LEARNING OUTCOMES BASED CURRICULUM FRAME WORK (LOCF) FOR POSTGRADUATE PROGRAMMES

(With effect from 2022-23)

MSc Data Science

Department of Data Science

LOYOLA COLLEGE (AUTONOMOUS)

CHENNAI 600034

PREFACE

Data Science will revolutionize every industry in the near future. India has the opportunity to be the talent provider to the world for data science. Spurring data science-based innovation and establishing data science-ready infrastructure will be critical for preparing India's jobs and skills markets for a data science-based future. Keeping in mind the extraordinary importance of data science, Loyola College has decided to start the Department of Data Science and offer M.Sc (Data Science) Programme from June 2019. At present, the department has four experienced staff members, all with Ph.D qualification in their own field of specialization. Be it financial services, healthcare, education or even security and governance, data science can be utilised for the benefit of citizens and the country. The global economic impact associated with the use, development, and adoption of data science from 2022 through 2027 is expected to be whopping $1.84 trillion to $2.95 trillion!

The main objective of this first-of-its-kind M.Sc. (Data Science) Programme is to enable the students to get a very good exposure to the promising field of data science. The PG Programme will lay a strong theoretical foundation that will enable the students to develop their own customized data science algorithms needed for deriving insights from very large data sets, which are now continuously generated, thanks to IoT, Social Media and Digitisation. Apart from the regular class room interactions, the PG Programme will involve a lot of guest lectures by industry experts, intensive lab work and discussion of several business case studies. The students will undergo an internship program at the end of second semester and carry out a major project in the fourth semester.

CONTENTS

VISION AND MISSION OF LOYOLA COLLEGE

VISION

Towards holistic formation of youth, grounded in excellence, through accompaniment to serve the humanity.

MISSION

- To provide inclusive education through an integral and holistic formative pedagogy.
- To promote skills that prepares them for the future.
- To kindle in young minds, the spirit of social and environmental justice with a blend of academic excellence and empathy.
- To stimulate critical and conscientious scholarship leading to meaningful and innovative human Capital.

CORE VALUES

- Cura Personalis
- Pursuit of Excellence
- Moral Rectitude
- Social Equity
- Fostering solidarity
- Global Vision
- Spiritual Quotient

VISION AND MISSION OF THE DEPARTMENT

VISION

To be the premier department in shaping young minds to achieve eminence in digital transformation.

MISSION

To provide a learning ambience and curiosity to explore new avenues with social responsibilities.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
(School of Computational Sciences)

PEOs	STATEMENTS
PEO1	**PEO1 LEARNING ENVIRONMENT AND LIFE LONG LEARNING** To access academic facilities in an environment of inclusiveness and inquisitiveness for effective and immersed learning throughout life to attain excellence in the chosen field of computational sciences.
PEO2	**GLOBALLY RELEVANT CURRICULUM AND SCIENTIFIC TEMPERAMENT** To think innovatively, analyse scientifically and make decisions appropriately, for handling contemporary global concerns through the knowledge earned in the computational sciences curriculum.
PEO3	**ACADEMIC EXCELLENCE AND CORE COMPETENCY** To excel in modern computational techniques and compete in higher studies/career, for addressing contemporary challenging problems with ease.
PEO4	**SKILL DEVELOPMENT AND ENTREPRENEURSHIP** To develop analytical, logical and critical problem-solving skills for executing professional Work and become experts/entrepreneurs in the field of computational sciences.
PEO5	**ENVIRONMENT AND SUSTAINABILITY** To identify real world problems concerning environment and other issues; and apply the expertise in the computational sciences, to face the challenges and provide sustainable Solutions.

PEO6	**PROFESSIONALISM AND ETHICS WITH SOCIAL RESPONSIBILITY** To equip themselves with the necessary competency towards professionalism in the computational sciences maintaining ethical standards in addressing the needs of industry and society.

PROGRAMME OUTCOMES (POs)

(School of Computational Sciences)

POs	STATEMENTS
PO1	**DISCIPLINARY KNOWLEDGE, INFORMATION/DIGITAL LITERACY &LIFE-LONG LEARNING:** To acquire scholarly knowledge for life-long learning of the respective discipline of computational sciences and demonstrate digital literacy.
PO2	**CRITICAL, ANALYTICAL & SCIENTIFIC THINKING IN PROBLEM-SOLVING** To critically explore, scientifically analyze and develop solutions through various computational techniques for real time problems
PO3	**GLOBALLY RELEVANT CURRICULUM, INDUSTRY REQUIREMENTS AND RESEARCH COMPETENCE** To acquire research competence and meet industry needs through a globally relevant curriculum
PO4	**PROFESSIONALISM AND ETHICS** To cultivate a promising work culture within ethical frameworks demonstrating exemplary professionalism.
PO5	**TEAMWORK AND EFFECTIVE COMMUNICATIONS** To manifest effective communication skills for constructive team work and Progress as professionals in key positions in the respective domains.
PO6	**EMPOWERMENT WITH EMPATHY TOWARDS SUSTAINABLE** **SOCIAL AND ENVIRONMENTAL CONSCIOUSNESS** To realize social and environmental problems with empathy and contribute the computational Expertise to face the challenges and provide sustainable solutions.
PO7	**SKILL DEVELOPMENT, EMPLOYABILITY, LEADERSHIP AND ENTREPRENEURSHIP** To develop expertise and professional skills for employment in the domain of computational sciences and emerge as leaders and entrepreneurs.

PROGRAMME SPECIFIC OUTCOMES (PSOs)
(Department of Data Science)

PSOs	STATEMENTS
PSO1	Ability to identify analyze and design solutions for data analytics problems using fundamental principles of mathematics, Statistics, computing sciences, and relevant domain disciplines
PSO2	Acquire the skills in handling data analytics programming tools towards problem solving and Solution analysis for domain specific problems.
PSO3	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices
PSO4	Understand the role of statistical approaches and apply the same to solve the real-life problems in the fields of data analytics.
PSO5	Ability to apply the advanced concepts of Big Data that pave the way to create a platform to gain analytical skills which impact business decisions and strategies
PSO6	Apply the research-based knowledge to analyse and solve advanced problems in data analytics.
PSO7	To become a skilled Data Scientist in industry, academia, or government and software tools for data storage, analysis and visualization

M.Sc. Restructured CBCS curriculum with effective from June-2022

PART	SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV	CREDITS
MC	Foundations of Data Science(4h+4c), Fundamentals of Mathematics(4h+4c), Statistics and Probability(4h+4c), Python for Data Science Lab (4h+4c) Machine Learning Lab (4h+4c),	Statistical Inference(4h+3c), Big Data Analytics(4h+3c), NoSQL Databases(4h+3c), Big Data Analytics - Lab(4h+3c), NoSQL Databases - Lab(4h+3c)	Multivariate Data Analytics (4h+4c), Deep learning (4h+4c), Deep Learning – Lab (4h+3c), Cloud Computing (4h+4c), Cloud Computing – Lab (4h+3c),		
	Python for Data Science(5h+4c) Machine Learning(5h+4c)	Research Methodology(3h+3c)			
ME		Elective 1A: Financial Analytics (4h+2c) Elective 1B: Health Analytics (4h+2c)	Elective 2A: Natural Language Processing(4h+2c), Elective 2B: Reinforcement Learning(4h+2c)		
ID			MEAN Stack (6h+3c)		
SI		Internship(1c)			
PJ				Project Architecture Planning (7C) Project Data Engineering(6C) Project Coding, Testing &	

				Implementation(7C)	
CD		Cross Disciplinary: Data Analytics/Visualization (3h+1c)			
MO		Self-Study Course - Online (2h + 2c)			
LS		Life Skill (2h + 1c)			
SK			Soft Skill (2h + 1c)		
VA			Value Added Course (2h + 1c)		
SL			Service Learning (2h + 1c)		
Hr/C	**30h/28C**	**30h/25 C**	**30h/26C**	**30h/20C**	**99**

Correlation Rubrics

High	Moderate	Low	No Correlation
3	2	1	0

Mapping of PEOs with Vision and Mission

	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
Vision	3	3	3	3	3	3
Mission	3	3	3	3	3	3

Mapping of POs with PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
PO1	3	3	3	3	3	3
PO2	3	3	3	3	3	3
PO3	3	3	2	2	3	3
PO4	3	3	3	3	2	3
PO5	3	2	3	3	3	3
PO6	3	3	3	3	3	3
PO7	3	3	2	3	3	2

Mapping of PSOs with PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5	PEO6
PSO1	3	3	3	3	3	3
PSO2	3	3	3	3	3	3
PSO3	3	3	3	3	3	3
PSO4	3	3	3	3	3	3
PSO5	3	3	3	3	3	3
PSO6	3	3	3	3	3	2
PSO7	3	3	3	3	3	3

Mapping of PSOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PSO1	3	3	3	3	3	3	3
PSO2	3	3	3	3	3	3	3
PSO3	3	3	3	3	3	3	3
PSO4	3	3	3	3	3	3	3
PSO5	3	3	3	3	3	3	3
PSO6	3	3	3	3	3	3	3
PSO7	3	3	3	3	3	3	3

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI

DEPARTMENT OF DATA SCIENCE

(2022 - Restructured Curriculum)

OVERALL COURSE STRUCTURE

Sem	Subject Code	Course Title	T/L	Category	Cr.	Hrs.
I	PDS1501 PDS1502	Foundations of Data Science Fundamentals of Mathematics	T T	MC MC	4 4	4 4
I	PDS1503 PDS1504 PDS1505	Statistics and Probability Python for Data Science Machine Learning	T T T	MC MC MC	4 4 4	4 5 5
‘I	PDS1506 PDS1507	Python for Data Science - Lab Machine Learning – Lab	L L	MC MC	4 4	4 4
II	PDS2501 PDS2502 PDS2504	Statistical Inference Big Data Analytics NoSQL Databases	T T T	MC MC MC	3 3 3	4 4 4
	PDS2506	Research Methodology	T	MC	3	3
II	PDS2503 PDS2505	Big Data Analytics - Lab NoSQL Databases - Lab	L L	MC MC	3 3	4 4
II	PDS2601 PDS2602	Elective 1A: Financial Analytics Elective 1B: Health Analytics	T T	ME ME	2 2	4 4
II	PDS2401	Cross Disciplinary: Data Analytics/Visualization	T	CD	1	3
II	PDS2901	Self-Study Course - Online	T	MO	2	-
II	PSS2902	Life Skill - SHE Dept	T	LS	1	2
II	PDS2801	Internship	P	SI	2	_
III	PDS3501 PDS3502 PDS3503 PDS3504 PDS3505	Multivariate Data Analytics Deep learning Deep Learning - Lab Cloud Computing Cloud Computing - Lab	T T L T L	MC MC MC MC MC	4 4 3 4 3	4 4 4 4 4

III	PDS3601 PDS3602	Elective 2A: Natural Language Processing Elective 2B: Reinforcement Learning	T	ME	2	4
III	PDS3301	MEAN Stack	L	ID	3	6
III **III**	PSS3401 PSL3402	Soft Skill - SHE Dept Service Learning Dept Course	T T	SK SL	1 1	2 2
III	PVA3403	Value Added Course	T	VA	1	2
IV	PDS4801 PDS4802	Project Architecture Planning Project Data Engineering	PJ PJ	MC MC	7 6	- -
IV	PDS4803	Project Coding, Testing & Implementation	PJ	MC	7	-

COURSES OFFERED TO OTHER DEPARMENTS

II	PDS2401	Cross Disciplinary: Data Analytics/Visualization	T	CD	1	3
III	PDS3301	INTER DISCIPLINARY: STATISTICS FOR COMPUTER SCIENCE	T	ID	3	6

COURSE DESCRIPTOR
Semester I

Course Code	**PDS1501**
Course Title	**FOUNDATIONS OF DATA SCIENCE**
Credits	**4**
Hours/Week	**4**
Category	**MC**
Semester	**I**
Regulation	**2022**

Course Overview:

1. To understand the stages of Data science projects
2. Descriptive statistics helps to understand the characteristics of the features involved in the data.
3. Course enables one to perform data cleaning and explanatory data analysis.
4. Provides knowledge on statistical modelling and evaluation techniques.
5. Enables one to handle data from various domain like Banking, Healthcare, retail, automobile etc..

