SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS)

Reaccredited with 'B++' Grade by NAAC

Affiliated to Periyar University

Fairlands, SALEM- 636 016.

OUTCOME BASED SYLLABUS

PG & RESEARCH DEPARTMENT OF COMPUTER SCIENCE

M.Sc. DATA SCIENCE

(Self-Financing)

(For the students admitted in 2025-2026)

(I, II, III & IV Semester)

PROGRAMME OUTCOMES

PO1	**Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through Research in Global Context
PO2	**Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making.
PO3	**Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals.
PO4	**Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment.
PO5	**Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM-16

PG & RESEARCH DEPARTMENT OF COMPUTER SCIENCE

M.Sc. DATA SCIENCE

PROGRAMME STRUCTURE UNDER CBCS

(For the students admitted in 2024-2025)

Total Credits: 92 + Extra Credits (Maximum 16)

SEMESTER – I				
Course	**Course Title**	**Code**	**Hrs./ Week**	**Credits**
Core Course- I	Fundamentals of Data Science	25PDSCC1	6	5
Core Course - II	Mathematics for Data Science	25PDSCC2	7	5
Core Course- III	Statistics-I	25PDSCC3	7	4
Elective – I	Internet of Things / Research Methodology for Computer Science	25PDSDSEC1A / 25PDSDSEC1B	5	3
Elective -II	Web Programming/ Java Programming	25PDSDSEC2A/ 25PDSDSEC2B	3	2
	Web Programming Practical/ Java Programming Practical	25PDSDSECQ2A/ 25PDSDSECQ2B	2	1
Total			**30**	**20**
Extra Skills	* *Articulation and Idea Fixation* * *Physical Fitness Practice* * *Productive Preparation for UGC NET/SET/JRF/TRB Competitive Examinations-I (25PDSSC1)(Self-Study - 1 Extra Credits)* * *Extra Credits are given for extra skills and courses qualified in MOOC/NPTEL*			

Total Credits: 92 + Extra Credits (Maximum 16)

SEMESTER – II				
Course	**Course Title**	**Code**	**Hrs./Week**	**Credits**
Core Course – IV	Python Programming	25PDSCC4	5	5
Core Course - V	Statistics-II	25PDSCC5	5	4
Core Practical - 1	Python Programming - Practical	25PDSCCQ1	6	5
Elective – III	Information Security and Ethics / Software Engineering for Data Science	25PDSDSEC3A / 25PDSDSEC3B	4	3
Elective - IV	Optimization Techniques / Applied Probability	25PDSDSEC4A/ 25PDSDSEC4B	4	3
EDC	Fundamentals of Computers and Communications	25PDSEDC1	4	2
Part - IV	Human Rights	25PHRSC	2	1

		Total	30	23
Extra Skills	* *Articulation and Idea Fixation* * *Physical Fitness Practice* * *Productive Preparation for UGC NET/SET/JRF/TRB Competitive Examinations-II (25PDSSC2)(Self-Study - 1 Extra Credits)* * *Extra Credits are given for extra skills and courses qualified in MOOC/NPTEL* * *Society Connect Activity (1 Extra Credits)* * *Internship / Industrial Visit During Summer Vacation*			

SEMESTER-III				
Course	**Course Title**	**Code**	**Hrs./ Week**	**Credits**
Core Course - VI	Machine Learning	25PDSCC6	6	5
Core Course - VII	Databases for Data Science	25PDSCC7	4	4
Core Course - VIII	Health Care Analytics (Industry Module)	25PDSCC8	6	4
Core Practical - II	Machine Learning – Practical	25PDSCCQ2	5	5
Core Practical - III	Databases for Data Science -Practical	25PDSCCQ3	2	1
Elective - V	Social Network Analysis/ Natural Language Processing	25PDSDSEC5A / 25PDSDSEC5B	4	3
EDC - II	Principles of Information Technology	25PDSEDC2	3	2
	Internship / Industrial Activity (Carried out in Summer Vacation at the end of I year – 30 Hours)	-	-	2
		Total	**30**	**26**
Extra Skills	- Articulation and Idea Fixation - Physical Fitness Practice - Productive Preparation for UGC NET/SET/JRF - III (Self-Study - 1 Extra Credits) 24*PDSSC3* - Extra Credits are given for extra skills and courses qualified in MOOC/NPTEL			

SEMESTER-IV				
Course	**Course Title**	**Code**	**Hrs./ Week**	**Credits**
Core Course - IX	Cloud Computing	25PDSCC9	6	5
Core Course - X	Big Data Analytics	25PDSCC10	3	3
Elective – VI	Deep Learning/ Artificial Intelligence and Data Science	25PDSDSEC6A / 25PDSDSEC6B	4	3
Core Practical - IV	Big Data Analytics – Practical	25PDSCCQ4	3	2
Core Course - XI	Project with Viva Voce	25PDSPC	10	7

Professional Competency Skill	Data Visualization – Practical	25PDSPCSQ	4	2
	Extension Activity	25PDSEX		1
Total			**30**	**23**
Extra Skills	- Articulation and Idea Fixation - Physical Fitness Practice - Productive Preparation for UGC NET/SET/JRF/TRB -Competitive Examinations – IV (Self-Study – 1 Extra Credit) 24PDSSC4 - Extra Credits are given for extra skills and courses qualified in MOOC/NPTEL			

Programme Title	:	**M.Sc. Data Science**	
Course Title	:	**CORE COURSE-I: FUNDAMENTALS OF DATA SCIENCE**	
Course Code	:	**25PDSCC1**	**Hours/Week:6**
Semester	:	**I**	**Credits:5**

COURSE OBJECTIVES:

To introduce the concepts and fundamentals of data science and its life cycle

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1: Understand the types of data and analytics, data science process, and its life cycle.

CO2: Apply math in data science

CO3: Analyze the various data intensive operations and tools

CO4: Evaluate the tools and methods for analyzing the data

CO5: Investigate the recent potential applications and development of data science with real time case studies

SYLLABUS

Unit – I: Hours: 16

Introduction of Data Science: Data Science - Data Science Venn diagram - Basic Terminology – Data Science Case Studies- Types of Data – Levels of data- Types of Data Analytics - Descriptive Analytics - Diagnostic Analytics- Predictive Analytics- Prescriptive Analytics- Five Steps of Data Science.

Unit – II: Hours:20

Mathematical Preliminaries - Basic Maths – Mathematics as discipline – Basic Symbols and terminology –Linear algebra - Basic Probability – Definitions- Probability – Bayesian vs frequentist – Compound events – Conditional probability – Rules of probability.

Unit – III: Hours: 18

Data Mining and Data Warehousing **-** Introduction to Data Warehousing – Design consideration of Data Warehouse - Data Loading Process – Case Study – Data Mining – Data Mining techniques – Tools and platforms – Case study.

Unit - IV: Hours: 18

Visualizing Data - Exploratory Data Analysis – Developing the visual aesthetic – Chart types –

Great Visualizations – Reading graphs – Interactive visualizations.

Unit - V: **Hours: 18**

Data Science – Recent Trends **-** Applications of Data Science, recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

BOOKS FOR STUDY:

1. Ozdemir, Sinan. Principles of Data Science. Packt Publishing Ltd, 2016.
2. Maheshwari, Anil." Data analytics made accessible". Seattle: Amazon Digital Services, 2nd edition, 2023.
3. Skiena, Steven S. The Data Science Design Manual. Springer, 2017.

BOOKS FOR REFERENCE:

1. Hadrien Jean. Education, C. (2023). Data Science. Certybox Education.
2. Pierson, Lillian. Data Science for dummies. John Wiley & Sons, 2021.
3. Grus, Joel. Data Science from Scratch: First principles with python. O'Reilly Media, 2019.
4. Blum, Avrim, John Hopcroft, and Ravindran Kannan. Foundations of Data Science. Cambridge University Press, 2020.

WEB RESOURCES :

1. https://www.analyticsvidhya.com/
2. https://www.simplilearn.com
3. https://www.ibm.com/in-en/topics/data-science
4. https://www.mygreatlearning.com/blog/what-is-data-science/

Mapping of COs with POs:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3
CO2	2	1	2	3	2
CO3	3	2	3	2	3
CO4	3	2	3	3	2
CO5	2	2	2	3	2
Weightage of course contributed to each PO	13	9	12	14	12

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title :   M.Sc. Data Science

Course Title   :   CORE COURSE -II: MATHEMATICS FOR DATA SCIENCE

Course Code   :   25PDSCC2   **Hours/Week:7**

Semester   :   I   **Credits:5**

COURSE OBJECTIVES:

   To build the mathematical background necessary to understand and implement in data science practical/research work.

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1: Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra

CO2: Describe properties of linear systems using vectors, perform and interpret matrix operations.

CO3: Describe and compute orthogonality and determinants

CO4: Solve linear differential equations

CO5: Understand and apply the concept of Linear transformations

SYLLABUS

UNIT-I   **Hours: 15**

Vectors and Matrices **-** Vectors and Linear Combinations-Lengths and Angles from Dot Products-Matrices and Their Column Spaces-Matrix Multiplication AB and CR -Solving Linear Equations Ax = b-Elimination and Back Substitution-Elimination Matrices and Inverse Matrices-Matrix Computations and A = LU-Permutations and Transposes.

