   b. Detail the **machine learning algorithms** or statistical techniques you plan to use.

   c. Include any **assumptions** made during the analysis.

4. **Results and Analysis**:

a. Present your findings in a clear and concise manner.

b. Use tables, charts, and visualizations to illustrate results.

c. Discuss any patterns, trends, or insights you've discovered.

5. **Discussion and Conclusion**:

a. Interpret the results and relate them to your research objectives.

b. Discuss limitations and potential areas for improvement.

c. Conclude by summarizing the project's impact and future directions.

6. **References**:

a. List all the sources you've referenced throughout your document.

b. Follow a consistent citation style (e.g., APA, MLA).

7. **Formatting and Style**:

a. Use a consistent font (e.g., Times New Roman, Arial) and font size (usually 12pt).

b. Set appropriate margins (usually 1 inch on all sides).

c. Organize content into sections with clear headings, Proofread carefully for grammar and spelling errors.

SEMESTER - IV

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	IV
Course Name	Artificial Intelligence
Course Code	PMSDA401
Type of course	Major
Level of the Subject	Advanced
Credit points	4 Theory + 2 Practical

Course Objectives:
1. The objective of the course is aimed to acquire skills in order to design intelligent solutions to problems in a variety of domains and business applications and fields such as natural language processing, text mining, and robotics, reasoning and problem-solving.
2. Explore the Rete algorithm and rule-based system architecture & Understand perception, communication, and expert systems.

Unit No	Unit Name	Topic No.	Content	Hours
1	The AI problems	1.1	**The AI problems** – AI techniques – problems, problems space & search – Defining the problem as a state Search – Production systems – problem characteristics	15
		1.2	Heuristic search techniques Generate & test – Hill climbing – Best first search. Problem reduction – constraint satisfaction means – ends analysis.	
2	Game Playing Problems & Predicate Calculus	2.1	**Game Playing Problems & Predicate Calculus** Game playing: Mini – max procedure – Adding Alpha – Beta cutoffs – Additional refinements Searching AND/OR Graphs – Iterative deepening. Using Predicate Logic –	15
		2.2	Representing simple facts & logic – Representing instance & IS a Relationships – Computable functions & Predicates – Use of the predicate calculus in AI – Resolution – natural deduction.	
3	Logic Programming & Rule Based Systems	3.1	**Logic Programming & Rule Based Systems** Representing knowledge using Rules – Procedural versus declarative knowledge logic programming forward versus backward reasoning – Resolving within AND/OR Graphs matching control knowledge –	15

		3.2	symbolic Reasoning under uncertainty – non – monotonic reasoning – Implementation Issues – Augmenting a problem solver implementation of depth first & breadth first search. Statistical reasoning – Bayes theorem – Certainty factors & Rule based Systems – Bayesian Networks – Dempster– Shafer theory – Fuzzy logic	
4	Expert Systems	4.1	**Expert Systems** – Architectural Components, Definition and structure of expert systems, The human element in expert systems, How expert systems work, Problem areas addressed by expert systems, Factors contributing to expert system success, Types of expert systems, Interaction of expert systems with the internet.	15
		4.2	**Knowledge Engineering:** Scope of knowledge, Difficulties in knowledge acquisition, Methods of knowledge acquisition, Machine learning approaches, Intelligent agents, Selecting appropriate knowledge acquisition methods	
Total No. of Lectures				60

Course Outcomes:
1. Understand the concept of Artificial intelligence.
2. Apply various search algorithms of artificial intelligence.
3. Explain Fuzzy Logic and rule based Systems.
4. Apply knowledge representation and reasoning techniques.
5. Understand & apply different types of machine learning and models.
6. Understand the design principles of pattern recognition with estimation and apply classification technique.

Books and References:
1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Introduction to Artificial Intelligence" by Wolfgang Ertel
3. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving" by George F. Luger.
4. "Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth
5. "Expert Systems: Principles and Programming" by Joseph C. Giarratano and Gary D. Riley
6. "Knowledge Engineering: Building Cognitive Assistants for Evidence-Based Reasoning" by Richard Ellis and Simon Colton

CASE STUDY
1 **Case Study: Medical Diagnosis Expert System** Dr. Smith, a seasoned physician, wants to develop an expert system to assist junior doctors in diagnosing common medical conditions. The system will take patient symptoms as input and provide potential diagnoses along with recommended treatments.