Course Objective:

1. To incorporate basic data pre-processing procedures.
2. To develop appropriate data reduction techniques.
3. To apply statistical tools to develop a model for prediction and decision making.
4. To evaluate the models developed and draw meaningful inference.

Pre requisites : Basic understanding of data handling

SYLLABUS				
UNIT	**CONTENT**	**HRS**	**COs**	**COGNITIVE LEVEL**
I	Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.	8	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

III	Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Model Evaluation Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression –Testing Multiple Parameters by using Grid Search.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

TEXT BOOKS:

1. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.

SUGGESTED READINGS:

1. Jojo Moolayil, “Smarter Decisions: The Intersection of IoT and Data Science”, PACKT, 2016.
2. Joel Grus, “Data Science from Scratch” O’REILLY, 2018.
3. Rafael A. Irizarry, “Introduction to Data Science”, Chapman & Hall, 2022
4. Gupta. S.C. & Kapoor,V.K. , Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi,2002.

Website:

1. https://www.udemy.com/course/introduction-to-data-science/
2. https://www.youtube.com/watch?v=9lRv01HDU0s/Ridge and Lasso
3. https://www.coursera.org/learn/regression-models
4. https://www.simplilearn.com/tutorials/machine-learning-tutorial/overfitting-and-underfitting

Course Outcomes (COs) and Cognitive Level Mapping

PDS1501-FOUNDATIONS OF DATA SCIENCE (MC)		**Cognitive levels**
CO1	Understand and pre-process data	K1, K2
CO2	Apply summary measures of averages, dispersion and plots to draw useful conclusions	K3
CO3	Statistically analyse the strengths of relationship between variables.	K4
CO4	Evaluate real-life problems and draw inferences	K5
C05	Construct suitable statistical models and evaluate for meaningful inferences.	K6

SEMESTER I

COURSE DESCRIPTION

Course Code	**PDS1502**
Course Title	**FUNDAMENTALS OF MATHEMATICS**
Credits	**4**
Hours/Week	**4**
Category	**MC**
Semester	**I**
Regulation	**2022**

Course Overview:

1. Demonstrate understanding of basic mathematical concepts in data science, relating to set language, algebra, and calculus.
2. Understanding of vector Space, its operations and relations.
3. Perform matrix operations to transform and decompose data.
4. Identify influence of multi variables using vector calculus.
5. Study on Multicollinearity using differences and similarities.

Course Objective:

1. To perform operations on a set and its relations.
2. Understand the numerical methods to solve and find the roots of the equations.
3. To perform operations on vector space and matrices.
4. To handle multiple variables and study the influence of factors using vector calculus.
5. To study the various methods of studying differences and similarities between vectors.

Pre requisites : Basic knowledge of Mathematical Concepts

SYLLABUS

UNIT	**CONTENT**	**HRS**	**COs**	**COGNITIVE LEVEL**
I	Set Theory - Number system, Sets and their operations, Relations and functions - Relations and their types, Functions and their types. Quadratic Functions – Quadratic equations- Minima, maxima, vertex, and slope. Gradients- Gradient descents-Learning rate-Loss function.	6	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Introduction to vector spaces – Addition and Multiplication- properties of vector spaces; Linear	6	CO1 CO2	K1 K2

	dependence; Linear independence – rank/dimension for vector space using gaussian elimination.		CO3 CO4 CO5	K3 K4 K5 K6
III	Rank and Nullity of a matrix- The null space of a matrix - finding nullity and a basis -System of linear equations-eigen values and eigen vectors-Linearmapping-Linear transformation, Kernel and Images - Linear transformations, ordered bases and matrices; Image and kernel of linear transformations.	6	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Multivariable functions, Partial derivatives, Limit, continuity and directional derivatives - Multivariable functions: visualization; Partial derivatives; Directional derivatives; Limits for scalar-valued multivariable functions; Continuity for multivariable functions; Directional derivatives in terms of the gradient- maxima and minima of single variable functions using derivatives- maxima and minima of multivariate functions using vector calculus.	6	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	L_p Distances and their Relatives- Mahalanobis Distance-Cosine and Angular Distance-Jaccard Distance-Edit Distance-Angular distance-Euclidean distance-Bag of words Vectors-k grams-Normed similarities-set similarities.	6	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

TEXT BOOKS:

1. Y.N.Singh, "Mathematical Foundations for Computer Science", New Age publication, 2005.
2. P.R.Vittal, " Mathematical Foundations", Margham Publications, January 2002.
3. Kenneth kunen, " The foundations of Mathematics", College Publication,2009.
4. Shahnaz Bhathul, " Mathematical foundations for Computer Science", PH1 Learning, Second edition, 2010.

SUGGESTED READINGS:
1. Jeff M. Phillips, “Mathematical Foundations for Data Analysis”, December 2018 . 2. https://www.cs.utah.edu/~jeffp/M4D/M4D-v0.4.pdf 3. Micheal D. Greenberg, Foundations of Applied Mathematics, Dover Publications Inc., 2013.
Website: 1. https://www.udemy.com/course/linear-algebra-for-machine-learning 2. https://www.youtube.com/watch?v=_uDSWIy8wX0 3. https://www.youtube.com/watch?v=hh0vmyVybSU

Course Code	**PDS1503**
Course Title	**STATISTICS AND PROBABILITY**
Credits	**4**
Hours/Week	**4**
Category	**MC**
Semester	**I**
Regulation	**2022**

Course Overview:

Able to analyse basic characteristics of the features.

Can perform univariate and Bivariate analysis.

Able to apply Probability concepts.

Can understand the concepts related to Distribution Functions.

Enable to identify and apply appropriate Probability Distributions.

Course Objective:

To perform Explanatory Data Analysis.

To study the relationship between two variables through correlation and regression.

To study discrete and continuous Random Variables & related concepts.

To identify and apply appropriate Probability Distributions.

Pre requisites: Basic understanding of Statistics

SYLLABUS

UNIT	**CONTENT**	**HRS**	**COs**	**COGNITIVE LEVEL**
I	Sampling Techniques – Data Classification – Tabulation – Frequency and graphic Representation – Measures of Central Tendency – Measures of Variation – Quartiles and Percentiles– Moments - Skewness and Kurtosis.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Scatter Diagram – Karl Pearson's Correlation Coefficient – Rank Correlation –Correlation Coefficient for Bivariate Frequency Distribution – Regression Coefficients – Fitting of Regression Lines.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

III	Random Experiment – Sample Space – Events – Axiomatic Definition of probability –Addition Theorem– Multiplication Theorem – Baye's Theorem- Applications.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Continuous and Discrete Random Variables – Distribution Function of a Random Variable –Probability Mass Functions and Probability Density Functions – Characteristic Functions – Central Limit Theorems.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Probability Distributions – Recurrence Relationships – Moment Generating Functions –Cumulant Generating Functions – Continuous Probability Distributions - Rectangular Distribution – Binomial Distribution – Poisson Distribution – Continuous Probability Distributions – Uniform Distribution - Normal Distribution – Exponential Distribution	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

REFERENCES:

1. Gupta,S.C.andKapoor,V.K.:"FundamentalsofMathematicalStatistics",Sultan&Chand&Sons, NewDelhi,11th Ed, 2002.
2. Hastie, Trevor, etal. "The elements of Statistical Learning", Springer, 2009.
3. Ross, S.M., "Introduction to Probability and Statistics", Academic Foundation, 2011.
4. Papoulis,A.andPillai,S.U.,"Probability,RandomVariablesandStochasticProcesses",TMH, 2010

Website:
https://onlinecourses.nptel.ac.in/noc22_mg87/preview https://www.udemy.com/tutorial/learn-probability-concepts-and-counting-techniques sample-space-sample-points-and-events/ https://www.udemy.com/tutorial/learn-probability-concepts-and-counting- techniques/concepts sample-space-sample-points-and-events/

Course Outcomes (COs) and Cognitive Level Mapping

PDS1503 - STATISTICS AND PROBABILITY (MC)		**Cognitive levels**
CO1	Concepts of descriptive Statistics and definitions	K1, K2
CO2	Problems in correlation and regression and its interpretation	K3
CO3	Concepts of Probability and their applications	K4
CO4	Concepts of discrete and continuous distribution functions	K5
C05	Identification and application of suitable probability distribution for a given problem situation	K6

Course Code	**PDS 1504**
Course Title	**PYTHON FOR DATA SCIENCE**
Credits	**04**
Hours/Week	**05**
Category	**Major Core(MC)–Theory**
Semester	**I**
Regulation	**2022**

Course Overview

1. Understand data structures and OOP concepts in Python
2. Explore the functionalities and applications of Numpy & Pandas packages
3. Provide hands on training in Data Wrangling
4. Apply Data Aggregation and Grouping operations on real time data sets.
5. Exposure to Data Visualization techniques made available by Python

Course Objectives

1. To develop Python programming skill with data science perspective
2. To perform Data Wrangling operations of different types
3. To effectively perform Data Aggregation and Grouping operations & Data Visualization

Prerequisites	Basic programming knowledge.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Installing and using Jupyter Notebook – Creating and executing Python Programs – Statements – Expressions – Variables – Operators – Data Types – Type Conversions – Control Flow Statements – Exception Handling	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	Functions – Data Structures: Lists, Dictionaries, Tuples, Sets – File handling – Regular Expressions – Object-Oriented Programming	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	Functional Programming: Lambda, Iterators, Generators, List Comprehensions – NumPy Arrays – Pandas Series – Pandas Dataframes	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	Data Wrangling with Pandas – Querying DataFrames – Merging DataFrames –	**12**	CO1 CO2	K1,K2,K3 K4,K5,K6

	Applying Functions to DataFrames – Aggregations with Pandas and NumPy		CO3 CO4 CO5	
V	Matplotlib package – Pandas.Plotting package: Scatter matrices, Lag Plots, Autocorrelation Plots, Bootstrap Plots Seaborn Package: Stripplot, Swarmplot, Heatmap, Pairplot,Regression Plot – Formatting – Customizing Visualizations	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

REFERENCES:

1. Gowrishanker and Veena, "Introduction to Python Programming", CRC Press, 2019
2. Stefanie Molin, "Data Analysis with Pandas", Packt, 2019
3. Joel Grus, "Data Science from scratch", O'Reilly, 2015
4. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012
5. Jake Vanderplas, "Python Data Science Handbook: Essential Tools for Working with Data ", 2012

1. **https://www.python.org/**
2. **https://www.w3schools.com/python/**
3. **https://www.tutorialspoint.com/python/index.htm**

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 1504 PYTHON FOR DATA SCIENCE (MC)		COGNITIVE LEVEL
CO1	To understand and apply the Python Programming concepts.	K1,K2
CO2	To apply the functions available in Numpy and Pandas packages	K3
CO3	To illustrate Data Wrangling operations in different contexts.	K4
CO4	To assess the usage of Data Aggregation and Grouping operations.	K5
CO5	To construct Visuals for various real-world problems.	K6

Course Code	**PDS1505**
Course Title	**PYTHON OR DATA SCIENCE LAB**
Credits	**04**
Hours/Week	**04**
Category	**Major Core (MC) – Lab**
Semester	**I**
Regulation	**2022**

Course Overview

This Lab course aims to acquire skills in Python Programming concepts like data structures, object oriented programming, data wrangling, data aggregation, grouping operations and data visualization techniques.

Course Objectives

1. To apply OOP concepts in Python to solve a variety of problems
2. To develop solutions using the functions in Numpy and Pandas packages
3. To perform data wrangling, data aggregation and grouping operations
4. To effectively build data visualizations for different contexts

Prerequisites	Basic programming knowledge.