UNIT-II: **Hours: 22**

The Four Fundamental Subspaces **-** Vector Spaces and Subspaces-Computing the Nullspace by Elimination: A = CR- The Complete Solution to Ax = b- Independence, Basis, and Dimension-Dimensions of the FourSubspaces.

UNIT-III: **Hours: 22**

Orthogonality **-** Orthogonality of Vectors and Subspaces-Projections onto Lines and Subspaces-Least Squares Approximations-Orthonormal Bases and Gram-Schmidt-The Pseudoinverse of a Matrix Determinants – 3 by 3 Determinants and Cofactors-Computing and Using Determinants-

Areas and Volumes by Determinants.

UNIT-IV :   **Hours: 23**

Eigenvalues and Eigenvectors-Introduction to Eigenvalues : $Ax = \lambda x$ - Diagonalizing a Matrix-Symmetric Positive Definite Matrices-Complex Numbers and Vectors and Matrices-Solving Linear Differential Equations

UNIT-V: **Hours: 23**

The Singular Value Decomposition (SVD)-Singular Values and Singular Vectors-Image Processing by Linear   Algebra-Principal Component Analysis (PCA by the SVD) - Linear Transformations-The Idea of a Linear Transformation-The Matrix of a Linear Transformation-The Search for a Good Basis.

BOOK FOR STUDY

1.Gilbert Strang, Introduction to Linear Algebra, Wellesley - Cambridge Press, Sixth Edition, 2023.

BOOKS FOR REFERENCE

1. David Lay, Steven Lay, Judi McDonald, Linear Algebra and Its Applications 5th Edition, Pearsons, 2015.

2. Sheldon Axler, Linear Algebra Done Right (Undergraduate Texts in Mathematics) 3rd Edition, Springer, 2015.

3. Jim Hefferon, Linear Algebra, Fourth edition, 2020.

4. Jeff M Philips, Mathematical Foundations for Data Analysis, 2021.

WEB RESOURCE :

- https://www.youtube.com/watch?v=579u2VemHB4

- https://www.youtube.com/watch?v=lOgccAjZ6Z8

- https://www.youtube.com/watch?v=UF59Mok4fsQ

Mapping of COs with POs:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	1	2	2	3	3
CO2	3	3	2	3	2
CO3	3	2	3	3	3
CO4	3	3	2	3	3
CO5	3	3	2	3	3
Weightage of course contributed to each PO	13	13	11	15	14

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : M.Sc. Data Science

Course Title : **CORE COURSE -III: STATISTICS-I**

Course Code : **25PDSCC3** Hours/Week:7

Semester : **I** Credits:4

COURSE OBJECTIVES:

To develop knowledge and understand fundamental concepts in probability and statistics.

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1: Organize, manage and present data.

CO2: Understand, describe, and calculate the measures of data and correlation.

CO3: Recognize and understand various probability distribution functions, calculate and interpret expected results

CO4: Apply the methods of estimating a parameter.

CO5: Understand the concept of probability and apply for simple events.

SYLLABUS

UNIT-I Hours: 15

Introduction to Statistics-Introduction-Data Collection and Descriptive Statistics-Inferential Statistics and Probability Models-Populations and Samples-A Brief History of Statistic-Organization and Presentation of Data-Origin and development of Statistics, Scope, limitation and misuse of statistics. Types of data: primary, secondary, quantitative and qualitative data. Types of Measurements: nominal, ordinal, discrete and continuous data. Presentation of data by tables: construction of frequency distributions for discrete and continuous data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions.

UNIT-II: Hours:22

Descriptive statistics-Introduction-Describing Data Sets-Frequency Tables and Graphs- Relative Frequency Tables and Graphs-Grouped Data, Histograms, Ogives, and Stem and Leaf Plots-Summarizing Data Sets-Sample Mean, Sample Median, and Sample Mode-Sample Variance

and Sample Standard Deviation-Sample Percentiles and Box Plots- Chebyshev's Inequality-Normal Data Sets-Paired Data Sets and the Sample Correlation Coefficient- Correlation-Scatter plot, Karl Pearson coefficient of correlation, Spearman's rank correlation coefficient, multiple and partial correlations (for 3 variates only).

UNIT-III: **Hours:22**

Random variables and expectation-Random Variables-Types of Random Variables-Jointly Distributed Random Variables-Independent Random Variables-Conditional Distributions-Expectation-Properties of the Expected Value- Expected Value of Sums of Random Variables-Variance- Covariance and Variance of Sums of Random Variables-Moment Generating Functions-Chebyshev's Inequality and the Weak Law of Large Numbers-Special random variables-The Bernoulli and Binomial Random Variables-Computing the Binomial Distribution Function-The Poisson Random Variable- Computing the Poisson Distribution Function-The Hypergeometric Random Variable-The Uniform Random Variable- Normal Random Variables-Exponential Random Variables-The Poisson Process-The Gamma Distribution-Distributions Arising from the Normal-The Chi-Square Distribution-The t-Distribution-The F Distribution-The Logistics Distribution.

UNIT-IV: **Hours:23**

Distributions of sampling statistics-Introduction-The Sample Mean-The Central Limit Theorem-Approximate Distribution of the Sample Mean, How Large a Sample Is Needed?-The Sample Variance-Sampling Distributions from a Normal Population-Distribution of the Sample Mean, Joint Distribution of X and S-Sampling from a Finite Population-Parameter estimation-Introduction-Maximum Likelihood Estimators-Interval Estimates- Confidence Interval for a Normal Mean When the Variance is Unknown-Confidence Intervals for the Variance of a Normal Distribution - Estimating the Difference in Means of Two Normal Populations-Approximate Confidence Interval for the Mean of a Bernoulli Random Variable-Confidence Interval of the Mean of the Exponential Distribution-The Bayes Estimator.

UNIT-V : **Hours:23**

Basics and Elements of Probability-Random experiment, sample point and sample space, event, algebra of events. Definition of Probability: classical, empirical and axiomatic approaches to probability, properties of probability. Theorems on probability, conditional probability and independent events, Laws of total probability, Baye's theorem and its applications-Introduction-Sample Space and Events-Venn Diagrams and the Algebra of Events-Axioms of Probability-

Sample Spaces Having Equally Likely Outcomes.

BOOKS FOR STUDY

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers And Scientists, Elsevier Academic Press, UK, Fifth Edition, 2023

2 Rohatgi V.K and Saleh E, An Introduction to Probability and Statistics, 3rd edition, John Wiley & Sons Inc., New Jersey, 2015.

3. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons, New Delhi, 2014

BOOK FOR REFERENCE

1. Jim Frost, Introduction to Statistics: An Intuitive Guide for Analyzing Data and Unlocking Discoveries, 2020.

WEB RESOURCES :

1. https://onlinestatbook.com/2/
2. https://www.simplilearn.com/tutorials/statistics-tutorial
3. https://towardsdatascience.com/fundamentals-of-statistics-for-data-scientists-and-data-analysts-69d93a05aae7

Mapping of COs with POs:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	2	3	3	3	2
CO3	2	2	3	2	3
CO4	3	3	3	2	3
CO5	3	3	2	3	3
Weightage of course contributed to each PO	13	14	13	13	14

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title	:	**M.Sc. Data Science**	
Course Title	:	**ELECTIVE I: INTERNET OF THINGS**	
Course Code	:	**25PDSDSEC1A**	**Hours/Week:5**
Semester	:	**I**	**Credits:3**

COURSE OBJECTIVE:

- To understand the concepts, data, framework, standards, protocols, reliability, security and privacy involved in IoT

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1: Describe the concepts of IoT

CO2: Know the essentials IoT data and framework

CO3: Learn IoT protocols

CO4: Design a basic IoT system

CO5: Examine the reliability, security and privacy of an IoT system

SYLLABUS

UNIT-I Hours : 12

IoT Ecosystem Concepts and Architectures - Introduction – IoT definition and evolution – IoT Architectures – OpenIoT Architecture for IoT/Cloud Convergence - Resource Management – IoT Data Management and Analytics - Communication Protocols – Internet of Things applications-Scheduling Process and IoT Services Lifecycle - IoT enabling technologies – IoT levels and Deployments templates – Introduction to M2M - Difference between IoT and M2M – SDN and NFV for IoT.

UNIT-II Hours : 12

IoT Data and Framework Essentials - Introduction - Programming framework for IoT– The foundation of Stream processing in IoT- Continuous Logic processing system – Challenges and Future directions – Anomaly detection – Problem statement and definitions – Efficient incremental local modelling – IoT Governance.

UNIT-III Hours: 20

RF Protocols RFID, NFC:IEEE 802.15.4 - ZigBee - ZWAVE, THREAD - Bluetooth Low

Energy (BLE) - IPv6 for Low Power and Lossy Networks (6LoWPAN) - Routing Protocol for Low power and lossy networks (RPL) - CoAP- XMPP - Web Socket- AMQP – MQTT – WebRTC - PuSH Architectural Considerations in Smart Object Networking - TinyTO Protocol. - Introduction to IoT based applications – Scenarios – Architecture overview – Sensors – The gateway – Data Transmission – Internet of Vehicles (IoV) – IoV Characteristics, technologies and its application.