2	**Case Study: Course Advisor Expert System** A university wants to develop an expert system to assist students in selecting their postgraduate study programs. The system will take into account the students' existing skills and interests, as well as the skills required by various programs. The goal is to recommend a customized study program that aligns with each student's background and aspirations.

Practical

Practical No	Details
1	Write a program to implement Breadth First Search using Python.
2	Write a program to implement Depth First Search using Python.
3	Write a program to implement Problem Solving Agent to find the best route using Python.
4	Write a program to implement an 8-puzzle problem using Python.
5	Write a program to implement Tic-Tac-Toe using Python.
6	Write a program to implement a Water Jug problem using Python.
7	Write a program to implement Traveling Salesman using Python.
8	Write a program to implement Tower of Hanoi using Python.
9	Write a program to implement Alpha Beta Pruning using Python.
10	Write a program to implement Missionaries and Cannibals problems using Python.

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	IV
Course Name	Deep Learning
Course Code	PMSDA402
Type of course	Major
Level of the Subject	Advanced
Credit points	4 Theory +2 Practical

Course Objectives:
1. To acquire knowledge on the basics of neural networks.
2. To implement neural networks using computational tools for a variety of problems & explore various deep learning algorithms.

Unit No	Unit Name	Topic No.	Content	Hours
1	Introduction to Deep Learning	1.1	Basics of Deep learning- Deep learning architectures: What is ANN, Types of Deep Learning, Supervised deep learning : Convolutional neural networks, Recurrent neural networks, LSTM networks, GRU networks.Unsupervised deep learning: Self-organized maps, Autoencoders, Restricted Boltzmann Machines. CNN : What are Convolutional Neural Network (CNN), CNN work, kernel, convolution feature, Pooling Layer, Limitations of CNN.	15
		1.2	RNN : What is RNN, working of RNN, types of recurrent neural networks, Architecture of RNN, limitations of RNN. LSTM : What is LSTM, Architecture and Working of LSTM, Advantages and Disadvantages of LSTM. GRU: What is GRU, Working of a Gated Recurrent Unit.Self Organized Map : Introduction to Self Organizing Map (or Kohonen Map or SOM), working of SOM, Sum on SOM. Autoencoders: What are Autoencoders, Architecture of Autoencoders in Deep Learning.	
2	Memory Augmented Neural Networks	2.1	Memory Augmented Neural Networks : Neural Turing Machines-Attention-Based Memory Access- NTM Memory Addressing Mechanisms-Differentiable Neural	15

			Computers-Interference-Free Writing in DNCs-	
		2.2	DNC Memory Reuse-Temporal Linking of DNC Writes-Understanding the DNC Read Head- The DNC Controller Network- Visualizing the DNC in Action-Implementing the DNC in TensorFlow-Teaching a DNC to Read and Comprehend.	
3	Deep Reinforcement Learning	3.1	Deep Reinforcement Learning: Deep Reinforcement Learning Masters Atari Games-What Is Reinforcement Learning?-Markov Decision Processes (MDP)-	15
		3.2	Explore Versus Exploit-Policy versus Value Learning-Pole-Cart with Policy Gradients-Q-Learning and Deep Q-Networks-Improving and Moving Beyond DQN.	
4	Implementing Neural Networks in TensorFlow	4.1	Implementing Neural Networks in TensorFlow : What Is TensorFlow?-How Does TensorFlow Compare to Alternatives?-Installing TensorFlow-Creating and Manipulating TensorFlow Variables- TensorFlow Operations-Placeholder Tensors-Sessions in TensorFlow	15
		4.2	Navigating Variable Scopes and Sharing Variables-Managing Models over the CPU and GPU-Specifying the Logistic Regression Model in TensorFlow-Logging and Training the Logistic Regression Model Applications: Deep learning for computer vision, Deep Learning Applications at the Enterprise Scale, Deep Learning Models for Healthcare Applications.	
Total No. of Lectures				**60**

Course Outcomes:

Students will be able to:
1. Understand the basics of Deep Learning.
2. Define, train and use a Deep Neural Network for solving real world problems that require artificial Intelligence based solutions.
3. Explain the Markov Decision Processes to know deep reinforcement learning.
4. Explore the essentials of Deep Learning and Deep Network architectures.
5. Implement Neural Networks in TensorFlow for solving problems.
6. Develop algorithms simulating the human brain.