SYLLABUS

UNIT	**CONTENT**	**HOURS**	**COs**	**COGNITIVE LEVEL**
I	1. Editing and executing Programs involving Flow Controls. 2. Editing and executing Programs involving Functions. 3. Program in String Manipulations	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	4. Creating and manipulating a Tuple 5. Creating and manipulating a List 6. Creating and manipulating a Dictionary	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	7. Object Creation and Usage 8. Program involving Inheritance 9. Program involving Overloading	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	10. Reading and Writing with Text Files	**12**	CO1	K1,K2,K3

	and Binary Files 11. Combining and Merging Data Sets		CO2 CO3 CO4 CO5	K4,K5,K6
V	12. Program involving Regular Expressions 13. Data Aggregation and GroupWise Operations	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

REFERENCES:

1. Gowrishanker and Veena, "Introduction to Python Programming", CRC Press, 2019
2. Stefanie Molin, "Data Analysis with Pandas", Packt, 2019
3. Joel Grus, "Data Science from scratch", O'Reilly, 2015
4. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012
5. Jake Vanderplas, " Python Data Science Handbook: Essential Tools for Working with Data", 2012

Website:

1. **https://www.python.org/**
2. **https://www.w3schools.com/python/**
3. **https://www.tutorialspoint.com/python/index.htm**

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 1505 python for data science (MC)		COGNITIVE LEVEL
CO1	To make use of data structures in Python to represent different types of data	K1, K2
CO2	To apply OOP concepts in Python to solve a variety of problems	
CO3	To develop solutions using the functions in Numpy and Pandas packages	K3
CO4	To perform data wrangling, data aggregation and grouping operations	K4
CO5	To effectively build data visualizations for different contexts	K5

Course Code	**PDS1506**
Course Title	**Machine Learning**
Credits	**04**
Hours/Week	**05**
Category	**Major Core(MC)–Theory**
Semester	**I**
Regulation	**2022**

Course Overview

1. This course provides the various types of machine learning algorithms.
2. Machine Learning focuses on the development of predictive models that learn automatically
3. This course covers complex Machine Learning algorithms used for solving real world problems.
4. It enables better decision making, predictive analysis, visualization and pattern discovery.

Course Objectives

1. To understand a range of Machine learning algorithms along with their merits and demerits.
2. To learn the methodology and apply the machine learning algorithms to real world problems.
3. To implement visualization of solutions for effective understanding and decision making.
4. To explore the concepts of market basket analysis and recommendation systems.

Prerequisites	Basic knowledge in data science algorithms

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Introduction: Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine Learning – Supervised Learning and Unsupervised Learning – Applications of Machine Learning – Tools Overview for ML.	**15**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	Supervised Learning – I: Simple Linear Regression – Multiple Linear Regression – Polynomial Regression – Ridge Regression – Lasso Regression – Evaluating Regression Models – Model Selection – Bagging – Ensemble Methods.	**15**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	Supervised Learning – II: Classification – Logistic Regression –	**15**	CO1 CO2	K1,K2,K3 K4,K5,K6

	Decision Tree Regression and Classification – Random Forest Regression and Classification – Support Vector Machine Regression and Classification - Evaluating Classification Models.		CO3 CO4 CO5	
IV	Unsupervised Learning: Clustering – K-Means Clustering – Density-Based Clustering – Dimensionality Reduction – Collaborative Filtering.	**15**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	Association Rule Learning and Reinforcement Learning: Association Rule Learning – Apriori – Eclat – Reinforcement Learning – Upper Confidence Bound – Thompson Sampling – Q-Learning.	**15**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
4. Sebastian Raschka, Vahid Mirjilili," Python Machine Learning and deep learning", 2nd edition, kindle book, 2018
5. Carol Quadros," Machine Learning with python, scikit-learn and Tensorflow", Packet Publishing, 2018
6. Gavin Hackeling," Machine Learning with scikit-learn", Packet publishing, O'Reily, 2018
7. Stanford Lectures of Prof. Andrew Ng on Machine Learning
8. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.

Suggested Readings

1. Samir Madhavan, 2016. Mastering Python for Data Science, PACKT Publishing.
2. Ethem Alpaydin, 2009. Introduction to Machine Learning, The MIT Press.
3. Jake VanderPlas, 2016. Python Data Science Handbook, O'REILLY.
4. Stanford Lectures of Prof. Andrew Ng.
5. NPTEL Lectures of Prof. B.Ravindra

Web Resources

1. https://data-flair.training/blogs/machine-learning-tutorial/
2. https://www.packtpub.com/application-development/complete-machine-learning-course-python-video
3. https://www.geeksforgeeks.org/machine-learning/

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 1506 MACHINE LEARNING(MC)		COGNITIVE LEVEL
CO1	To understand the concepts of Machine learning.	K1,K2
CO2	To understand and distinguish Supervised, Unsupervised and Reinforcement Learning.	K3
CO3	To apply Supervised, Unsupervised and semi supervised algorithms for a specific problem	K4
CO4	To compare the performance of various machine learning techniques for real world problems	K5
CO5	To propose solutions for real world problems using huge volume of data.	K6

Course Code	PDS 1507
Course Title	**Machine Learning Lab**
Credits	**04**
Hours/Week	**04**
Category	**Major Core(MC)–Lab**
Semester	**I**
Regulation	**2022**

Course Overview

1. This course helps to understand a wide variety of machine learning algorithms
2. It helps to understand how to evaluate models generated from data
3. Machine learning techniques enable us to automatically extract features from data so as to solve predictive tasks, such as speech recognition, object recognition, machine translation
4. This course helps to design and implement various machine learning algorithms in a range of real-world application.

Course Objectives

1. To be able to formulate machine learning problems agreeing to different applications
2. To understand a variety of machine learning algorithms along with their strengths and weaknesses
3. To be able to apply machine learning algorithms to solve problems of moderate complexity
4. To apply the algorithms to a real-world problem, enhance the models learned and report on the expected accuracy that can be achieved by applying the model.

Prerequisites	Basic Knowledge in Programming

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	1. Simple and Multiple Linear Regression 2. Polynomial Regression	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	3. Bagging Technique 4. Adaboost Methods	**10**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	5. Logistic Regression algorithm 6. Decision Tree Classification	**12**	CO1 CO2 CO3	K1,K2,K3 K4,K5,K6

	7. Random Forest Classification		CO4 CO5	
IV	8. SVM Classification 9. K Means Clustering 10. Density based Clustering	**13**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	11. Apriori algorithm for market basket analysis 12. Comparison of Supervised Machine Learning algorithms	**13**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (First Edition)-O'Reilly Media
2. John Paul Mueller and Luca Massaron, Machine Learning (in Python and R) For Dummies (1st Edition).
3. Drew Conway & John Myles, Machine Learning for Hackers: Case Studies and Algorithms to Get You Started (1st Edition).

Suggested Readings

1. Ethem Alpaydin, Machine Learning: The New AI (The MIT Press Essential Knowledge Series)
2. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies.
3. Andriy Burkov, The Hundred-Page Machine Learning Book.
4. Valliappa Lakshmanan, Machine Learning Design Patterns: Solutions to Common Challenges in Data Preparation, Model Building, and MLOps

Web Resources

1. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm
3. https://pythonprogramming.net/machine-learning-tutorial-python-introduction/

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 1507MACHINE LEARNING LAB(MC)		COGNITIVE LEVEL
CO1	Apply structured thinking to unstructured problems	K1,K2
CO2	Understand a very broad collection of machine learning algorithms and problems	K3
CO3	Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory	K4
CO4	Learn to apply accuracy metrics for various models	K5
CO5	Develop an appreciation for what is involved in learning models from data.	K6

Semester II

COURSE DESCRIPTION

Course Code	**PDS2501**
Course Title	**STATISTICAL INFERENCE**
Credits	**3**
Hours/Week	**4**
Category	**MC**
Semester	**II**
Regulation	**2022**

Course Overview:

1. Able to understand and apply basic concepts of Statistical Inference.
2. Able to understand and apply important results such as NP Lemma and LR test.
3. Enable to easily derive conclusions from Large Samples.
4. Can understand the concepts related to Small Sample tests.
5. Enable to identify problematic situations and apply Non-parametric Tests.

Course Objectives:

1. To study basic concepts of Statistical Inference.
2. To apply important results such as NP Lemma and LR test.
3. To study Large Sample Tests and Small Sample tests.
4. To identify problematic situations and apply Non-parametric Tests.

Pre requisites: Basic understanding of Statistics

SYLLABUS

U	**CONTENT**	**HRS**	**COs**	**COGNITIVE LEVEL**
I	Testing of Hypothesis - Statistical Hypothesis - Simple and composite hypothesis, Null and Alternative hypothesis - two kinds of errors, level of significance, size and power of a test most powerful test, Neyman-Pearson lemma with proof.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

II	Simple examples using Neyman Pearson lemma. Uniformly most powerful tests andun biased tests based on normal Likelihoodratiotest(withoutproof)and its properties. Application of LR test for single mean.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
III	Testofsignificanceformean(s),variance(s),proportion (s),correlationcoefficient(s)basedon Normal distribution.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Test of significance for mean(s), variance(s), correlation coefficient(s), regression coefficient, based on t, Chi-square and F-distributions. Applications of Chi-square in test of significance(independence of attributes, goodness off it).-ANOVA-One way Classification-Two way Classification-CRD-RBD-LSD.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Non-parametric tests – Kolmogorov -Smirnov test, Sign test, Wald- Wolfowitz run test, runtestfor randomness, median test, Wilcoxontest and Wilcoxon – Mann-WhitneyUtest.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

REFERENCES:

1. Gupta,S.C.andKapoor,V.K.:“FundamentalsofMathematicalStatistics”,Sultan&Chand&Sons, NewDelhi,11th Ed, 2002.
2. Rohatgi,V.K.:“Statistical Inference”,JohnWileyand sons,1984.
3. Hogg,R.V,Craig.A.T.andTannis:“Introductiontomathematicalstatistics”,PrenticeHall,England , 1995.
4. Dudewicz.E.JandMishra.S.N.:“ModernMathematicalstatistics”,JohnWileyandsons,1988.

. **Website:** . 1.https://www.udemy.com/tutorial/python-for-statistical-analysis/hypotesis-introduction/ 3. https://www.coursera.org/lecture/inferential-statistics-intro/the-chi-square-independence-test- 4. LEIm3 **5.** https://www.youtube.com/watch?v=RgKy7URFx1c

Course Outcomes (COs) and Cognitive Level Mapping

PDS1502 - STATISTICS FOR COMPUTER SCIENCE(IDE)		**Cognitive levels**
CO1	Definitions and Concepts of Statistical Inference	K1,K2
CO2	Interpretations and applications of Important results, such as NP Lemma and LR test	K3
CO3	Concepts of Large sample Tests	K4
CO4	Concepts of Small Sample Tests	K5
C05	Identification and application of suitable non-parametric test for a given problem situation	K6

Course Code	**PDS 2502**
Course Title	**BIG DATA ANALYTICS THROUGH SPARK**
Credits	**03**
Hours/Week	**04**
Category	**Major Core(MC)–Theory**
Semester	**II**
Regulation	**2022**

Course Overview

1. Understand the Big Data Platform and its Use cases
2. Provide Concepts and Interfacing with HDFS and Map Reduce
3. Provide hands on Spark programming and Eco System
4. Apply spark analytics on Structured, Unstructured Data.
5. Exposure to Data Analytics with Machine Learning Algorithm using Spark

Course Objectives

1. To develop dynamic RDD spark programming using Different dataset.
2. To perform Big Data analytics using Spark.
3.To effectively build Model using Machine Learning Algorithms to analysis in Big data

Prerequisites	Basic programming knowledge.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Unit I: Introduction to Big Data and Hadoop** Big Data and its importance – Sources of Big Data – Characteristics of Big Data – Big Data Analytics – Big Data Applications, Hadoop Distributed File System – Map Reduce Paradigm- Hadoop Ecosystem	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	**Unit II: Spark Programming with Python** Apache Spark Ecosystem - Resilient Distributed Datasets – Spark Architecture -Loading and Storing Data – Transformations – Actions – Key-Value Resilient Distributed Datasets – Local Variables – Broadcast Variables – Accumulators – Partitioning – Persistence. .	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

III	**Unit III: Spark SQL** Overview of Spark SQL – Spark Session – Data Frames – Schema of a Data Frame – Operations supported by Data Frames – Filter, Join, GroupBy, Agg operations – Nesting the Operations – Temporary Tables – Viewing and Querying Temporary Tables.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	**Unit IV: Spark Streaming** Use Cases for Real time Analytics – Transferring, Summarizing,Analysing Real time data – Data Sources supported by Spark Streaming – Flat files, TCP/IP – Flume – Kafka – Kinesis – Streaming Context –D DStreams operations.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	**Unit V: Machine Learning with Spark** Linear Regression – Decision Tree Classification – Principal Component Analysis – Random Forest Classification – Text Pre-processing with TF-IDF – Naïve Bayes Classification – K-Means Clustering – Recommendation Engines.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. 2. Tom
2. White " Hadoop: The Definitive Guide" Third Edition, O‟reilly Media, 2011
3. Tomasz Drabos, "Learning PySpark", PACKT, 2017.