UNIT-IV :   **Hours: 16**

Developing Internet of Things - Introduction – IoT Design Methodology – Case study on IoT system for Weather monitoring – IoT Device - IoT physical devices and endpoints - Exemplary Device: Raspberry Pi - Linux on Raspberry Pi - Raspberry Pi interfaces – Programming Raspberry Pi and with python – Other IoT devices.

UNIT-V: **Hours: 15**

IoT Reliability, Security and Privacy - Introduction - Concepts - IoT Security Overview – Security Frameworks for IoT – Privacy in IoT networks – IoT characteristics and reliability issues - Addressing reliability.

BOOKS FOR STUDY:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands -on Approach", 1st Edition 2015, University Press, ISBN: 978-81-7371- 954-7

2. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016.

3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.

BOOKS FOR REFERENCE:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978- 3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

3. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI, 1st Edition, 2015.

WEB RESOURCES:

1. https://www.youtube.com/watch?v=FRxRT0DjE7A

2 http://dret.net/lectures/iot-spring15/protocols

3 https://www.youtube.com/watch?v=drB_NEuE9vA

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	2
CO2	3	3	1	2	3
CO3	3	2	2	2	2
CO4	3	3	3	3	2
CO5	2	3	1	2	3
Weightage of course contributed to each PO	14	13	8	11	12

Strong – 3　　　　**Medium – 2**　　　　**Low - 1**

Programme Title   : **M.Sc. Data Science**

Course Title   : **ELECTIVE I: RESEARCH METHODOLOGY FOR COMPUTER SCIENCE**

Course Code   : **25PDSDSEC1B**   **Hours/Week:5**

Semester   : **I**   **Credits:3**

COURSE OBJECTIVE:

- To develop an understanding of the research methods relevant to effectively address a research problem

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1: Develop an understanding of Research methods

CO2: Formulate a Research problem

CO3: Collect and Analyse data

CO4: Effectively write a research paper

CO5: Present the Paper more professionally.

SYLLABUS

UNIT-I: **Hours:12**

Introduction to Research-Meaning, Objectives and Characteristics of research - Research Methods Vs. Methodology - Types of research- Research process - Criteria of good research - Research Project-Shaping a Research Project-Research Planning-Students and Advisors – Checklist.

UNIT-II: **Hours:12**

Literature Review **-**Reading and Reviewing - Hypotheses, Questions, and Evidence.

UNIT-III: **Hours:20**

Experiments for Computing**-**Experimentation-Statistical Principles - Writing a Paper-Organization-Good Style-Style Specifics-Punctuation-Mathematics-Algorithms- Graphs, Figures, and Tables -Other Professional Writing.

UNIT-IV: **Hours:16**

Presentation **-**Editing- Presentations-Slides-Posters-Ethic

UNIT-V: **Hours:15**

Report writing**-**Report writing using LATEX for a research problem

BOOKS FOR STUDY:

1. Kothari C. R. Research Methodology Methods and Techniques. 2nd ed. New Delhi: New Age, 2004.

2. Justin Zobel. Writing for Computer Science.3rd ed. Springer-Verlag,2014

BOOKS FOR REFERENCE:

1. Ranjit Kumar. Research Methodology -a step-by-step guide for beginners. 3rd ed. SAGE Publications India Pvt Ltd, 2011.

2. Panneerselvam R. Research Methodology. 2nd ed. New Delhi: Prentice Hall, 2014.

WEB RESOURCES:

1. https://www.youtube.com/watch?v=j3wbbuOQmvw

2. https://www.youtube.com/watch?app=desktop&v=YLm3sXlKpHQ&t=515s

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	2	3	2	2	3
CO3	3	2	1	3	2
CO4	2	3	3	3	2
CO5	3	3	3	2	2
Weightage of course contributed to each PO	13	14	12	12	11

| **Strong – 3** | **Medium – 2** | **Low - 1** |

Programme Title	:	**M.Sc. Data Science**	
Course Title	:	**ELECTIVE II: WEB PROGRAMMING**	
Course Code	:	**25PDSDSEC2A**	**Hours/Week:3**
Semester	:	**I**	**Credits:2**

COURSE OBJECTIVE:

- To introduce students about web application and state management.

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1: Comprehend.NET Framework and Windows Application

CO2: Know about presentation controls and namespaces

CO3: Connect with backend using ADO.NET

CO4: Get the knowledge about web application and state management

CO5: Gain knowledge on connecting XML, LINQ and AJAX

SYLLABUS

UNIT-I: Hours :9

Overview of .NET Framework-CLR-CTS- Metadata and Assemblies-.NET Framework Class Library – BCL- Windows Forms – ASP.NET and ASP.NET AJAX-ADO.NET – Tools in the .NET Framework- New Features of .NET Framework: Portable Class Libraries **-**Introducing Windows Application**-**Introduction – Creating Windows Forms- Customizing a Form - Collecting User Input in windows Forms and Events**-**Buttons-Text Boxes- Check Boxes- Radio Buttons –Combo Boxes –Date and TimePicker – Calendar-List Boxes – Checked List Box –List View – Tree View.

UNIT-II: Hours : 9

Presentation and Informational Controls in Windows Forms and Events**-**Labeling- Link Label- Status Bar- Picture Box-Image List-Progress Bar-Tool Tip –MDI and Menus Creation - Data Types in C# **-**Type Conversions – Boxing and Unboxing - Namespace **-**Introduction – Adding a reference to the Namespace – Accessing a predefined Namespace through the using Directive - Introducing to ADO.net-Understanding ADO.NET- Creating Connection Strings –Creating a Connection to a Database- Creating a Command Object-Working with DataAdapters –Using DataReader work with Database.

UNIT-III: **Hours : 9**

ASP.NET-Life cycle- Specifying a Location for a Web Application -Single-File Page Model - Code- Behind Page Model- Adding controls to web form - Web Server Controls-The Control Class - The WebControl Class - The Button Control - The TextBox Control -The Label Control - The HyperLink Control -The LinkButton Control -The PlaceHolder Control - The HiddenField Control - The CheckBox Control -The RadioButton Control -The ListBox Control -The DropDownList Control -The Image Control -The ImageButton Control - The Table Control - Menus - Validation Server Controls - Master Page - Web.Config.

UNIT-IV: **Hours : 9**

State Management-Understanding the session object Sessions and the Event Model, Configuring, In-Process Session State, Out-of-Process Session state Application Object, Query strings, Cookies, ViewState, Global.asax- XML and .NET-Basics of XML, Create XML Document - Reading XML with XmlReader – Reading XML with XmlDocument - Working with XmlNode - Animations-Understanding WPF's Animation services – The Role of the Animation class types-The To, From and by properties – The Role of the Timeline Base Class – Authoring and Animation in C# Code – Controlling the pace of an animation – Reversing and Looping an Animation – The Role of StoryBoards.

UNIT-V: **Hours : 9**

LINQ-Introducing LINQ Queries- Standard Query Operators- Introducing LINQ to Dataset, SQL and XML- The LinqDataSource Control. Data Binding – Grid View, Details view, Forms view - ASP. NET AJAX-Understanding the need for AJAX, Building a simple ASP.NET page without AJAX, Building a simple ASP.NET page with AJAX.

BOOKS FOR STUDY:

1. C# 2012 Programming Covers .NET 4.5 Black Book. Dreamtech press, Kogent Learning Solutions, 2013.

2. Liberty, Jesse, and Dan Hurwitz. Programming. NET Windows Applications. " O'Reilly Media, Inc.", 2004.

3. Troelsen, Andrew, and Philip Japikse, C# 6.0 and the .NET 4.6 Framework. Apress, 2015.

BOOKS FOR REFERENCE:

1. Albahan Joseph, and Ben Albahari. C# 5.0 in a NutShell: The Definitive Reference. "Orielly Media Inc", 2012.

2. Anne Boehm . Joel. Murach's C# 2015. United States of America: Murach's,2016. Delamater. Mary. Anne Boehm. ASP.NET 4.5 Web Programming with C# 2012. United States of America: Murach's, 2013.

3. John Sharp. Microsoft Visual C# Step by Step. United States of America: Pearson Edition,2018.

4. Price, Jason, and Mike Gunderlov. Mastering Visual C#.Net. John Wiley & Sons, 2006

WEB RESOURCES:

1. https://www.youtube.com/watch?v=8ew1LgfWV6s
2. https://www.youtube.com/watch?v=jGwexlejAcM
3. https://www.youtube.com/watch?v=EWOENHkxJ0k

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	2	2
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	2	3
Weightage of course contributed to each PO	15	15	15	10	13

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title : **ELECTIVE II: JAVA PROGRAMMING**

Course Code : **25PDSDSEC2B**   **Hours/Week:3**

Semester : **I**   **Credits:2**

COURSE OBJECTIVE:

- To enable the students to understand and appreciate the need for Object Oriented Programming.

COURSE OUTCOME:

On Completion of the Course the students will be able to

CO1 Understand the concepts of object-oriented programming

CO2 Use Java programming language at a basic level and construct simple software applications

CO3 Understand classes, objects and implementing inheritance

CO4 Analyze and understand the functionality of Inheritance, Interface and develop simple applications

CO5 To develop software applications and services using Java code

SYLLABUS

UNIT-I: **Hours:9**

Introduction to Java-Overview – Features - Fundamental OOPS concepts – JDK – JRE – JVM -Structure of a Java program - Data types – Variables – Arrays – Operators –Keywords - Naming Conventions - Control statements, Type conversion and Casting - Scanner - String - equals(), equalsIgnoreCase(), length().