Books and References:

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
3. "Neural Networks and Deep Learning: A Textbook" by Charu Aggarwal

4. "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani.
5. "Memory Networks: Unifying Declarative Memory and Neural Networks" by Jason Weston, Sumit Chopra, and Antoine Bordes
6. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. **Barto**

CASE STUDY	
1	**Case Study: Bird Identification in Offshore Wind Farms** **Problem** Offshore wind farms face challenges related to bird identification. Accurate bird species identification is crucial for environmental impact assessments and ensuring the safety of avian populations.
2	**Case Study: Improving Customer Retention with Personalized Recommendations** **Problem** A large e-commerce platform faces challenges in retaining customers and increasing their lifetime value. The existing recommendation system lacks personalization, leading to suboptimal user engagement and lower sales.

Practical

Practical No	Details
1	Artificial Neural Network
2	Convolutional Neural Network
3	Recurrent Neural Network
4	LSTM
5	Linear Regression
6	Object Detection
7	Face Detection and Recognition
8	Tensor flow operations
9	Simple Example on Reinforcement Learning
10	To study Reinforcement Learning Concept on Cart-Pole with DQN

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	IV
Course Name	Natural Language Processing
Course Code	PMSDA403
Type of course	Major
Level of the Subject	Advanced
Credit points	2 Theory + 2 Practical

Course Objectives:

1. The prime objective of this course is to introduce the students to the field of Language Computing and its applications ranging from classical era to modern context.
2. To provide understanding of various NLP tasks and NLP abstractions such as Morphological analysis, POS tagging, concept of syntactic parsing, semantic analysis etc.

Unit No	Unit Name	Topic No.	Content	Hours
1	Introduction to NLP	1.1	Introduction to NLP, brief history, NLP applications: Speech to Text(STT), Text to Speech(TTS), Story Understanding, NL Generation, QA system, Machine Translation, Text Summarization, Text classification, Sentiment Analysis, Grammar/Spell Checkers etc., challenges/Open Problems, NLP abstraction levels, Natural Language (NL)	15
		1.2	Characteristics and NL computing approaches/techniques and steps, NL tasks: Segmentation, Chunking, tagging, NER, Parsing, Word Sense Disambiguation, NL Generation, Web 2.0 Applications : Sentiment Analysis; Text Entailment; Cross Lingual Information Retrieval (CLIR).	
2	Overview of Language Scripts and	2.1	Text Processing Challenges, Overview of Language Scripts and their representation on Machines using Character Sets, Language, Corpus and Application Dependence issues, Segmentation: word level(Tokenization), Sentence level.	15
		2.2	Regular Expression and Automata Morphology, Types, Survey of English and Indian Languages Morphology, Morphological parsing FSA and FST, Porter stemmer, Rule based and Paradigm based Morphology, Human Morphological Processing, Machine Learning approaches.	

3	Stochastic approaches	3.1	Word Classes as Part-of-Speech tagging(POS), survey of POS tagsets, Rule based approaches (ENGTOWL),	15
		3.2	Stochastic approaches(Probabilistic, N-gram and HMM), TBL morphology, unknown word handling, evaluation metrics: Precision/Recall/F-measure, error analysis.	
4	NL parsing basics, approaches	4.1	NL parsing basics, approaches: TopDown, BottomUp, Overview of Grammar Formalisms: constituency and dependency school, Grammar notations CFG, LFG, PCFG, LTAG, Feature- Unification, overview of English CFG, Indian Language Parsing in Paninian Karaka Theory, CFG parsing using Earley's and CYK algorithms, Probabilistic parsing, Dependency Parsing: Covington algorithm, MALT parser, MST parser.	15
		4.2	Concepts and issues in NL, Theories and approaches for Semantic Analysis, Meaning Representation, word similarity, Lexical Semantics, word senses and relationships, WordNet (English and IndoWordnet), Word Sense Disambiguation: Lesk Algorithm Walker's algorithm, Coreference Resolution:Anaphora, Cataphora.	
Total No. of Lectures				**60**