Suggested Readings

1. Padma Priya Chitturi, "Apache Spark for Data Science", PACKT, 2017.
2. Holden Karau, " Learning Spark". PACKT, 2016.
3. Sandy Riza, "Advanced Analytics with Spark", O' Reilly, 2016.
4. Romeo Kienzler, "Mastering Apache Spark", PACKT, 2017.

Web Resources

1. https://spark.apache.org/
2. https://databricks.com/

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 2502 BIG DATA ANALYTICS THROUGH SPARK (MC)		COGNITIVE LEVEL
CO1	To remember and understand the SPARK Programming concepts.	K1,K2
CO2	To apply Algorithm constructs to implement RDD concept.	K3
CO3	To illustrate Spark SQL and Temp table operations.	K4
CO4	To assess Spark Streaming operations through different method.	K5
CO5	To construct solutions to resolve various real-world problems.	K6

<table>
<tr><td>Course Code</td><td colspan="4">PDS2503</td></tr>
<tr><td>Course Title</td><td colspan="4">BIG DATA ANALYTICS THROUGH SPARK - LAB</td></tr>
<tr><td>Credits</td><td colspan="4">03</td></tr>
<tr><td>Hours/Week</td><td colspan="4">04</td></tr>
<tr><td>Category</td><td colspan="4">Major Core (MC) – Lab</td></tr>
<tr><td>Semester</td><td colspan="4">II</td></tr>
<tr><td>Regulation</td><td colspan="4">2022</td></tr>
<tr><td colspan="5">Course Overview
• This Lab course aims to acquire skills in Big Data Analytics Through Spark concepts like creating RDD, various RDD operations, Spark with SQL, Spark Streaming, and spark with Machine Learning</td></tr>
<tr><td colspan="5">Course Objectives
1. To apply RDD concepts to solve the real-world problems
2. To develop dynamic RDD spark programming using Different dataset.
3. To perform analysis in Big data using various Methods
4. To effectively build Model using Machine learning Algorithms to analysis in big data</td></tr>
<tr><td>Prerequisites</td><td colspan="4">Basic programming knowledge.</td></tr>
<tr><td colspan="5">SYLLABUS</td></tr>
<tr><td>UNIT</td><td>CONTENT</td><td>HOURS</td><td>COs</td><td>COGNITIVE LEVEL</td></tr>
<tr><td>I</td><td>1. Program involving Resilient Distributed Datasets
2. Program involving Transformations and Actions
3. Program involving Key-Value Resilient Distributed Datasets</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
<tr><td>II</td><td>4. Program involving Local Variables, Broadcast Variables and Accumulators
5. Program involving Filter, Join, GroupBy, Agg operations
6. Viewing and Querying Temporary Tables</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
<tr><td>III</td><td>7. Transferring, Summarizing and Analysing Twitter data
8. Program involving Flume, Kafka and Kinesis
9. Program involving DStreams and Dstream RDDs</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
</table>

IV	10. Linear Regression 11. Decision Tree Classification 12. Principal Component Analysis	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	13. Random Forest Classification 14. Text Pre-processing with TF-IDF 15. Naïve Bayes Classification 16. K-Means Clustering	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. 2. Tom
2. White " Hadoop: The Definitive Guide" Third Edition, O"reilly Media, 2011
3. Tomasz Drabos, "Learning PySpark", PACKT, 2017.

Suggested Readings

1. Padma Priya Chitturi, "Apache Spark for Data Science", PACKT, 2017.
2. Holden Karau, " Learning Spark". PACKT, 2016.
3. Sandy Riza, "Advanced Analytics with Spark", O' Reilly, 2016.
4. Romeo Kienzler, "Mastering Apache Spark", PACKT, 2017.

Web Resources

1. https://spark.apache.org/
2. https://databricks.com/

Course Outcomes (COs)and Cognitive Level Mapping

PDS 2504 BIG DATA ANALYTICS THROUGH SPARK (MC)		**COGNITIVE LEVEL**
CO1	To remember and understand the RDD operation concepts.	**COGNITIVE LEVEL**
CO2	To remember and understand the RDD operation concepts.	K1, K2
CO3	To apply Algorithm to implement spark SQL concept.	K3
CO4	To illustrate Spark SQL and Temp table operations.	K4
CO5	To assess Spark Streaming operations through different machine Learning Algorithms.	K5

<table>
<tr><td>Course Code</td><td colspan="4">PDS 2504</td></tr>
<tr><td>Course Title</td><td colspan="4">NoSQL DATABASES</td></tr>
<tr><td>Credits</td><td colspan="4">03</td></tr>
<tr><td>Hours/Week</td><td colspan="4">04</td></tr>
<tr><td>Category</td><td colspan="4">Major Core (MC) – Theory</td></tr>
<tr><td>Semester</td><td colspan="4">II</td></tr>
<tr><td>Regulation</td><td colspan="4">2022</td></tr>
<tr><td colspan="5">Course Overview
• NoSQL database course introduction, overview NoSQL databases (non-relational databases). The four types of NoSQL databases (e.g. Document-oriented, Key-Value Pair, Column-oriented and Graph) will be explored in detail</td></tr>
<tr><td colspan="5">Course Objectives
1. Knowledge on SQL query language.
2. Knowledge on MongoDB query language.
3. Ability to comprehend the principles of NoSQL.
4. Understand the difference of NoSQL key value and Document database
5.Understand the Column database and data modeling technique</td></tr>
<tr><td colspan="5">Prerequisites: Basic Big Data knowledge.</td></tr>
<tr><td colspan="5">SYLLABUS</td></tr>
<tr><td>UNIT</td><td>CONTENT</td><td>HOURS</td><td>COs</td><td>COGNITIVE LEVEL</td></tr>
<tr><td>I</td><td>Introduction of Relational Data Base

Creating a table Inserting, deleting, alter, Updating Select command , Where clause, Aggregate functions, Numeric functions, Constraints, keys, Group By, Having, Sub Queries, Alias, Joins, Operators, String Functions, Normalization.</td><td>12</td><td>CO1</td><td>K1,K2,K3
K4,K5,K6</td></tr>
<tr><td>II</td><td>Introduction of NO SQL

Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points Comparison of relational databases to new NoSQL stores, Mongo DB,</td><td>12</td><td>CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
</table>

	Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer replication, Combining Sharding and Replication .			
III	**KEY VALUE DATA STORES** NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	12	CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	**DOCUMENT ORIENTED DATABASE** Column- oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.	12	CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	**DATA MODELING WITH GRAPH** Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank-Markov chain, page rank computation, Topic specific page rank Page Ranking Computation techniques iterative processing, Random walk distribution Querying Graphs	12	CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books 1. Sadalage, P. & Fowler,NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition,2022.
Suggested Readings 1. Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, An introduction to Information Retrieval, Cambridge University Press 2. Daniel Abadi, Peter Boncz and Stavros Harizopoulas, The Design and Implementation of Modern Column-Oriented Database Systems, Now Publishers. 3. Guy Harrison, Next Generation Database: NoSQL and big data, Apress.
Web Resources 1. https://www.oracle.com/in/database/nosql/technologies/nosql/ 2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp 3. https://www.geeksforgeeks.org/introduction-to-nosql/ 4. https://www.javatpoint.com/nosql-database

Course Outcomes (COs)and Cognitive Level Mapping

PDS2504- NoSQL DATABASES (MC)		**COGNITIVE LEVEL**
CO1	To remember and understand the SQL concepts.	K1,K2,K3
CO2	To apply objects, load data, query data and performance tune Column-oriented NoSQL databases.	K1,K2,K3
CO3	To illustrate NoSQL database operations.	K3,k4
CO4	To assess concept such as Cassandra, Hadoop Hbase, MongoDB, Neo4J	K5
CO5	To construct solutions to resolve various real-world problems.	K6

Course Code	**PDS2505**
Course Title	**NoSQL DATABASES – LAB**
Credits	**03**
Hours/Week	**04**
Category	**Major Core (MC) – Lab**
Semester	**II**
Regulation	**2022**

Course Overview

1. Knowledge on MongoDB query language.
2. Ability to comprehend the principles of NoSQL.
3. Understand the difference of NoSQL key value database and Document database
4. Know the concept of Column database
5. Understand the data modelling technique

Course Objectives

1. Demonstrate competency in designing NoSQL database management systems.
2. Demonstrate competency in describing how NoSQL databases differ from relational databases from a theoretical perspective
3. Demonstrate competency in selecting a particular NoSQL database for specific use cases.

Prerequisites	Basic SQL and Big Data knowledge.

SYLLABUS

UNIT	**CONTENT**	**HOURS**	**COs**	**COGNITIVE LEVEL**
I	1. Query to create and drop database. 2.Query to create, display and drop collection 3.Query to insert, query, update and delete a document	12	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	4.Key-value databases 5.Implement with column-family stores (cassandra) 6.Graph databases (neo4j)	12	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	7.Aggregate function 8 .Push and addtoset expression. 9. First and last expression.	12	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	10.Replica of existing database	12	CO1	K1,K2,K3

	11.Backup of existing database		CO2 CO3 CO4 CO5	K4,K5,K6
V	12. Restore database from the backup 13.Connecting python with mongodb and inserting, retrieving, updating and deleting.	12	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Practical mongodb by “shakuntala gupta edward navin sabharwal publisherapress
2. Nosql distilled by pramod sadalge, martin fowler
3. Nosql for dummies by a willy Brand

Suggested Readings

4. Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, An introduction to Information Retrieval, Cambridge University Press
5. Daniel Abadi, Peter Boncz and Stavros Harizopoulas, The Design and Implementation of Modern Column-Oriented Database Systems, Now Publishers.
6. Guy Harrison, Next Generation Database: NoSQL and big data, Apress.

Web Resources

1. https://www.oracle.com/in/database/nosql/technologies/nosql/
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/
4. https://www.javatpoint.com/nosql-database

Course Outcomes (COs)and Cognitive Level Mapping

PDS2505- NoSQL DATABASES LAB (MC)		**COGNITIVE LEVEL**
CO1	To remember and understand the No SQL Basic Query.	K1,K2
CO2	To apply objects, load data, query data and performance tune Column-oriented NoSQL databases in Data Set.	K3
CO3	To illustrate NoSQL database Operations with Big Data.	K4
CO4	To assess concept such as Cassandra, Hadoop Hbase, MongoDB, Neo4J using Various Data set.	K5
CO5	To construct solutions to resolve various real-world problems.	K6

Course Code	PDS2601
Course Title	MARKETING ANALYTICS
Credits	**2**
Hours/Week	**4**
Category	**ME**
Semester	**II**
Regulation	**2022**

Course Overview:

1. Analyse the various types of marketing data
2. Assess the quality of marketing data and make appropriate interpretations of meaning according to data sources and intended uses.
3. Compare and contrast common data models used in marketing data systems.
4. Able to identify social media platforms for forming Marketing strategies
5. Identify Web resources for forming effective Marketing strategies

COURSE OBJECTIVES:

1. Recognize challenges in dealing with data sets in marketing.
2. Identify and apply appropriate algorithms for analyzing the social media and web data
3. Make choices for a model for new machine learning tasks.