UNIT-II: **Hours:10**

Classes and Objects-Class – Objects – Methods - Method Overloading - Constructors – Constructor Overloading - this keyword - usage of static with data and methods – Garbage Collection - Access Control - Inheritance-Concept – extends keyword - Single and Multilevel Inheritance – Composition – super keyword - Method Overriding - Abstract Classes - Dynamic Method Dispatch – Usage of final with data, methods and classes – Packages and Interfaces-Concepts - package and import keywords - Defining, Creating and Accessing a Package – Interfaces - Multiple Inheritance in Java, Extending and Initialising fields in

Interfaces.

UNIT-III: **Hours:9**

Exception Handling-Exception handling- Types of Exceptions- try, catch, throw, throws and finally keywords - User defined Exceptions - JDBC-Database Connectivity- Types of JDBC drivers- Executing statements- Prepared statements- Callable statements - Mapping SQL types to Java- ResultSet Metadata.

UNIT-IV :   **Hours:10**

Multithreading-Introduction - Life Cycle of a Thread, Thread class and Runnable Interface, Thread Priorities, Synchronisation. GUI Programming with JavaFX-JavaFX Basic Concepts – Packages - Stage and Scene Classes - Nodes and Scene Graphs – Layouts - The Application Class and the Lifecycle Methods - Launching a JavaFX Application - JavaFX Application Skeleton - Compiling and Running -Application Thread - JavaFX Controls-Label – Button – Image – RadioButton – CheckBox – ListView- ComboBox- TextField ScrollPane.

UNIT-V: **Hours:7**

Event-Event Handling – Input Event, Action Event and Window Event - Java Library-java.util – List, ArrayList.

BOOK FOR STUDY:

1. Schildt, Herbert. Java: The Complete Reference. McGraw-Hill Education Group, 2014.

BOOKS FOR REFERENCE:

1. Eckel, Bruce. Thinking in Java. 4th ed. Pearson Education, 2006.

2. Liang, Y. Daniel. Intro to Java Programming, Brief Version. Pearson Higher Ed, 2015.

3. Holmes, J. Barry, Joyce, T. Daniel. Object-oriented Programming with Java. Jones & Bartlett Learning. 2001

WEB RESOURCES:

1. https://www.youtube.com/watch?v=eIrMbAQSU34

2. https://www.youtube.com/watch?v=sL9RmjAJLvI

3. https://www.youtube.com/watch?v=AX0e-Yi9f08

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	2	3
CO3	3	2	3	2	3
CO4	3	3	3	2	2
CO5	1	3	3	2	3
Weightage of course contributed to each PO	**13**	**14**	**15**	**10**	**13**

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title : **Elective -II : WEB PROGRAMMING - PRACTICAL**

Course Code : **25PDSDSEQC2A** **Hours/Week:2**

Semester : **I** **Credit:1**

COURSE OBJECTIVES:

To equip students with the knowledge and skills required to design and develop dynamic web applications using modern web technologies.

COURSE OUTCOME:

CO1: To provide a comprehensive understanding of the .NET Framework and its components..

CO2: To enable students to design and develop Windows and Web applications using C# and ASP.NET.

CO3: To introduce various data access techniques using ADO.NET and   LINQ   for effective backend integration.

CO4: To equip learners with practical skills in XML handling and application development   using Visual Studio.

CO5: To familiarize students with modern web development techniques including state management and AJAX for enhanced user interaction.

<div align="center">

SYLLABUS

</div>

1 Create a Basic Window and Web Application

2 Implement Checkbox, RadioButton, and List Controls in Window and Web Forms

3 Connect Windows Form to SQL Server Using ADO.NET

4 Design a Basic ASP.NET Web Form with TextBox and Button

5 ASP.NET Form Validation with RequiredFieldValidator and CompareValidator

6 State Management Using Session ViewState and Cookies

7 XML File Creation and Reading Using XmlDocument

8 Building simple ASP.NET page with AJAX

BOOKS FOR STUDY:

1. C# 2012 Programming Covers .NET 4.5 Black Book. Dreamtech press, Kogent Learning Solutions, 2013.

2. Liberty, Jesse, and Dan Hurwitz. Programming. NET Windows Applications. " O'Reilly Media, Inc.", 2004.

3. Troelsen, Andrew, and Philip Japikse, C# 6.0 and the .NET 4.6 Framework. Apress,

2015.

BOOKS FOR REFERENCE:

1. Albahan Joseph, and Ben Albahari. C# 5.0 in a NutShell: The Definitive Reference. "Orielly Media Inc", 2012.

2. Anne Boehm . Joel. Murach's C# 2015. United States of America: Murach's,2016. Delamater. Mary. Anne Boehm. ASP.NET 4.5 Web Programming with C# 2012. United States of America: Murach's, 2013.

3. John Sharp. Microsoft Visual C# Step by Step. United States of America: Pearson Edition,2018.

4. Price, Jason, and Mike Gunderlov. Mastering Visual C#.Net. John Wiley & Sons, 2006

WEB RESOURCES:

1. http://www.w3schools.com/aspnet/aspnet.asp

2. http://csharp.net-tutorials.com/xml/introduction/

3. http://ajax.net-tutorials.com/basics/introduction/

4. http://www.c-sharpcorner.com/

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	2	3	3
CO3	3	3	2	3	3
CO4	3	3	2	3	3
CO5	3	3	2	3	3
Weightage of course contribute to each PO	15	15	10	15	15

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title : **ELECTIVE II: JAVA PROGRAMMING - PRACTICAL**

Course Code : **25PDSDSEQC2B**   **Hours/Week:2**

Semester : **I**   **Credit:1**

COURSE OBJECTIVES:

To enable students to design and develop efficient Java applications using object-oriented principles, GUI, database connectivity, and event-driven programming..

COURSE OUTCOME:

CO1: To understand Java basics, data types, control structures, and string handling
CO2: To apply object-oriented concepts like classes, inheritance, and interfaces in Java.
CO3: To Handle exceptions and connect Java applications to databases using JDBC.
CO4: To develop GUI applications and manage threads using JavaFX and multithreading..
CO5: To familiarize students with event handling and use Java utility classes like List and ArrayList.

SYLLABUS

1. Build a basic Java Program Using Scanner, Strings, and Type Casting

2. Create a Java Program Using Class, Arrays, and Average Calculation

3. Develop a Java Program Demonstrating Method and Constructor Overloading

4. Build the Model Java Classes Using Inheritance, Method Overriding

5. Implement a Java Program for Handling Arithmetic Exception Using try-catch-finally

6. Develop a Java Program for Inserting Data Using JDBC PreparedStatement

7. Program to Demonstrate Multithreading Using Thread Class

8. JavaFX Program to Create a Simple Form with Label, TextField, and Button Java

9. Program to Handle Button Click Event and Store Input Using ArrayList

BOOKS FOR STUDY:

1. Programming with Java: A Primer. McGraw Hill Education, E. Balagurusamy, Latest Edition.

BOOKS FOR REFERENCE:

1. Java: The Complete Reference. McGraw Hill Education, Herbert Schildt, Latest Edition.
2. Core Java Volume I – Fundamentals. Pearson Education, Cay S. Horstmann, Latest Edition.

3. Head First Java. O'Reilly Media, Kathy Sierra and Bert Bates, Latest Edition.

WEB RESOURCES:

1. https://docs.oracle.com/javase/tutorial/
2. https://www.geeksforgeeks.org/java/
3. https://www.javatpoint.com/java-tutorial
4. https://www.w3schools.com/java/
5. https://stackoverflow.com/questions/tagged/java

Mapping of COs with POs:

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CO3	3	3	2	3	3
CO4	3	3	2	3	3
CO5	3	3	2	3	3
Weightage of course contribute to each PO	15	15	10	15	15

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title : **Core Course – IV: PYTHON PROGRAMMING**

Course Code : **25PDSCC4** **Hours/Week:5**

Semester : **II** **Credits:5**

COURSE OBJECTIVES:

To be able to think logically and develop interactive programs using the python constructs, functions, data structures, classes and objects, files.

COURSE OUTCOME:

CO1: Recall the components of a computer, demonstrate the appropriate use of data types, mathematical functions and strings in a program.

CO2: State the use of selection and looping constructs, compare and choose an appropriate construct for a given problem.

CO3: Define Functions, Classes and Objects, defend the use of functions, classes and objects in a given problem.

CO4: Define Strings and Lists, implement Lists and Strings appropriately, design new problems using appropriate data structures.

CO5: Define Tuples, sets, dictionaries and files, compare programs with and without files, develop applications using the different data structures science with real time case studies.

SYLLABUS

UNIT-I : **Hours : 15**

Introduction - Computer and its components - Programming Languages - Operating Systems - The history of Python - Introduction to python programming - Programming Style and Documentation - Programming Errors - Introduction to Graphics Programming - Input - Output - Identifiers - Variables, Assignment Statements and Expressions - Simultaneous Assignments - Named Constants - Numeric Data Types and Operators - Evaluating Expressions and Operator Precedence - Augmented Assignment Operators - Type Conversion and Rounding - Common Python Functions - Strings and Characters - Introduction to Objects and Methods - Formatting Numbers and Strings - Drawing various shapes with Colors and Fonts.