Course Outcomes:

After completion of the course, a student should be able to:

1. Students will get ideas about know-hows, issues and challenges in Natural Language Processing and NLP applications and their relevance in the classical and modern context.
2. Student will get understanding of Computational techniques and approaches for solving NLP problems and
3. Students will also be introduced to various grammar formalisms, which they can apply in different fields of study.
4. Students can take up project work or work in R&D firms working in NLP and its allied areas.
5. Student will be able to understand applications in different sectors
6. Develop modules for NLP tasks and tools such as Morph Analyzer, POS tagger, Chunker, Parser, WSD tool etc.

Books and References:

1. Handbook of Natural Language Processing Indurkhya, N., & Damerau, F. J.
2. CRC Press Taylor and Francis Group 2nd 2010
3. Speech and Language Processing Martin, J. H., &Jurafsky, D. Pearson Education India 2nd 2013
4. Foundations of Statistical Natural Language Processing Manning, Christopher and Heinrich, Schutze MIT Press 1st 1997
5. Natural Language Processing With Python Steven Bird, Edward Loper O'Reilly Media 2nd 2016
6. Video Links 1. http://www.nptelvideos.in/2012/11/natural-language-processing.html

CASE STUDY	
1	**Case Study: Sentiment Analysis for Product Reviews** **Background:** A leading e-commerce platform wants to enhance its user experience by analyzing customer reviews. They have a vast collection of product reviews across various categories, from electronics to fashion. The goal is to automatically determine the sentiment expressed in each review (positive, negative, or neutral). **Data:** The dataset consists of thousands of reviews, each associated with a product. Each review is a text snippet, and the corresponding sentiment label (positive, negative, or neutral) is provided.
2	**Case Study: Automated Email Classification** **Background:** A large corporation receives thousands of emails daily from clients, partners, and internal teams. These emails cover a wide range of topics, from customer inquiries to project updates. The company wants to streamline email management by automatically classifying incoming emails into relevant categories. The goal is to improve response time, prioritize urgent matters, and ensure efficient handling of communication. **Data:** The dataset consists of labeled emails, each associated with a specific category (e.g., "Sales," "Technical Support," "Billing," "General Inquiry," etc.). The emails vary in length and content.

Practical

Practical No	Details
1	Regular Expression
2	a) Write a program to tokenize the sentences and words, identify and remove stop words. b) Write a program to find Unicode code point for the following letters (P,C,A,C,S)
3	a) Write a program to generate N-gram (Unigram, Bigram & trigram) b) Write a program to identify Stem and Lemma of the give words
4	Generate a Fake corpus using faker library and extract important word from the corpus using TF-IDF
5	Generate a word cloud for the above generated fake corpus.
6	Write a program to identify Part of Speech of given english text.
7	Write a python program to perform Context Free Grammar (CFG) and print parse tree
8	Write a python program to perform Probabilistic Context-Free Grammar (PCFG) and print Probability value and parsing tree.
9	Write a function for morphological parser using spacy library and extract text, corresponding POS
10	Write a function for morphological parser using NLTK library and extract text, corresponding POS and morphological tag.

BOS	Computer Science
Class	M.Sc. Data Analytics Part - II
Semester	IV
Course Name	Project Dissertation with Implementation.
Course Code	PMSDA407
Type of course	Research Project
Level of the Subject	Advanced
Credit points	6

Goals of the course Project Dissertation with Implementation.