Pre requisites: Basic knowledge in Statistics and Data analysis

SYLLABUS

UNIT	**CONTENT**	**HRS**	**Cos**	**COGNITIVE LEVEL**
I	**Marketing Analytics Basics** Introduction, Data for Marketing Analytics, Business Intelligence, Analytics, and Data Science, Exploratory Data Analysis, Descriptive Analysis, Predictive Analytics, Prescriptive Analytics. Price Analytics – Goals, Bunding, Skimming, Promotions, Discounting	8	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	**Customer Analytics** Segmentation- Introduction, Benefit of Customer Analytics, Factors Essential, Segmentation Analytics, Cluster Analysis. Nurturing Customers - Metrics for Tracking Customer Experience, Logistic Regression Analysis, Use of Logistic Regression as a	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

	Classification Technique. Customer Analytics -Customer Lifetime Value, Churn Analytics			
III	**Digital Marketing Analytics** Traditional Vs Digital Marketing, Strategies, Advertising: Concept of Display Advertising, Display Ads, Buying Models – Cost per Click, Milli, Lead, Acquisition, Fixed Cost. Social Media Marketing: How to build a successful business strategy.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	**Social Media Analytics** Facebook for Business - Ad Campaign – Adverts - Facebook insights – groups – hashtags - apps. Case Study: Tata Docomo. How Twitter building blocks - How is it different - Twitter Usage – Ads - Analytics and Twitter Tools.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	**Web Analytics** Web Logs- Javascript tags- Making web analytics actionable- Multi channel attribution- Types of Tracking Codes-Google Analytics Code - Ad words conversion code - Mobile and Universal Analytics	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

TEXT BOOKS

1. Marketing Analytics, Seema Gupta and Avadoot Jather, Wiley, 2021
2. Digital Marketing, Seema Gupta, McGrawHill(India), 2018
3. Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, Chuck Hemann & Ken Burbary, Pearson, ISBN 9780789750303
4. Matthew Ganis, Avinash Kohirkar. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media. Pearson 2016.
5. Jim Sterne. Social Media Metrics: How to Measure and Optimize Your Marketing Investment. Wiley, 2020.
6. Marshall Sponder. Social Media Analytics. McGraw Hill Latest edition.

REFERENCE BOOKS

1. Marketing Analytics: A practical guide to real marketing science, Mike Grigsby, Kogen Page, ISBN 9780749474171
2. Marketing Metrices 3e, Bendle, Farris, Pferfery, Reibstein,
3. Cutting Edge Marketing Analytics: Real World Cases and Data Sets for Hands on Learning, Raj Kumar Venkatesan, Paul Farris, Ronald T. Wilcox.

Course Outcomes (Cos) and Cognitive Level Mapping

PDS1501-INTRODUCTION TO DATA SCIENCE (MC)		**Cognitive levels**
CO1	Understanding concepts **Marketing Analytics**	K1, K2
CO2	Understanding concepts Marketing Analytics	K3
CO3	Understanding concepts Customer Analytics	K4
CO4	Understanding concepts Facebook Analytics	K5
C05	Understanding concepts Web Analytics	K6

Course Code	**PDS2602**
Course Title	**HEALTH ANALYTICS**
Credits	**2**
Hours/Week	**4**
Category	**ME**
Semester	**II**
Regulation	**2022**

Course Overview:

Analyse the various types and sources of healthcare data, including clinical, operational, claims, and patient generated data.

Assess the quality of healthcare data and make appropriate interpretations of meaning according to data sources and intended uses.

Compare and contrast common data models used in healthcare data systems.

Able to identify common measures used in healthcare data analysis for predictive models.

Identify approaches for precision medicine and treatments for personalised services.

Course Objective:

To understand the basic sources of healthcare data.

To perform image analysis and sensor data analysis.

To derive and evaluate data mining and analysis from social media.

To frame advanced data analytic models through visual analytics.

To identify fraud detection in healthcare from different sources of data.

Pre requisites : Basic knowledge in Statistics and Data analysis

SYLLABUS

UNIT	CONTENT	HRS	COs	COGNITIVE LEVEL
I	Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges- Phenotyping Algorithms.	8	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

III	Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical Social Media Analytics for Healthcare.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Advanced Data Analytics for Healthcare– Review of Clinical Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive 53 Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Data Publishing Methods in Healthcare.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

TEXT BOOKS:

1. Chandan K. Reddy and Charu C Aggarwal, “Healthcare data analytics”, Taylor & Francis, 2015.
2. Ross M.Muller and Edward M.Rafalski, “Healthcare Analytics”, T&F/Routledge, 2020.
3. Chandan K.Reddy, “Healthcare Data Analytics”, CRC Press, 2020.
4. Vikas Kumar, “Healthcare Analytics made simple”, Packt, 2020.

SUGGESTED READINGS:

1. Hui Yang and Eva K. Lee, “Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.
2. Tim O’reilly , “How data science is transforming Healthcare”, O’reilly,2022.
3. Laura B. Madsen, “Data driven healthcare”, Wiley,2022.
4. Jason Burke, “Health Analytics”, Wiley, 2020.

Course Outcomes (COs) and Cognitive Level Mapping

PDS1501-INTRODUCTION TO DATA SCIENCE (MC)		Cognitive levels
CO1	Understanding data sources and concepts	K1, K2
CO2	Image analysis and genomic studies	K3
CO3	NLP techniques in healthcare data from social media	K4
CO4	Predictive and prescriptive models of healthcare data	K5
C05	Fraud detection in healthcare and Assistive image analysis system	K6

Course Code	**PDS2506**
Course Title	**RESEARCH METHODOLOGY`**
Credits	**03**
Hours/Week	**03**
Category	**Major Core (MC) – Theory**
Semester	**II**
Regulation	**2022**

Course Overview

This methodology achieving competence and proficiency in the theory of and practice to research. This fundamental objective can be realized through helping these students to develop the subject of their research, encourage the formation of higher level of trained intellectual ability, critical analysis, rigour, and independence of thought, foster individual judgment, and skill in the application of research theory and methods, and develop skills required in writing research proposals, reports, and dissertation

Course Objectives

These methodologies include, but are not limited to, experimental, survey and content analysis. Class discussions and instructor lectures Examination and will be able to describe basic approaches to qualitative research. and identify and critique articles based on different research methods and to the know the data visualization

Prerequisites	No prerequisites

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research.	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database.	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

III	Interpretation of Findings, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Research Papers; Writing Research Papers, Thesis, Reports and Project Proposals; Formatting, Appendices, Citation Formats and Style; General Conventions, Issues, Plagiarism and Copyright.	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	Development of working hypotheses, Types of Errors, Level of Significance, Critical Region , Power of a Test, Tests of Significance for Large Samples, Tests of Significance Small Samples, Confidence Intervals	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	Chart Types-Bar charts, Legends, Filters and Hierarchies -Line charts - Highlight Tables - He maps-Bullet charts-Cumulative sums with waterfall charts. Aggregate Functions - Calculated fields - Aggregations in calculated fields - Text operator-Data fields-Logical functions - Parameters-Types of calculations - Quick table calculations-Level of detail expression	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical Indications. Universal Law Publishing

3. Research Methodology: a step-by-step guide for beginners, Kumar, Pearson Education.

4 Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd.

Suggested Readings

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York

Web Resources

1.https://shodhganga.inflibnet.ac.in/

CourseOutcomes (COs)and Cognitive LevelMapping

PDS2506-RESEARCH METHODOLOGY`(MC)		COGNITIVE LEVEL
CO1	To remember and understand the R**esearch Methodology** concepts.	K1,K2
CO2	To apply report writing concept in the research.	K3
CO3	To illustrate Plagiarism and Copyrights.	K4
CO4	To assess data visualizations operations through different method.	K5
CO5	To construct solutions to resolve various real-world problems.	K6

Course Code	**PDS3501**
Course Title	**MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS**
Credits	**4**
Hours/Week	**4**
Category	**MC**
Semester	**III**
Regulation	**2022**

Course Overview:

1. To understand the relationships between the variables.
2. Descriptive statistics helps to understand the characteristics of the features involved in the data.
3. Course enables one to group features in a data set.
4. Provides knowledge to form clusters of the observation in big data.
5. Learn techniques for dimension reduction and feature selection.

Course Objective:

1. To understand the basic measurement techniques and nature of the features.
2. To study the characteristics of the features and their relationship.
3. To derive and evaluate the factors and validate them.
4. To perform cluster analysis and group observations based on clusters.
5. To reduce the dimension of the features by discriminant technique and Principal component analysis.

Pre requisites: Basic knowledge in mathematics

SYLLABUS

UNIT	CONTENT	HRS	COs	COGNITIVE LEVEL
I	Measurement Scales(Metric and Non-metric Measurement Scales) – Classification of Multivariate Techniques(Dependence and Inter-dependence Techniques) – Applications of Multivariate Techniques in different disciplines.	8	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Introduction to Factor Analysis – Meaning, Objectives and Assumptions – Designing a Factor Analysis Study – Deriving Factors – Assessing	14	CO1 CO2 CO3	K1 K2 K3

	Overall Factors – Validation of Factor Analysis.		CO4 CO5	K4 K5 K6
III	Introduction to Cluster Analysis – Objectives and Assumptions – Research Design in Cluster Analysis – Hierarchical and Non-hierarchical Methods – Interpretation of Clusters – Validation of Profiling of Clusters.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Introduction to Discriminant Analysis – Concepts, Objectives and Applications – Procedure for conducting Discriminant Analysis – Stepwise Discriminant Analysis – Mahalanobis Procedure – Logit Model.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Dimensionality Reduction – Deriving Orthogonal Projections – Lower Dimensional Subspaces – Characterization through Singular Value Decomposition and Eigenvalue Analysis – Rayleigh Quotient – Kernel PCA – Functional PCA.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

TEXT BOOKS:

1. Joseph F Hair, William C Black etal , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.
2. T. W. Anderson , “An Introduction to Multivariate Statistical Analysis, 3rd Edition”, Wiley, 2003.
3. William r Dillon, John Wiley & sons, “Multivariate Analysis methods and applications”, Wiley, 1984.
4. Naresh K Malhotra, Satyabhusan Dash, “Marketing Research An Applied Orientation”, Pearson, 2011.

SUGGESTED READINGS:

1. Chatfield C, A.J.Collins, “Introduction to Multivariate Analysis”, Springer Nature, 2020.
2. Dawn Iacobucci, “Multivariate Statistics and Marketic Analytics”,2014.
3. David A.Aaker “Multivariate analysis in marketing- Theory and application”, Wadsworth Pub Co., 2017.
4. Johnson and Wichern, “Applied Multivariate Statistical Analysis”, Pearson,2015.