UNIT-II : **Hours : 15**

Boolean Types, Values and Expressions - Generating Random Numbers - Different forms of if statements - Logical Operators - Conditional Expressions - Operator Precedence and Associativity- while, for , Nested Loops - break and continue.

UNIT-III : **Hours : 15**

Defining and calling a function - Return single and multiple values - Positional, Keyword and Default Arguments - Passing Arguments by Reference Values - Modularizing Code -

Function Abstraction and Stepwise Refinement - Recursion- Defining Classes for Objects - UML Class Diagrams - Immutable vs Mutable Objects - Hiding Data Fields - Class Abstraction and Encapsulation - Object Oriented Thinking - Superclasses and Subclasses - Overriding methods - Object class - Polymorphism and Dynamic binding.

UNIT-IV: **Hours: 15**

Str class - Operator Overloading and Special Methods - List Basics - Copying Lists - Passing Lists to Functions - Returning a List from a Function - Searching, Sorting Lists - Processing Two - Dimensional Lists - Passing Two - Dimensional Lists to Functions - Multidimensional Lists

UNIT-V: **Hours: 15**

Tuples - Sets - Comparing the Performance of Sets and Lists - Dictionaries - Text Input and Output - File Dialogs - Retrieving Data from Web - Exception Handling - Raising Exceptions - Processing Exceptions using Exception Objects - Defining Custom Exception Classes - Binary IO Using Pickling - Case Studies related to the above topics given in the Text Book to be solved.

BOOK FOR STUDY:

1. Y. Daniel Lang, Introduction to Programming using Python, 2nd Edition, Pearson Education Inc., 2013.

BOOKS FOR REFERENCE:

1. Allen B. Downey. Think Python. How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Publishers, 2016.
2. Corey Wade, et al : *The Python Workshop*, 2nd Edition, Packt, 2022.
3. David Beazley, Brian K. Jones. Python Cookbook: Recipes for Mastering Python 3, 3rd Edition, 2013 Harsh Bhasin. Python for Beginners. New Age International Publishers,2018.
4. Martin C. Brown. Python: The Complete Reference. McGraw Hill Education; Fourth edition, 2018.

WEB RESOURCES:

- https://realpython.com
- http://docs.python.org
- http://diveintopython.org/
- https://www.w3schools.com/python/
- https://www.tutorialspoint.com/python/index.html

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	2	3	3	3	3
CO3	2	2	3	3	2
CO4	3	3	3	3	3
CO5	3	1	2	3	2
Weightage of course contributed to each PO each PO	13	12	13	15	13

Strong – 3   Medium – 2   Low - 1

Programme Title	:	**M.Sc. Data Science**	
Course Title	:	**CORE COURSE -V: STATISTICS - II**	
Course Code	:	**25PDSCC5**	**Hours/Week:5**
Semester	:	**II**	**Credits:4**

COURSE OBJECTIVES:

To develop knowledge and understand fundamental concepts in probability and statistics.

COURSE OUTCOME:

CO1: Identify the four steps of hypothesis testing.

CO2: Gain a thorough understanding of applied principles of statistics.

CO3: To develop knowledge and skills in theoretical, computational and application-oriented statistics.

CO4: Apply the methods of analysis of variance

CO5: Understand and apply the concept of non-parametric tests

SYLLABUS

UNIT-I: **Hours : 15**

Introduction- Population and Statistics – Finite and Infinite population – Parameter and Statistics – Types of sampling - Sampling Distribution – Sampling Error - Standard Error – Test of significance –concept of hypothesis – types of hypothesis – Errors in hypothesis-testing – Critical region – level of significance - Power of the test – p-value - Hypothesis testing -Significance Levels-Tests Concerning the Mean of a Normal Population-Case of Known Variance-Case of Unknown Variance: The t-Test-Testing the Equality of Means of Two Normal Populations-Case of Known Variances-Case of Unknown Variances-Case of Unknown and Unequal Variances-The Paired t-Test- Hypothesis Tests Concerning the Variance of a Normal Population-Testing for the Equality of Variances of Two Normal Populations-Hypothesis Tests in Bernoulli Populations-Testing the Equality of Parameters in Two Bernoulli Populations-Tests Concerning the Mean of a Poisson Distribution-Testing the Relationship Between Two Poisson Parameters.

UNIT-II: **Hours : 15**

Hypothesis Testing-II -Students t-distribution and its properties (without proofs) – Single sample mean test – Independent sample mean test – Paired sample mean test – Tests of proportion (based on t distribution) – F distribution and its properties (without proofs) – Tests of equality of two variances using F-test – Chi-square distribution and its properties (without proofs) – chisquare test for independence of attributes – Chi-square test for goodness of fit.

UNIT-III: **Hours : 15**

Least Squares Estimators of the Regression Parameters-Distribution of the Estimators-Statistical Inferences About the Regression Parameters-Inferences Concerning β -Inferences

Concerning α- Inferences Concerning the Mean Response α+β x 0 - Prediction Interval of a Future Response-Summary of Distributional Results- The Coefficient of Determination and the Sample Correlation Coefficient-Analysis of Residuals: Assessing the Model-Transforming to Linearity- Weighted Least squares-Polynomial Regression - Multiple Linear Regression-Predicting Future Responses - Logistic Regression Models for Binary Output Data.

UNIT-IV: **Hours : 15**

Analysis of variance -An Overview-One-Way Analysis of Variance-Multiple Comparisons of Sample Means-One-Way Analysis of Variance with Unequal Sample Sizes-Two-Factor Analysis of Variance: Introduction and Parameter Estimation-Two-Factor Analysis of Variance: Testing Hypotheses-Two-Way Analysis of Variance with Interaction - Goodness of fit tests and categorical data analysis-Goodness of Fit Tests When All Parameters Are Specified-Determining the Critical Region by Simulation-Goodness of Fit Tests When Some Parameters Are Unspecified-Tests of Independence in Contingency Tables -Tests of Independence in Contingency Tables Having Fixed Marginal Totals-The Kolmogorov–Smirnov Goodness of Fit Test for Continuous Data

UNIT-V :   **Hours : 15**

Nonparametric hypothesis tests -The Sign Test-The Signed Rank Test-The Two-Sample Problem-The Classical Approximation and Simulation-Wilcoxon Signed Rank Test for one and paired samples-The Runs Test for Randomness -Median test and Mann-Whitney-Wilcoxon tests for two samples.

BOOKS FOR STUDY:
1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier Academic Press, UK, Fifth Edition, 2023
2. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 12th edition, Sultan Chand & Sons, New Delhi, 2020.
3. Brian Caffo, Statistical Inference for Data Science, Learnpub, 2016.

BOOKS FOR REFERENCE:
1. Allen B. Downey, Think Stats- Exploratory data analysis, O'Reilly, 2nd Edition
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Publications, Tenth Edition
3. Jim Frost, Introduction to Statistics: An Intuitive Guide for Analyzing Data and Unlocking Discoveries.

WEB RESOURCES:
- https://onlinestatbook.com/2/
- https://www.simplilearn.com/tutorials/statistics-tutorial
- https://towardsdatascience.com/fundamentals-of-statistics-for-data-scientists-and-data-analysts-69d93a05aae7

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	1	1	2
CO2	3	3	2	2	3
CO3	3	2	2	3	3
CO4	3	2	2	2	2
CO5	3	3	2	3	2
Weightage of course contributed to each PO	14	13	9	11	12

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title	:	**M.Sc. Data Science**	
Course Title	:	**CORE PRACTICAL -I: PYTHON PROGRAMMING - PRACTICAL**	
Course Code	:	**25PDSCCQ1**	**Hours/Week:6**
Semester	:	**II**	**Credits:5**

COURSE OBJECTIVES:

To be able to apply appropriately the python programming knowledge gained and develop computer-based solutions for a given problem.

COURSE OUTCOME:

CO1: Recall the components of a computer, demonstrate the appropriate use of data types, mathematical functions and strings in a program.

CO2: State the use of selection and looping constructs, compare and choose an appropriate construct for a given problem.

CO3: Develop modular programming using functions, Design program using OO constructs.

CO4: Demonstrate Strings and Lists, implement Lists and Strings appropriately, design new problems using appropriate data structures.

CO5: Demonstrate Tuples, sets, dictionaries and files, compare programs with and without files, develop applications using different data structures.

SYLLABUS

UNIT-I :

1. Installation of the required software
2. Programs using basic data types and operators
3. Programs involving Mathematical functions
4. Program in String Manipulations

UNIT-II :

5. Programs using different forms of if statement
6. Drawing various shapes using turtle
7. Programs involving repeated execution of a set of statements
8. Programs using break and continue
9. Programs using random

UNIT-III :

10. Modular programming using functions
11. Programs using positional, keyword and default argument
12. Programs using pass by value, pass by reference
13. Programs using classes and objects
14. Programs using Inheritance

UNIT-IV :

15. Programs on Str class and special methods
16. Programs using Lists and List manipulation
17. Programs using Two-Dimensional Lists

UNIT-V:

18. Programs using Tuple and its methods
19. Programs with Set and Set manipulation
20. Programs using Dictionaries
21. Program comparing the performance of Sets and Lists
22. Programs handling Text Files
23. Programs handling Binary Files
24. Programs handling exceptions

BOOK FOR STUDY:

1. Y. Daniel Lang, *Introduction to Programming using Python*, 2nd Edition, Pearson Education Inc., 2013.

BOOKS FOR REFERENCE:

1. Allen B. Downey. Think Python. How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Publishers, 2016.
2. Corey Wade, et al : *The Python Workshop*, 2nd Edition, Packt, 2022.
3. David Beazley, Brian K. Jones. Python Cookbook: Recipes for Mastering Python 3, 3rd Edition, 2013 Harsh Bhasin. Python for Beginners. New Age International Publishers,2018.
4. Martin C. Brown. Python: The Complete Reference. McGraw Hill Education; Fourth edition, 2018.