The student should:

be able to apply relevant knowledge and abilities, within the main field of study, to a given problem within given constraints, even with limited information, independently analyze and discuss complex inquiries/problems and handle larger problems on the advanced level within the main field of study reflect on, evaluate and critically review one's own and others' scientific results be able to document and present one's own work with strict requirements on structure, format, and language usage be able to identify one's need for further knowledge and continuously develop one's own knowledge

To start the project:

- Start thinking early in the programme about suitable projects.
- Read the instructions for the project.
- Attend and listen to other students' final oral presentations.
- Look at the finished reports.
- Talk to senior master students.
- Attend possible information events (workshops / seminars / conferences etc.) about the related topics.

Application and approval:

- Read all the detailed information about the project.

- Finalize finding a place and supervisor.
- Check with the coordinator about the subject/project, place and supervisor.
- Write the project proposal and plan along with the supervisor.
- Fill out the application together with the supervisor.
- Hand over the complete application, proposal and plan to the coordinator.
- Get an acknowledgement and approval from the coordinator to start the project.

During the project:

- Search, gather and read information and literature about the theory.
- Document well the practical work and your results.
- Take part in seminars and the running follow-ups/supervision.
- Think early on about disposition and writing of the final report.
- Discuss your thoughts with the supervisor and others.
- Read the SOP and the rest you need again.
- Plan for and do the mid-term reporting to the coordinator/examiner.
- Do a mid-term report also at the work-place (can be a requirement in some work-places).
- Write the first draft of the final report and rewrite it based on feedback from the supervisor and possibly others.
- Plan for the final presentation of the report.

Finishing the project:

- Finish the report and obtain an OK from the supervisor.
- Ask the supervisor to send the certificate and feedback form to the coordinator.
- Attend the pre-final oral presentation arranged by the Coordinator.
- Rewrite the final report again based on feedback from the opponents and possibly others.
- Prepare a title page and a popular science summary for your report.
- Send the completed final report to the coordinator (via plagiarism software)
- Rewrite the report based on possible feedback from the coordinator.
- Appear for the final exam.

Project Proposal/research plan

- The student should spend the first 1-2 weeks writing a 1-2 pages project plan containing:
- Short background of the project
- Aims of the project
- Short description of methods that will be used
- Estimated time schedule for the project
- The research plan should be handed in to the supervisor and the coordinator.
- Writing the project plan will help you plan your project work and get you started in finding information and understanding of methods needed to perform the project.

Project Documentation

1. **Project Proposal**:
   a. Start with a **project proposal** that outlines the purpose, objectives, and scope of your research. Include the following sections:
      i. **Introduction**: Briefly describe the problem or topic you're addressing.
      ii. **Objectives**: Clearly state what you aim to achieve.
      iii. **Methodology**: Explain the research methods you plan to use.
      iv. **Expected Outcomes**: Mention the expected results or contributions.
      v. **Timeline**: Provide a project schedule.
2. **Literature Review**:
   a. Conduct a thorough **literature review** to understand existing work related to your topic.
   b. Summarize relevant research papers, articles, and studies.
   c. Highlight gaps in the existing literature that your project aims to address.
3. **Methodology Section**:
   a. Describe the **data collection process**:
      i. Specify data sources (datasets, APIs, surveys, etc.).
      ii. Explain how you'll preprocess and clean the data.
   b. Detail the **machine learning algorithms** or statistical techniques you plan to use.
   c. Include any **assumptions** made during the analysis.
4. **Results and Analysis**:
   a. Present your findings in a clear and concise manner.
   b. Use tables, charts, and visualizations to illustrate results.
   c. Discuss any patterns, trends, or insights you've discovered.

5. **Discussion and Conclusion**:
    a. Interpret the results and relate them to your research objectives.
    b. Discuss limitations and potential areas for improvement.
    c. Conclude by summarizing the project's impact and future directions.

6. **References**:
    a. List all the sources you've referenced throughout your document.
    b. Follow a consistent citation style (e.g., APA, MLA).

7. **Formatting and Style**:
    a. Use a consistent font (e.g., Times New Roman, Arial) and font size (usually 12pt).
    b. Set appropriate margins (usually 1 inch on all sides).
    c. Organize content into sections with clear headings, Proofread carefully for grammar and spelling errors.