Course Outcomes (COs) and Cognitive Level Mapping

PDS3501-MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS (MC)		**Cognitive levels**
CO1	Understanding Measurement scales and features.	K1, K2
CO2	Apply statistical method to form and avaluate factors	K3
CO3	Construct clusters and grouping observations	K4
CO4	Dimension reduction techniques	K5
C05	Feature selection and grouping techniques	K6

<table>
<tr><td>Course Code</td><td colspan="4">PDS 3502</td></tr>
<tr><td>Course Title</td><td colspan="4">Deep Learning</td></tr>
<tr><td>Credits</td><td colspan="4">04</td></tr>
<tr><td>Hours/Week</td><td colspan="4">04</td></tr>
<tr><td>Category</td><td colspan="4">Major Core(MC)–Theory</td></tr>
<tr><td>Semester</td><td colspan="4">III</td></tr>
<tr><td>Regulation</td><td colspan="4">2022</td></tr>
<tr><td colspan="5">Course Overview
1. This course represents the computational challenges of building stable representations for high-dimensional data, such as images, text and data.
2. Deep Learning covers the concept of various neural networks such as CNN and RNN.
3 . It helps to understand the concept of Boltzmann machine and computer vision
4. This course covers the fundamentals of deep learning, and the main research activities in this field.</td></tr>
<tr><td colspan="5">Course Objectives
1. Understand the context of neural networks and deep learning
2. Understand the data needs of deep learning
3. Have a working knowledge of neural networks and deep learning
4. Explore the parameters for neural networks</td></tr>
<tr><td>Prerequisites</td><td colspan="4">Basic Knowledge in linear algebra, and probability theory.</td></tr>
<tr><td colspan="5">SYLLABUS</td></tr>
<tr><td>UNIT</td><td>CONTENT</td><td>HOURS</td><td>COs</td><td>COGNITIVE LEVEL</td></tr>
<tr><td>I</td><td>Artificial Neural Networks:
The Neuron – Activation Function – Gradient Descent – Stochastic Gradient Descent – Back Propagation – Business Problem.</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
<tr><td>II</td><td>Convolutional Neural Networks:
Convolution Operation – ReLU layer – Pooling – Flattening – Full Conversion Layer – Softmax and Cross-Entropy.</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
<tr><td>III</td><td>Recurrent Neural Networks:
RNN intuition – Tackling Vanishing Gradient Problem – Long Short-Term Memory – Building a RNN – Evaluating the RNN – Improving the RNN – Tuning the RNN.</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
</table>

IV	**Boltzmann Machines:** Components of Boltzmann Machine – Search and Learning Problem – Applications of Boltzmann Machine – Restricted Boltzmann Machine – Deep Belief Networks – Deep Boltzmann Machine	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	**Computer Vision:** Viola-Jones Algorithm – Haar-like Features – Integral Image – Training Classifiers – Adaptive Boosting – Cascading – Face Detection with Open CV.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Francois Challot, " Deep learning with Python", Manning, 2017.
2. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence,By Jon Krohn, Grant Beyleveld and Aglaé Bassens, September 2022.
3. Ian Goodfellow, "Deep Learning", MIT Press, 2017.

Suggested Readings

1. Josh Patterson, "Deep Learning: A Practitioner's Approach", PACKT, 2017.
2. Dipayan Dev, " Deep Learning with Hadoop", PACKT, 2017.
3. Hugo Larochelle's Video Lectures on Deep Learning

Web Resources

1. https://www.ibm.com/cloud/learn/deep-learning
2. https://www.coursera.org/specializations/deep-learning
3. https://www.simplilearn.com/tutorials/deep-learning-tutorial

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 3502DEEP LEARNING(MC)		**COGNITIVE LEVEL**
CO1	To understand the fundamentals of deep learning.	K1,K2
CO2	To improve the research in computer vision and multimedia field.	K3
CO3	To implement, train, and validate their own neural network.	K4
CO4	Be able to design and implement deep neural network systems.	K5
CO5	Be able to identify new application requirements in the field of computer vision.	K6

Course Code	**PDS 3503**
Course Title	**Deep Learning - Lab**
Credits	**03**
Hours/Week	**04**
Category	**Major Core(MC)–Lab**
Semester	**III**
Regulation	**2022**

Course Overview

1. This course helps to install deep learning libraries such as tensorflow, keras and pytorch.
2. It covers the details of neural networks, CNN, RNN and its applications.
3. This course covers the various operations on images such as Segmentation, Transformations, etc…
4. It helps to develop deep learning application using neural networks.

Course Objectives

1. To develop the neural networks for handling Sequence and Image data
2. To learn hyper-parameter tuning in neural networks, which are crucial to make deep learning systems.
3. To perform various operations on image such as gradients, contours, etc.
4. To understand the neural network-based models with a wide range of exciting applications

Prerequisites	Basic Knowledge in Python Programming & Machine Learning Techniques

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	1. Setting up the Spyder IDE Environment and Executing a Python Program 2. Installing Keras, Tensorflow and Pytorch libraries and making use of them 3. Artificial Neural Networks	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	4. Convolutional Neural Networks with Images and Text data 5. Image Transformations	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	6. Image Gradients and Edge Detection	**12**	CO1	K1,K2,K3

	7. Image Contours		CO2 CO3 CO4 CO5	K4,K5,K6
IV	8. Image Segmentation 9. Harris Corner Detection	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	10. Face Detection using Haar Cascades 11. Chatbot Creation	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016, ISBN: 0387848576
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009. 3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Suggested Readings

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition, Springer, 2009, ISBN: 0387848576
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006, ISBN: 0387310738
3. Sebastian Raschka, Python Machine Learning, Packt Publishing, 2015, ISBN: 1783555130

Web Resources

1. CS231n: Convolutional Neural Networks for Visual Recognition, Stanford
2. CS224d: Deep Learning for Natural Language Processing, Stanford
3. CS285: Deep Reinforcement Learning, Berkeley
4. MIT 6.S094: Deep Learning for Self-Driving Cars, MIT

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 3503DEEP LEARNING LAB (MC)		COGNITIVE LEVEL
CO1	Understand the role of deep learning in machine learning applications and get familiar with the use of TensorFlow/Keras in deep learning applications.	K1,K2
CO2	Apply various concepts related with Deep Learning to solve Problems.	K3
CO3	Compare Various deep learning Algorithms used for Classification Segmentation and detection.	K4
CO4	Analyze different deep learning models in Image related projects.	K5
CO5	Be able to create deep learning applications such as Chatbot, Object detection, etc.	K6

Course Code	**PDS 3504**
Course Title	**Cloud Computing**
Credits	**04**
Hours/Week	**04**
Category	**Major Core(MC)–Theory**
Semester	**III**
Regulation	**2022**

Course Overview

1. This course helps to understand the concepts and techniques in cloud computing.
2. It provides in-depth knowledge on cloud computing, types of cloud services and models.
3. This course imparts knowledge on the concepts of serverless architecture and DevOps.
4. It also explains the various cloud applications and data analytics as a service in cloud.

Course Objectives

1. To identify the basic elements of cloud architecture.
2. To familiarize the different services and models in cloud with examples.
3. To learn the concept of serverless architecture and DevOps.
4. To understand the cloud data centers and cloud security.

Prerequisites	Basic knowledge in Computer Science and Internet.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Unit – I: Introduction** Overview of Cloud Computing –Essential Characteristics of cloud computing -Cloud computing architecture, Cloud Reference Model (NIST Architecture) – Operational models such as private, dedicated, virtual private, community, hybrid and public cloud – Service models such as IaaS, PaaS and SaaS – Example cloud vendors – Google cloud platform, Amazon AWS, Microsoft Azure and Open Stack.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	**Unit – II: Platform Engineering** Cloud Native Design and Microservices–Containerized - Dynamically orchestrated design – Continuous delivery - Support for a variety of client devices – Monolithic vs Microservices Architecture - Characteristics of microservice architecture – 12 factor application design - Service discovery – Service Registry.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

III	**Unit – III: Serverless Architecture and DevOps** Function as a Service (FaaS) - Backend as a Service (BaaS) - Advantages of serverless architectures – AWS Lamda – AWS Fargate; Introduction to DevOps - The DevOps toolchain – DevOps Practices -Continuous Integration (CI), Continuous Delivery (CD), Continuous Deployment – Quality Attributes for DevOps – DevOps cloud models.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	**Unit- IV Cloud Data Centers & Cloud Security** Historical Perspective, Data center Components, Design Considerations, Power Calculations, Evolution of Data Centers, Cloud data storage – CloudTM. Security Considerations – CIA Triad – STRIDE Threat Model - Cloud specific Cryptographic Techniques – Security by Design	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	**Unit V Data Analytics as a Service & Cloud applications** Hadoop as a service, Map Reduce on Cloud, Chubby locking Service; Amazon Simple Notification Service (Amazon SNS), multi-player online game hosting on cloud resources, Building content delivery networks using clouds.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. Architecting Cloud Computing Solutions by Scott Goessling, Kevin L. Jackson, Publisher: Packt Publishing, Release Date: May 2018
2. Software Architect's Handbook, by Joseph Ingeno, Published by Packt Publishing, 2018
3. Kai Hwang, Geoffrey Fox, Jack J. Dongarra, Morgan Kaufmann, “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things,” 1st Edition, 2011.
4. Gautham Shroff, “Enterprise Cloud Computing: Technology, Architecture, Applications”, Cambridge press, 2010.
5. Learning Path: AWS Certified Machine Learning-Specialty ML, By Noah Gift, April 2022
6. Microservices: Flexible Software Architecture, by Eberhard Wolff, Publisher: Addison-Wesley Professional, Release Date: October 2016

Suggested Readings

1. KrisJamsa,2014. Cloud computing SaaS, PaaS, Virtualization, Business, Mobile security and more, 1st Edition, Jones & Batrlett Students Education.
2. Rajkumar Buyya, Christian Vecchiola, S.Thamaraiselvi, 2013. Mastering cloud computing, 1st Edition, Tata McGrawHill.
3. Arshdeep Bahhga and Vijay Madisetti, 2017. Cloud Computing Hands on Approach, 1st Edition, University Press.

Web Resources
1. https://www.javatpoint.com/cloud-computing-tutorial 2. https://www.simplilearn.com/tutorials/cloud-computing-tutorial 3. https://nptel.ac.in/courses/106/104/106104182/

CourseOutcomes (COs)and Cognitive LevelMapping

PDS 3504CLOUD COMPUTING(MC)		**COGNITIVE LEVEL**
CO1	To remember and understand cloud computing Services, Models and cloud Vendors.	K1,K2
CO2	To understand the characteristics of cloud native applications and microservices.	K1, K2
CO3	To explore the concept of Serverless architecture and DevOps.	K3, K4
CO4	To evaluate the historical perspective of cloud data centers and understand the cloud security considerations	K5
CO5	To create different use cases of the applications of cloud in diverse domains.	K6

<table>
<tr><td>Course Code</td><td colspan="4">PDS 3505</td></tr>
<tr><td>Course Title</td><td colspan="4">Cloud Computing – Lab</td></tr>
<tr><td>Credits</td><td colspan="4">03</td></tr>
<tr><td>Hours/Week</td><td colspan="4">04</td></tr>
<tr><td>Category</td><td colspan="4">Major Core(MC)–Lab</td></tr>
<tr><td>Semester</td><td colspan="4">III</td></tr>
<tr><td>Regulation</td><td colspan="4">2022</td></tr>
<tr><td colspan="5">Course Overview
1. This course provides the way to create web applications in the cloud environment.
2. It helps to enable the file sharing and deploying the web applications in the cloud.
3. This course helps to create Docker Artifactory and execute the push/pull commands.
4. It also helps to create pipeline for Git and serverless applications</td></tr>
<tr><td colspan="5">Course Objectives
1. To explore cloud computing driven commercial systems such as Microsoft Azure, Amazon AWS, and other cloud applications
2. To provide a foundation of the Cloud Computing enabling them to start using and adopting Cloud Computing services and tools in their real-life scenarios
3. Formulate DevOps based design and development of cloud applications
4. To impart knowledge in applications of cloud computing</td></tr>
<tr><td>Prerequisites</td><td colspan="4">Basic Knowledge in Programming and Network</td></tr>
<tr><td colspan="5" align="center">SYLLABUS</td></tr>
<tr><td>UNIT</td><td>CONTENT</td><td>HOURS</td><td>COs</td><td>COGNITIVE LEVEL</td></tr>
<tr><td>I</td><td>1. Create an EC2 Instance and Deploy the Sample web application in EC2.
2. Developing the sample web apps in Azure / GCP Platform</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
<tr><td>II</td><td>3. Connect Linux instance using SSH and enable File sharing SCP from one EC2 Instance to another.
4. Deployment of a basic web app and add additional functionality (Java scripts based)</td><td>12</td><td>CO1
CO2
CO3
CO4
CO5</td><td>K1,K2,K3
K4,K5,K6</td></tr>
</table>