WEB RESOURCES:

- https://realpython.com
- http://docs.python.org
- http://diveintopython.org/
- https://www.w3schools.com/python/
- https://www.tutorialspoint.com/python/index.html

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
		Strong – 3			Medium – 2
CO1	3	1	1	3	3
CO2	3	3	3	3	3
CO3	3	3	2	2	2
CO4	3	2	2	3	3
CO5	2	3	3	3	2
Weightage of course contributed to each PO	14	12	11	14	13

Low -1   Strong – 3   Medium – 2

Programme Title : M.Sc. Data Science

Course Title   : ELECTIVE -III: INFORMATION SECURITY AND ETHICS

Course Code   : 25PDSDSEC3A   Hours/Week:4

Semester   : II   Credits:3

COURSE OBJECTIVE:

To introduce and familiarize the students to security issues in computing, core concepts and vocabulary of computer security

COURSE OUTCOME:

CO1: Understand all aspects of computer security, including users, software, devices, operating systems, networks, law, and ethics.

CO2: Apply cryptography an essential tool that is critical to computer security.

CO3: Analyse the different aspects of computer security and privacy.

CO4: Evaluate the aspects of computer security.

CO5: Develop a system that uses user authentication, prevents malicious code execution, encrypts the data, protects privacy, implements firewall, detects intrusion, and more.

SYLLABUS

UNIT-I: Hours : 15
Security Problem in Computing - Meaning of "Secure" – Attacks - Meaning of Computer and information Security - Computer Criminals - Methods of Defense – Cryptography – Terminology and Background - Principles of Cryptography - Cryptography tools - Substitution Ciphers - Transpositions (Permutations) – Making "Good" Encryption Algorithms - The Data Encryption Standard (DES) – The AES Encryption Algorithm - Public Key Encryption - The Uses of Encryption - Digital Signatures and Certificates - Hybrid Cryptography Systems - Steganography - Protocols for secure communication.

UNIT-II: Hours : 10
Program Security- Secure Programs - Nonmalicious Program Errors - Viruses and Other Malicious Code - Targeted Malicious Code - Controls against Program Threats- Security Issues in Social Networking - Acceptable Use Policies - Reasons for social media being hazardous to the corporate network - Balancing Security and Social Networking in business - Precautions that can be taken to secure the private information.

UNIT-III: Hours : 10
 Database and Data Mining Security- Introduction to Databases - Security Requirements - Reliability and Integrity – Sensitive Data - Inference - Multilevel Databases - Proposals for Multilevel Security – Data Mining - Security in Networks - Network Concepts - Threats in Networks - Network Security Controls - Firewalls – Intrusion Detection Systems - Secure E-Mail.

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UNIT-IV: **Hours : 10**

Administering Security - Security Planning - Risk Analysis - Organisational Security Policies - Physical Security - The Economics of Cyber security - Making a Business Case - Quantifying Security - Modeling Cyber security

UNIT-V: **Hours : 15**

Privacy in Computing Privacy Concepts - Privacy Principles and Policies - Authentication and Privacy – Data Mining - Privacy on The Web - E-Mail Security - Impacts on Emerging Technologies - Legal and Ethical Issues in Computer Security - Protecting Programs and Data - Information and the Law - Rights of Employees and Employers - Redress for Software Failures - Computer Crime - Ethical Issues in Computer Security - Case Studies of Ethics

BOOK FOR STUDY:

1. Pfleeger ,Charles P and Shari Lawrence Pfleeger. Security in Computing, Released January 2015, Pearson, ISBN: 9780134085074

BOOKS FOR REFERENCE:

1. Bahadur ,Gary. Securing the Clicks Network Security in the Age of Social Media. 1st ed. McGraw-Hill, 2012.

2. Daswani, Neil, Christoph Kern and Anita Kesavan. Foundations of Security: What Every Programming Needs to Know. Apress, 2007

WEB RESOURCES:

*   http://www.trendmicro.fr/media/wp/securityguide-social-networks-whitepaper-en.pdf

*   http://paper.ijcsns.org/07_book/201306/20130619.pdf

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CO4	3	2	2	2	3
CO5	3	3	3	2	2
Weightage of course contributed to each PO	14	13	13	11	10

Strong – 3   Medium – 2   Low – 1

Programme Title	:	**M.Sc. Data Science**
Course Title	:	**ELECTIVE -III: SOFTWARE ENGINEERING FOR DATA SCIENCE**
Course Code	:	**25PDSDSEC3B** Hours/Week:4
Semester	:	**II** Credits:3

COURSE OBJECTIVE:

To understand the software engineering principles and ensure software quality

COURSE OUTCOME:

CO1: To describe the Software Engineering Principles.

CO2: To apply Software Life Cycle Models for Software Development.

CO3: To use Requirements Engineering skills and gather Requirements.

CO4: To develop a quality Software.

CO5: To apply appropriate testing methodologies.

SYLLABUS

UNIT-I: Hours : 10

Software and Software Engineering **-** The nature of software - Software Engineering - The Software Process - Software Engineering Practice - Software Myths- Process Models**:** A Generic Process Model - Process Assessment and Improvement - Prescriptive Process Models - Product and Process -Agile Development - Introduction - Agility and Cost of Change - Agile Process - Scrum - Other Agile Frameworks.

UNIT-II: Hours : 15

Recommended Process Model**:** Requirements Definition - Preliminary Architectural Design - Resource Estimation - First Prototype Construction - Prototype Evaluation - Prototype Evolution - Prototype Release - Maintain Release Software - Human Aspects of Software Engineering**:** Characteristics of a Software Engineer - The Psychology of Software Engineer - The Software Team - Team Structures - The impact of Social Media - Global Teams- Principles that guide practice: Core Principles - Principles that guide each Framework Activity - Communication Principles - Planning Principles - Modeling Principles - Construction Principles - Deployment Principles.

UNIT-III: Hours : 15

Understanding Requirements: Requirements Engineering - Establishing the groundwork - Requirements Gathering - Developing Use Cases -Building the Analysis Model - Negotiating Requirements - Requirements Monitoring - Validating Requirements-Requirements Modeling - A Recommended Approach: Requirements Analysis - Scenario-Based Modeling - Class-Based Modeling - Functional Modeling - Behavioural Modeling.

UNIT-IV: **Hours : 10**

Design Concepts: Design within the context of Software Engineering - The Design Process - Design Concepts - The Design Model - Quality and Security: Introduction - Software Quality - The Software Quality Dilemma - Achieving Software Quality -Software Quality Assurance: Background Issues - Elements of Software Quality Assurance - SQA Process and Product Characteristics - SQA Tasks, Goals and Metrics - Formal Approaches - Statistical SQA - Software Reliability - ISO 9000 Quality standards - SQA Plan

UNIT-V: **Hours : 10**

Software Testing -Component Level: A Strategic Approach to Software Testing - Planning and RecordKeeping - Test-Case Design - White-box Testing - Black-Box Testing - Object-oriented Testing -Software Testing - Integration Level: Software Testing Fundamentals - Integration Testing - Artificial Intelligence and Regression Testing - Integration Testing in the OO context - Validation Testing - Testing Patterns

BOOK FOR STUDY:

1. Pressman, Roger S., and Bruce R. Maxim. Software Engineering: A Practitioner's Approach, Ninth Edition, 2020.

BOOKS FOR REFERENCE:

1. Martin, Robert C. Agile software development: principles, patterns, and practices. Prentice Hall, 2002.

2. Schach, Stephen R. Object-oriented software engineering. McGraw-Hill, 2008.

3. Sommerville, Ian. "Software engineering 9th Edition." ISBN-10 137035152 (2011).

WEB RESOURCES:

- https://www.d.umn.edu/~gshute/softeng/principles.html
- https://www.youtube.com/watch?v=uDnm7nlodDk

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CO5	3	3	1	2	2
Weightage of course contributed to each PO	14	15	7	10	11

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title : **ELECTIVE -IV: OPTIMIZATION TECHNIQUES**

Course Code : 25PDSDSEC4A   Hours/Week:4

Semester : **II**   Credits:3

COURSE OBJECTIVE:

　　　　To study of model formulation and apply the mathematical results and numerical techniques of optimization theory to real world problems

COURSE OUTCOME:
 CO1: Explain the fundamental knowledge of Linear Programming.
 CO2: Use classical optimization techniques and numerical methods of optimization.
 CO3: Enumerate fundamentals of Integer programming technique and apply different
 　　　　techniques to solve various optimization problems.
 CO4: Describe the basics of different Heuristic algorithms and solve dynamic
 　　　　programming problems.
 　CO5: Understand Queuing systems and understand constrained and unconstrained
 　　　　problems.