III	5. Installing and Configuring Dockers in local host and running multiple images on a Docker Platform 6. Create a Docker Repo or Artifactory and execute Push/Pull commands for modified docker base images	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	7. DevOps deployment of library automation etc. on the cloud platform with one complete upgrade of the application 8. Create One simple Pipeline for Git, Jenkins, and Docker in local mode	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	9. Serverless on AWS- sample application AWS Lambda/ AWS Fargate 10. Amazon Simple Notification Service - AWS SNS	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. John Rhoton and Risto Haukiojal, “Cloud Computing Architectured : Solution Design Handbook”, Recursive Press, 2013.
2. Dinkar Sitaram, Geetha Manjunathan, “Moving to the Cloud: Developing Apps in the new world of Cloud Computing”, Syngress, 2012

Suggested Readings

1. Rajkumar buyya, Christian vecchiola, S Thamarai Selvi , “Mastering cloud computing”, Tata McGraw Hill Education Private Limited, 2013
2. Anthony T .Velte, Toby J. Velte, Robert Elsenpeter, “Cloud Computing a Practical Approach”, Tata McGraw-HILL, 2010 Edition.
3. Barrie sosinsky, “Cloud computing bible, Wiley publishing

Web Resources

1. https://cloud.google.com/appengine/docs
2. https://www.chef.io/solutions/cloud-management/
3. https://aws.amazon.com/documentation
4. https://www.cloudfoundry.org/
5. https://puppet.com/blog/implement-a-message-queue-your-cloud-application

Course Outcomes (COs)and Cognitive Level Mapping

PDS 3505CLOUD COMPUTING LAB(MC)		COGNITIVE LEVEL
CO1	Analyze and study the basics of cloud computing, cloud models and its applications	K1,K2
CO2	An ability to use techniques, tools, skills in a secured cloud environment	K3
CO3	Design, implement and evaluate a cloud-based system, process, component, or program to meet desired needs	K4
CO4	Analyze and use of an appropriate framework and APIs for the task	K5
CO5	Deploy real-world applications onto the cloud	K6

Course Code	**PDS3601**
Course Title	**NATURAL LANGUAGE PROCESSING**
Credits	**2**
Hours/Week	**4**
Category	**ME**
Semester	**III**
Regulation	**2022**

Course Overview:

1. Get an overview of traditional NLP concepts and methods
2. Preprocess the text and text classification.
3. To perform language modelling and sequence tagging.
4. Enable one to perform sequence to sequence task.
5. Semantic and pragmatic analysis on text coherence.

Course Objective:

1. To incorporate basic data pre-processing procedures on text.
2. To develop appropriate language modelling.
3. To apply statistical tools to develop a model for prediction using probabilistic approach.
4. To perform topic analysis using semantic analysis.

Pre requisites : Basic understanding of English language, mathematics and Statistics

SYLLABUS

UNIT	CONTENT	HRS	COs	COGNITIVE LEVEL
I	Overview: Origins and challenges of NLP- Theory of Language -Features of Indian Languages – Issues in Font –Models and Algorithms- NLP Applications.	8	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Phonology – Computational Phonology - Words and Morphemes – Segmentation – Categorization and Lemmatisation – Word Form Recognition – Valency - Agreement - Regular Expressions – Finite State Automata – Morphology- Morphological issues of Indian Languages – Transliteration.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

III	Probabilistic Models of Pronunciation and Spelling – Weighted Automata – N- Grams – Corpus Analysis – Smoothing – Entropy - Parts-of-Speech – Taggers – Rule based – Hidden Markov Models – Speech Recognition.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Basic Concepts of Syntax – Parsing Techniques – General Grammar rules for Indian Languages – Context Free Grammar – Parsing with Context Free Grammars – Top Down Parser – Earley Algorithm – Features and Unification - Lexicalised and Probabilistic Parsing.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Computational Representation – Meaning Structure of Language – Semantic Analysis – Lexical Semantics – WordNet – Pragmatics – Discourse – Reference Resolution – Text Coherence – Dialogue Conversational Agents.	12	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

TEXT BOOKS:

1 Daniel Jurafskey and James H. Martin “Speech and Language Processing”, Prentice Hall, 2009.

2. Christopher D.Manning and Hinrich Schutze, “Foundation of Statistical Natural Language Processing”, MITPress, 1999.

3. Ronald Hausser, “Foundations of Computational Linguistics”, Springer-Verleg, 1999.

4. James Allen, “Natural Language Understanding”, Benjamin/Cummings Publishing Co. 1995.

SUGGESTED READINGS:

1. James Pustejovsky and Amber stubbs, “Natural language Annotation for machine learning”, Shroff Publishers,2012.
2. Daniel M. Bikel, “Multilingual Natural language processing”, Pearson, 2012.
3. Emily M. Bender, “Linguistic Fundamentals for Natural language processing”, Margon & Claypool Pub., 2013.
4. Hobson Lane, “Natural language processing in action”, Manning Pub.,2013.

Course Outcomes (COs) and Cognitive Level Mapping

PDS3601- NATURAL LANGUAGE PROCESSING (ME)		**Cognitive levels**
CO1	Traditional NLP concepts and methods	K1, K2
CO2	Text preprocessing	K3
CO3	Probabilistic models and corpus analysis	K4
CO4	Lexical and parsing techniques	K5
C05	Topic analysis using semantic and lexical semantic approach	K6

Course Code	**PDS 3602**
Course Title	**Reinforcement Learning**
Credits	**02**
Hours/Week	**04**
Category	**Major Elective(ME)–Theory**
Semester	**III**
Regulation	**2022**

Course Overview

1. Reinforcement Learning focuses on general-purpose formalism for automated decision-making and AI.
2. Reinforcement learning aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available.
3. This course introduces the statistical learning techniques where an agent explicitly takes actions and interacts with the world.
4. It enables to understand the importance and challenges of learning agents that make intelligent decision-making is of vital importance today.
5. This course enables the key concepts of Reinforcement Learning, underlying classic and modern algorithms in RL.

Course Objectives

1. To formalize problems as Markov Decision Processes.
2. To understand the algorithmic concepts in Temporal Difference Learning.
3. To learn the RL tasks and the core principals behind the RL, including policies and eligibility traces.
4. To understand and work with function approximate solutions.
5. To Learn the policy gradient methods from vanilla to more complex cases

Prerequisites	Linear Algebra, Multivariable Calculus, Probability and Statistics

SYLLABUS

UNIT	**CONTENT**	**HOURS**	**COs**	**COGNITIVE LEVEL**
I	**Unit I: Monte-Carlo Methods** Monte-Carlo methods: policy evaluation, rollouts, on policy and off-policy learning, importance sampling	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

II	**Unit II: Temporal Difference Learning** Temporal Difference learning: TD prediction, Optimality of TD(0), SARSA, Q-learning, Games and after states, Maximization Bias and Double Learning.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
III	**Unit III: Eligibility Traces** Eligibility traces: n-step TD prediction, TD(lambda), forward and backward views, Q(lambda), SARSA(lambda), replacing traces and accumulating traces.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	**Unit IV: Function Approximation** Function Approximation: Value prediction, gradient descent methods, linear function approximation, Feature Construction for Linear Methods, Selecting Step-Size Parameters, Deep Q-learning.	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	**Unit V: Policy Gradient methods** Policy Approximation and its Advantages, REINFORCE algorithm, actor-critic methods, Policy Gradient for Continuing Problems, Policy Parameterization for Continuous Actions, Asynchronous Advantage Actor-Critic. Case studies: Samuel's checker player, TDgammon, Acrobot,AlphaGo	**12**	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press.2nd Edition. 2018.

Suggested Readings

1. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
2. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3.
3. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."Pearson Education Limited, 2016.

Web Resources

1. https://www.coursera.org/learn/fundamentals-of-reinforcement-learning
2. https://onlinecourses.nptel.ac.in/noc20_cs74/preview
3. Video Lectures by Prof. David Silver
4. Video Lectures by Prof. B.Ravindran

Course Outcomes (COs)and Cognitive Level Mapping

PDS 3602REINFORCEMENT LEARNING (ME)		COGNITIVE LEVEL
CO1	Identify basic concepts, terminology, theories, models and methods in reinforcement learning.	K1,K2
CO2	To apply the reinforcement learning algorithmic concepts to the real-world problems.	K3
CO3	To know the modelling and analysis tools, techniques for problems of dynamic decision making under uncertainty	K4
CO4	To know the reinforcement learning algorithms when faced with uncertainty problems and the convergence and accuracy guarantees that such algorithms would provide.	K5
CO5	To create numerous Reinforcement Learning Applications	K6

Course Code	**PDS 3701**
Course Title	**MEAN Stack**
Credits	**03**
Hours/Week	**06**
Category	**Major Core(MC)–Theory**
Semester	**III**
Regulation	**2022**

Course Overview

The aim of a MEAN stack developer is to build complete web applications including frontend, backend, and database management. It possesses knowledge of every part of the development and work across a number of tools and frameworks.

Course Objectives

1. To implement Forms, inputs and Services using Angular JS
2. To develop a simple web application using Nodejs; Angular JS and Express
3. To implement data models using Mongo DB

Prerequisites	Basic knowledge on front end application using HTML5, CSS3, JavaScript along with jQuery frame work.

SYLLABUS

UNIT	**CONTENT**	**HOURS**	**Cos**	**COGNITIVE LEVEL**
I	Introduction to Web Technology and Angular JS Introduction to Web Technology - Angular JSModel-View-Controller – Expression -Directives and Controllers - Angular JS Modules – Arrays – Working with ng-model – Working with Forms – Form Validation – Error Handling with Forms – Nested Forms with ng-form – Other Form Controls. 1. Develop a Form and validate using Angular JS 2. Create and implement modules and controllers in Angular JS 3. Implement Error Handling in Angular JS	**12**	**CO1, CO2, CO3, CO4 CO5**	**K1, K2,K3,K4, K5**

II	DIRECTIVES& BUILDING DATABASES Filters – Using Filters in Controllers and Services – Angular JS Services – Internal Angular JS Services – Custom Angular JS Services - Directives – Alternatives to Custom Directives – Understanding the Basic options – Interacting with Server –HTTP Services – Building Database, Front End and Back End 1. Create and implement Custom directives 2. Front End and Back End applications.	**12**	**CO1 CO3 CO4 CO5**	**K1, K2, K4.K5,K6**
III	NODE JS AND EXPRESS FRAMEWORK Introduction –Using the Terminals – Editors – Building a Webserver with Node – The HTTP Module – Views and Layouts – Form Handling with Express - The Request and Response Objects –Handle bars – Comments and Blocks. 1. Create web applications using Express, Node JS and Angular JS 2.Form Handling with Express 3.Handle bars, Comments and Blocks.	**12**	**CO1 CO2 CO3CO4 CO5**	**K1, K2, K3, K4,K5, K6**
IV	INTRODUCTION TO MONGODB JSON and MongoDB – Adopting a Non-relational Approach – Opting for Performance vs. Features Running the Database Anywhere – Generating or Creating a Key – Using Keys and Values – Implementing Collections 1. Implement CRUD operations in MONGODB.	**12**	**CO 1 CO 2 CO 3 CO 4 CO5**	**K1, K2, K3, K4,K5,K6**
V	DATA MODELS Designing the Database – Building Indexes – Inserting Data – Querying for Data – Updating Data – Removing Data – Referencing a Database 1. Implement MongoDB data models	**12**	**CO1 CO2CO3 CO4 CO5**	**K1, K2, K3, K4,K5,K6**