SYLLABUS

UNIT-I: Hours : 10
Modelling with Linear programming - Two variable LP model – Graphical LP solution – Applications-Simplex method and sensitivity analysis **-** Simplex method- Artificial starting solution - Special cases in simplex method- Graphical sensitivity analysis.

UNIT-II: Hours : 10
Duality and post-optimal Analysis **-** Definition of Dual problem - Primal-Dual Relationships-Additional Simplex algorithms- Post optimal analysis - Advanced Linear Programming - Simplex method fundamentals-Revised Simplex Method, Bounded-Variable Algorithm, Duality, Parametric programming

UNIT-III: Hours : 10
Goal Programming -Goal programming formulation - Goal Programming algorithms - Integer Programming -Formulation and Applications-Cutting Plane Algorithm-Branch and Bound Method

UNIT-IV: Hours : 15
Heuristic Programming - Greedy Heuristics- Meta heuristic - Tabu Search algorithm - Constraint programming - Deterministic dynamic programming -Recursive nature of Dynamic programming computations - Forward and backward recursion- Selected DP applications - Knapsack/Fly-away kit/cargo-loading model- Investment models-Inventory models.

UNIT-V: Hours : 15
Queuing Systems -Pure birth and Pure death models- Generalized Poisson queuing model,

single server models-Classical optimization theory -Unconstrained problems - Constrained problems.

BOOK FOR STUDY:

1. Hamdy A.Taha, Operations Research- An Introduction, 10th Edition, Pearson Education – 2017.

BOOKS FOR REFERENCE:

1. L.R.Foulds, Optimization Techniques , Springer ,Utm , 1981
2. Garrido José M. Introduction to Computational Models with Python. CRC Press, 2016.

WEB RESOURCES:

- https://www.pre-scient.com/knowledge-center/optimization-problems/optimization-problems-and-techniques/
- https://www.shsu.edu/~eco_dgf/web_chapter_a.pdf

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	3
CO2	2	2	3	2	3
CO3	2	3	2	3	2
CO4	3	3	2	3	1
CO5	2	3	2	2	2
Weightage of course contributed to each PO	13	14	11	12	11

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title : **ELECTIVE– IV :APPLIED PROBABILITY**

Course Code : **25PDSDSEC4B** **Hours/Week:4**

Semester : **II** **Credits:3**

COURSE OBJECTIVE:

To develop knowledge and understand fundamental concepts and applications of probability

COURSE OUTCOME:
CO1: Define the principal concepts about probability.
CO2: Understand combinatorics and convexity
CO3: Understand the nature and properties of density functions and hence determine the moments and moment generating functions of any random variable
CO4: Obtain the value of the point estimators using the method of moments and method of maximum likelihood
CO5: Define and formulate discrete-time and continuous-time Markov chains.

UNIT-I: **Hours : 10**
Basic Notions of Probability Theory-Probability and Expectation-Sample Spaces and Events-Random Experiments, Sample Spaces, Events, Counting Techniques-Interpretations and Axioms of Probability-Addition Rules-Conditional Probability-Multiplication and Total Probability Rules-Independence-Bayes'Theorem-Random Variables,Distributions, Densities, and Moments-Convolution-Random Vectors-Multivariate Normal Random Vectors -Calculation of Expectations -Indicator Random Variables and SymmetryConditioning-Moment Transforms-Tail Probability Methods-Moments of Reciprocals and Ratios-Reduction of Degree-Spherical Surface Measure.

UNIT-II: **Hours : 10**
Convexity and Combinatorics-Convex Functions-Minimization of Convex Functions-The MM Algorithm-Moment Inequalities-Combinatorics-Introduction-Bijections-Inclusion-Exclusion -Applications to Order Statistics-Catalan Numbers-Pigeonhole Principle-Combinatorial Optimization-Introduction-Quick Sort-Data Compression and Huffman Coding-Graph Coloring.

UNIT-III: **Hours : 10**
Discrete Random Variables Probability Distributions and Probability Mass Functions-Cumulative Distribution Functions-Mean and Variance of a Discrete Random Variable-Discrete Uniform Distribution-Binomial Distribution-Geometric and Negative Binomial Distributions-Hypergeometric Distribution-Poisson Distribution- Continuous Random Variables Probability Distributions and Probability Density Functions - Cumulative Distribution Functions-Mean and Variance of a Continuous Random Variable-Continuous Uniform Distribution-Normal Distribution - Normal Approximation to the Binomial and Poisson Distributions-Exponential Distribution-Erlang and Gamma Distributions-Weibull

Distribution-Lognormal Distribution-Beta Distribution.

UNIT-IV: **Hours : 15**
Two or More Random Variables Joint Probability Distributions-Marginal Probability Distributions-Conditional Probability Distributions-Independence-More Than Two Random Variables-Covariance and Correlation-Common Joint Distributions-Multinomial Distribution-Bivariate Normal Distribution-Linear Functions of Random Variables-General Functions of Random Variables - Sampling Distributions and Point Estimation of Parameters Point Estimation-Sampling Distributions and the Central Limit Theorem-General Concepts of Point Estimation-Unbiased Estimators-Variance of a Point Estimator -Standard Error: Reporting a Point Estimate-Mean Squared Error of an Estimator-Methods of Point Estimation-Method of Moments-Method of Maximum Likelihood-Bayesian Estimation of Parameters.

UNIT-V: **Hours : 15**
 Discrete-Time Markov Chains -Definitions and Elementary Theory-Examples-Coupling-Convergence Rates for Reversible Chains-Hitting Probabilities and Hitting Times-Markov Chain Monte Carlo-simulated annealing- Continuous-Time Markov Chains-Finite-Time Transition Probabilities-Derivation of the Backward Equations-Equilibrium Distributions and Reversibility-Examples-Calculation of Matrix Exponentials-Kendall's Birth-Death-Immigration Process.

BOOKS FOR STUDY:
1. Lange, Kenneth. Applied probability. Vol. 224. New York: Springer, 2003.
2. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Fifth Edition, John Wiley & Sons, Inc. 2010.

BOOKS FOR REFERENCE:
1. Mario Lefebvre, Applied Probability and Statistics, Springer Newyork, 2006.
2. Michael Mitzenmacher Eli Upfal, Probability and Computing Randomized Algorithms and Probabilistic Analysis, Cambridge University press, 2005.

WEB RESOURCES:

- https://www.youtube.com/watch?v=vEM4YnRFGoA

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	1
CO2	3	3	3	2	1
CO3	3	3	3	2	1
CO4	3	3	3	2	1
CO5	3	3	3	2	1
Weightage of course contributed to each PO	**15**	**15**	**15**	**10**	**5**

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title	:	M.Sc. Data Science	
Course Title	:	EDC – I : FUNDAMENTALS OF COMPUTERS AND COMMUNICATIONS	
Course Code	:	25PDSEDC1	Hours/Week:4
Semester	:	II	Credits:2

COURSE OBJECTIVE:

To know the basics of computers, understand the OS and basics of networks and internet.

COURSE OUTCOME:
CO1: Know the basics and internal parts of Computers
CO2: Gain the knowledge on OS and its types
CO3: Understand the basics of networks and Internet
CO4: Learn the databases and DBMS concepts
CO5: Understand the role of RDBMS in IT

UNIT -I: **Hours :12**
Introduction: What is computer – Components of Computers – Advantages and Disadvantages of using computers – Computer Software – Categories of Computers - Elements of information systems. The Components of the Systems Unit: Processor – Data representation – Memory – Mobile Computers and Devices.

UNIT -II: **Hours :12**
Input and Output Device: What is input – what are input devices – keyboard – pointing device – mouse – other pointing devices – Voice input –Digital Cameras – Video input – Scanners and Reading devices Terminals – Biometric input - Input devices for physically challenged users-Output: What is output – display devices – Monitors – Printers –Speakers, Headphones and Ear phones – output device for physically challenged users – Storage devices.

UNIT -III: **Hours :12**
Operating Systems and Utility Programs: System software – Operating system – Operating system functions – types of operating systems – standalone operating systems–network operating systems – embedded operating system. Application Software: Application software – Business software – Graphics and Multimedia Software–Application software for Communication.

UNIT -IV: **Hours :12**
Internet and World Wide Web: Internet – History of the Internet – How the Internet works – WWW– E-commerce–Communications and Networks: Communications – Uses of Computer Communications – Networks – Communication software – Communication devices – Communications Channel – Physical transmission media and Wireless transmission media.

UNIT-V: **Hours :12**
Database Management: Databases, Data and Information, The Hierarchy of data–Maintaining data – File processing versus databases – database management systems–relational, object

oriented and multi-dimensional databases – web databases – database administration. Computer Security: Computer security risks – Internet and network attacks –Unauthorized access and use.

BOOK FOR STUDY:
1. Gary B. Shelly, Thomasj. Cashman, Misty E.Vermaat, "Introduction to Computers,"Cengage Learning, 2008.