Text Book 1. Getting MEAN with Mongo, Express, Angular, and NodeBy Simon Holmes, Clive Herber · 2022 Manning Publications 2. AgusKurniawan–"AngularJS Programming by Example", First Edition, PE Press, 2014. 3. David Hows, Peter Membrey, EelcoPlugge – "MongoDB Basics", Apress, 2014. 4. Ethan Brown, "Web Development with Node and Express", Oreilly Publishers, First Edition, 2014
Suggested Readings 1. Full Stack JavaScript Development With MEAN MongoDB, Express, AngularJS, and Node.JS By Colin J Ihrig, Adam Bretz · 2015 SitePoint Pty, Limited
Web Resources 1. https://www.geeksforgeeks.org/introduction-to-mean-stack/https://www.icmr.nic.in/ 2. https://www.javatpoint.com/mean-stack-tutorial 3. https://www.sitepoint.com/introduction-mean-stack/

Course Outcomes (COs)

MEAN Stack Lab		Cognitive Level
CO 1	To understand the usages of MEAN stack.	K1, K2
CO 2	To Applying programming constructs to Create Forms, validate and use Filters	K3
CO 3	To Illustrates identifying and handling errors.	K4
CO 4	To Implement Directives and Controllers.	K5
CO 5	To Create various Implement Data models in real world applications.	K6

Course Code	**PDS2901**
Course Title	**DATA VISUALIZATION THROUGH R**
Credits	**01**
Hours/Week	**02**
Category	**Major Core (MC) – Theory**
Semester	**II**
Regulation	**2022**

Course Overview

This course introduces the basics of R and the practical knowledge of data cleaning, reorganization, modeling, statistics, and analysis for research and visualization, particularly in geospatial fields. The goal of the course is to introduce students to the use of R programming for univariate and multivariate analysis and visualization, mapping and spatial analysis.

Course Objectives

1. Use RStudio to perform basic data analysis functions including Input/Output, basic Exploratory Data Analysis (EDA), and graphical output.
2. Use RStudio to develop, test, and execute R script.
3. Use advanced R programming to import, clean, transform, and summarize data.
4. Use ggplot2 to visualize data in points, lines, area charts and smoothed curves.
5. Import and map spatial data using R sf and ggplot2 package

Prerequisites	No prerequisites

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Introduction Introduction to R – Help Functions in R – Vectors – Vectorized Operations – Functions in R – Packages in R..	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
II	Matrix Operations – Adding and Deleting Rows and Columns – Higher Dimensional Arrays – Lists – General List Operations – Accessing List Components and Values – Applying functions to Lists	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

III	Creating Data Frames – Matrix-like Operations on a Data Frame – Merging Data Frames – Applying functions to Data Frames – Factors and Tables – Common Functions used with Factors – Working with Tables	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
IV	OOP- S3 Classes – S4 Classes – Managing the Objects – Input/Output – Accessing Keyboard and Monitor – Reading and Writing Files – accessing the Internet – String Manipulation. ggplot2, Part I: Visualization of non-spatial data ggplot2, Part II: Visualization of nonspatial data.	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6
V	Data Visualization Introduction to GGPlot2 – Factors – Aesthetics – Plotting with Layers – Overriding Aesthetics – Mapping vs Setting – Histograms – Density Charts – Statistical Transformation – Facets – Coordinates – Themes	9	CO1 CO2 CO3 CO4 CO5	K1,K2,K3 K4,K5,K6

Text Books

1. g gplot2, Elegant Graphics for Data Analysis (2nd Edition), by Hadley Wickham, Springer, (2016)
2. R for Data Science, Import, Tidy, Transform, Visualize and Model Data, (1st Edition) by Hadely Wickham and Garrett Grolemund, O'Reilly (2016)
3. Geocomputation with R by Robin Lovelace, Jakub Nowosad, Jannes Muenchow (2019). Available at https://geocompr.robinlovelace.net/.
4. patial Data Science with R by Robert J.
5.

Course Outcomes (COs)and Cognitive Level Mapping

PDS2901- DATA VISUALIZATION (DC)		COGNITIVE LEVEL
CO1	Use RStudio to perform basic data analysis functions including Input/Output, basic Exploratory Data Analysis (EDA), and graphical output.	K1,K2
CO2	Use R Studio to develop, test, and execute R script.	K3
CO3	Use advanced R programming to import, clean, transform, and summarize data.	K4
CO4	Use ggplot2 to visualize data in points, lines, area charts and smoothed curve.	K5
CO5	Import and map spatial data using R sf and ggplot2 packages.	K6

Course Code	**PDS3701**
Course Title	**INTER DISCIPLINARY: STATISTICS FOR COMPUTER SCIENCE**
Credits	**3**
Hours/Week	**6**
Category	**IDE**
Semester	**III**
Regulation	**2022**

Course Overview:

1. Able to analyse basic characteristics of the features.
2. Can perform univariate and Bivariate analysis.
3. Enable decision making using testing of hypothesis.
4. Based on the relation of the features can be able to form factors.
5. Enable to perform dimension reduction and feature selection.

Course Objective:

1. To perform Explanatory data analysis.
2. To study the relationship between the features and develop a model.
3. To apply statistical techniques and derive factors.
4. To perform dimension reduction and feature selection and fine tune the precision of the model

Pre requisites: Basic understanding of Statistics

SYLLABUS

UNIT	**CONTENT**	**HRS**	**COs**	**COGNITIVE LEVEL**
I	Sampling Techniques – Data Classification – Tabulation – Frequency and graphic Representation – Measures of Central Tendency – Measures of Variation – Quartiles and Percentiles– Moments -Skewness and Kurtosis.	14	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	Scatter Diagram – Karl Pearson's Correlation Coefficient – Rank Correlation –Correlation Coefficient for Bivariate Frequency Distribution – Regression Coefficients – Fitting of Regression Lines.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

III	Statistical Tests of Significance - Test of significance for mean(s), variance(s), correlation coefficient(s), regression coefficient, based on t, Chi-square and F-distributions. Applications of Chi-square in test of significance (independence of attributes, goodness off it).	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	Introduction to Factor Analysis – Meaning, Objectives and Assumptions – Designing a Factor Analysis Study – Deriving Factors – Assessing Overall Factors – Validation of Factor Analysis.	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
V	Introduction to Discriminant Analysis – Concepts, Objectives and Applications – Procedure for conducting Discriminant Analysis – Stepwise Discriminant	15	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

REFERENCES:

1. Gupta,S.C.andKapoor,V.K.:"FundamentalsofMathematicalStatistics",Sultan&Chand&Sons, NewDelhi,11th Ed, 2002.
2. Joseph F Hair, William C Black etal , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.
3. Joseph F Hair, William C Black etal , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.
4. T. W. Anderson , "An Introduction to Multivariate Statistical Analysis, 3rd Edition", Wiley, 2003.

SUGGESTED READINGS:

1. James D.Miller, " Statistics for Data Science", Packt,2017.
2. Chatfield C, A.J.Collins, "Introduction to Multivariate Analysis", Springer Nature, 2020.
3. Dawn Iacobucci, "Multivariate Statistics and Marketic Analytics",2014.

1.

1. https://onlinecourses.nptel.ac.in/noc22_mg87/preview 2. https://www.udemy.com/tutorial/learn-probability-concepts-and-counting-techniques/concepts-of- 3. sample-space-sample-points-and-events/ 4. https://www.udemy.com/tutorial/learn-probability-concepts-and-counting-techniques/concepts-of- **5.** sample-space-sample-points-and-events/

Course Outcomes (COs) and Cognitive Level Mapping

PDS3701- INTER DISCIPLINARY: STATISTICS FOR COMPUTER SCIENCE(IDE)		**Cognitive levels**
CO1	Concepts of descriptive Statistics and definitions	K1, K2
CO2	Problems in correlation and regression and its interpretation	K3
CO3	Frame appropriate model and test its significance	K4
CO4	Perform Factor analysis and its efficiency	K5
C05	Data reduction and feature selection using discriminant analysis	K6

LOCF BASED DIRECT ASSESSMENTS

COGNITIVE LEVEL (CL) AND COURSE OUTCOME (CO) BASED CIA QUESTION PAPER FORMAT (PG)

SECTION		Q. NO	COGNITIVE LEVEL (CL)					
			K1	K2	K3	K4	K5	K6
A	(5 x 1 = 5) Answer ALL	1(a)	+					
		(b)	+					
		(c)	+					
		(d)	+					
		(e)	+					
	(5 x 1 = 5) Answer ALL	2(a)		+				
		(b)		+				
		(c)		+				
		(d)		+				
		(e)		+				
B	(1 x 8 = 8) Answer 1 out of 2	3			+			
		4			+			
C	(1 x 8 = 8) Answer 1 out of 2	5				+		
		6				+		
D	(1 x 12 = 12) Answer 1 out of 2	7					+	
		8					+	
E	(1 x 12 = 12) Answer 1 out of 2	9						+
		10						+
No. of CL based Questions with Max. marks			5 (5)	5 (5)	1 (8)	1 (8)	1 (12)	1 (12)
No. of CO based Questions with Max. marks			CO1		CO2	CO3	CO4	CO5
			10 (10)		1 (8)	1 (8)	1 (12)	1 (12)

Forms of questions of **Section A** shall be MCQ, Fill in the blanks, True or False, Match the following, Definition, Missing letters. Questions of **Sections B, C, D and E** could be Open Choice/ built in choice/with sub sections. Component III shall be exclusively for cognitive levels K5 and K5 with 20 marks each. CIA shall be conducted for 50 marks with 90 min duration.

COGNITIVE LEVEL (CL) AND COURSE OUTCOME (CO) BASED END SEMESTER EXAMINATION QUESTION PAPER FORMAT (PG)

SECTION		Q. NO	COGNITIVE LEVEL (CL)					
			K1	K2	K3	K4	K5	K6
A	(5 x 1 = 5) Answer ALL	1(a)	+					
		(b)	+					
		(c)	+					
		(d)	+					
		(e)	+					
	(5 x 1 = 5) Answer ALL	2(a)		+				
		(b)		+				
		(c)		+				
		(d)		+				
		(e)		+				
B	(3 x 10 = 30) Answer 3 out of 5	3			+			
		4			+			
		5			+			
		6			+			
		7			+			
C	(2 x 12.5 = 25) Answer 2 out of 4	8				+		
		9				+		
		10				+		
		11				+		
D	(1 x 15 = 15) Answer 1 out of 2	12					+	
		13					+	
E	(1 x 20 = 20) Answer 1 out of 2	14						+
		15						+
No. of CL based Questions with Max. marks			5 (5)	5 (5)	3 (30)	2 (25)	1 (15)	1 (20)
No. of CO based Questions with Max. marks			CO1		CO2	CO3	CO4	CO5
			10 (10)		3 (30)	2 (25)	1 (15)	1 (20)

IMPORTANT

- Forms of questions of **Section A** shall be MCQ, Fill in the blanks, True or False, Match the following, Definition, Missing letters.
- Questions of **Sections B, C, D and E** could be Open Choice/ built in choice/questions with sub divisions.
- Maximum sub divisions in questions of Sections B, C shall be 2 and 4 in Sections D, E).

TOTAL MARKS DISTRIBUTION OF DIRECT ASSESSMENTS BASED ON CL AND CO (PG)

Course Outcome	**CO1**		**CO2**	**CO3**	**CO4**	**CO5**	**TOTAL**
Cognitive Levels	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	
CIA 1	5	5	8	8	12	12	50
CIA 2	5	5	8	8	12	12	50
Comp III	-	-	-	-	20	20	40
Semester	5	5	30	25	15	20	100
Total Marks (CL)	**15 (6%)**	**15 (6%)**	**46 (19%)**	**41 (17%)**	**59 (25%)**	**64 (27%)**	**240**
Total Marks (CO)	**30 (12%)**		**46 (19%)**	**41 (17%)**	**59 (25%)**	**64 (27%)**	**240**