BOOKS FOR REFERENCE:

1.Reema Thareja, - Fundamentals of Computers, Oxford Univ. Press,2015.
2.Deborah Morley, Charles S.Parker - Understanding Computers-Today andTomorrow",14th Edition, Thomson Course Technology, 2012.
3.Alexis Leon, Mathew's Leon, - Fundamentals of Computer Science and Communication Engineering‖, Vikas Publishing House, New Delhi, 1998.

WEB RESOURCES:

- https://www.youtube.com/watch?v=SDryuP0jqxw

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	2	3	3	3	3
CO3	3	1	2	3	2
CO4	3	3	3	2	2
CO5	3	3	1	2	2
Weightage of course contributed to each PO	14	12	11	12	12

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title : **HUMAN RIGHTS**

Course Code : **25PHRSC**   Hours/Week:2

Semester : **II**   Credits:1

COURSE OBJECTIVE:

To enlighten the students about the different rights.

 UNIT – I: Hours : 6
Human rights- Definition- characteristics of human rights-classification of rights- The Universal declaration of human rights-international covenants on economic, social and cultural rights

 UNIT – II: Hours : 6
Constitutional guarantee on human rights - Fundamental rights -Part III of constitution-Directive principles Part IV of the constitution.

UNIT – III: Hours : 6
Civil and political rights- right to work, right to personal freedom, right to freedom of expression, right to property, right to education, right to equality, right to religion, right to form association and unions, right to family, right to contract, right to constitutional remedies, right to contest in election, right to hold public office, right to petition, right to criticize government.

UNIT – IV: Hours : 6
Economic rights: Right to work, right to adequate wages, right to reasonable hours of work, right to self-government in industry.

UNIT -V: Hours : 6
Women's Rights: Right to inheritance, right to divorce, right to remarry, right to education, right to employment and career advancement.

BOOKS FOR STUDY:
1. Human Rights UNESCO.1982
2. Desai A.R.-Violation of democratic rights in India.1986.
3. Pandey- Constitutional Law
4. Human Rights - A selected bibliography, USIS.
5. Singh K.S Indian Social Instituition.1983

Programme Title : **M.Sc. Data Science**

Course Title : **CORE COURSE -VI: MACHINE LEARNING**

Course Code : **25PDSCC6** **Hours/Week:6**

Semester : **III** **Credits:5**

COURSE OBJECTIVES:

- To understand the different types, steps and algorithms involved in Machine Learning Process

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Describe the data, essential steps for creating a typical ML model and the fundamentals of pattern classification

CO2: Able to examine different ML algorithms and unprocessed data and features

CO3: Implement the essential techniques to reduce the number of features in a dataset and test the performance of predictive models

CO4: Select multiple algorithms, combine and produce ensembles, discuss the essential techniques for modeling linear relations

CO5: Discuss the clustering algorithms, develop a Web application embedding a ML model

SYLLABUS

UNIT-I: **Hours:20**

Data Analytics with pandas and NumPy **-** NumPy and basic stats - Matrices - pandas library - Working with data - Null Values - Creating statistical graphs. Giving Computers the ability to learn from data **-** Introduction - Building intelligent systems to transform data into knowledge - The three different types of Machine Learning (ML) - Introduction to basic terminology and notations - A roadmap for building ML systems - Using Python for ML.Training Simple ML Algorithms for Classification **-** Early History of ML - Implementing a Perceptron learning algorithm - Adaptive linear neurons and the convergence of learning.

UNIT-II: **Hours:15**

ML Classifiers using sckikit-learn - Choosing a classification algorithm - Training a perceptron - Modeling class probabilities via logistic regression - Maximum margin classification with support vector machines (SVM) - Solving nonlinear problems using a kernel SVM - Decision tree learning - K-nearest neighbours: a lazy learning algorithm. Data Preprocessing **-** Missing data - Categorical data - Partitioning a dataset into separate training and test datasets - Bringing features onto the same scale - Selecting meaningful features - Assessing feature importance with random forests

UNIT-III: **Hours:20**

Compressing Data via Dimensionality Reduction **-** Unsupervised dimensionality reduction via principal component analysis - Supervised data compression via linear discriminant analysis - Using kernel principal component analysis for nonlinear mappings Learning Best Practices for Model Evaluation and Hyperparameter Tuning **-** Streamlining workflows with pipelines - Using k-fold cross-validation to assess model performance - Debugging algorithms with learning and validation curves - Fine-tuning ML models via grid search - Looking at different performance evaluation metrics.

UNIT-IV: **Hours:20**

Combining different models for ensemble learning - Learning with ensembles - Combining classifiers via majority vote - Bagging: building an ensemble of classifiers from bootstrap samples - Leveraging weak learners via adaptive boosting. Predicting Continuous Target Variables with Regression Analysis - Introducing Linear regression **-** Implementing an ordinary least squares linear regression model - Fitting a robust regression model using RANSAC - Evaluating the performance of linear regression models - Using regularised methods for regression - Turning a linear regression model into a curve -polynomial regression - Dealing with nonlinear relationships using random forests.

UNIT-V: **Hours:15**

Working with Unlabelled Data – Grouping objects by similarity using k-means - Organising clusters as a hierarchical tree - Locating regions of high density via DBSCAN . Introduction to Embedding a ML model into a Web Application **-** Serialising fitted scikit-learn estimators - Setting up an SQLite database for data storage - Developing a web application with Flask -

Turning any classifier into a web application - Deploying the web application to a public server

BOOKS FOR STUDY:

1. Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022
2. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packt publishing, 2019

BOOKS FOR REFERENCE:

1. Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python. O'Reilly Media, Inc., 2016.
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, 2010
3. Wes McKinney. Python for Data Analysis. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018

WEB RESOURCES:

1. https://data-flair.training/blogs/machine-learning-tutorial/
2. https://www.geeksforgeeks.org/machine-learning/
3. https://www.youtube.com/watch?v=2-ccInULI_0

Mapping of Cos with Pos:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	2	3	3
CO3	3	2	3	2	3
CO4	3	2	3	2	3
CO5	3	3	3	3	2
Weightage of course contributed to each PO	15	13	13	12	13

Strong – 3 Medium – 2 Low - 1

Programme Title : **M.Sc. Data Science**

Course Title : **CORE COURSE -VII: DATABASES FOR DATA SCIENCE**

Course Code : **25PDSCC7** **Hours/Week:4**

Semester : **III** **Credits:4**

COURSE OBJECTIVES:

- To provide fundamentals of database design, modeling systems, data storage, world of data warehousing and NoSQL

COURSE OUTCOME:

CO1: Understand and discuss the importance of relational data modeling and conceptual modelling

CO2: Experiment with various database and compose effective queries

CO3: Analyse the process of OLAP system construction

CO4: Evaluate the use of NOSQL and its approach to the database

CO5: Develop applications using Relational and NoSQL databases

SYLLABUS

Unit-I **Hours:15**

Fundamental Concepts of Database Management :Applications of Database Technology - Key Definitions - File versus Database Approach to Data Management - Elements of a Database System - Advantages of Database Systems and Database Management - Architecture and Categorization of DBMSs. Conceptual Data Modeling using the ER Model and UML Class Diagram : Phases of Database Design - The Entity Relationship Model - UML Class Diagram

Unit-II **Hours:15**

Types of Database Systems: Legacy Databases - Relational Databases: The Relational Model – Normalization. Relational Databases : Structured Query Language - SQL Data Definition Language - SQL Data Manipulation Language

Unit-III **Hours:20**

Data Warehousing and Business Intelligence: Operational versus Tactical/Strategic Decision-Making - Data Warehouse Definition - Data Warehouse Schemas - The Extraction, Transformation, and Loading (ETL) Process - Data Marts - Virtual Data Warehouses and Virtual Data Marts - Operational Data Store - Data Warehouses vs Data Lakes - Business Intelligence. 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, 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.

Unit-IV   **Hours:20**
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.

Unit -V   **Hours:20**
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. Data Modeling with Graph **:** Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page RankMarkov chain, page rank computation, Topic specific page rank Page Ranking Computation techniques iterative processing, Random walk distribution Querying Graphs

BOOKS FOR STUDY:

1. Lemahieu, W., Broucke, S.vanden and Baesens, B. Principles of database management: The Practical Guide to storing, managing and analyzing big and small data. Cambridge, United Kingdom: Cambridge University Press, 2018.

2. Sadalage, P. & Fowler,NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition, 2022.

BOOKS FOR REFERENCE:

1. SQL for Data Scientists: A Beginner's Guide for Building Datasets for Analysis Renee M. P. Teate.
2. SQL for Data Science: Data cleaning, wrangling and analytics with relational databases, Antonio Badia.
3. Guy Harrison, Next Generation Database: NoSQL and big data, Apress.

WEB RESOURCES:

- **https://www.geeksforgeeks.org/introduction-to-nosql/**
- **https://www.youtube.com/watch?app=desktop&v=rhzUrejsA4A**
- **https://www.youtube.com/watch?v=w-S0fj0fmqg**

Mapping of Cos with Pos:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	3
CO2	2	3	1	1	3
CO3	2	3	2	2	2
CO4	3	3	1	3	2
CO5	3	3	2	2	3
Weightage of course contributed to each PO	**12**	**14**	**8**	**10**	**13**

Strong – 3   Medium – 2   Low - 1

Programme Title : M.Sc. Data Science

Course Title   : CORE COURSE -VIII: HEALTH CARE ANALYTICS

Course Code   : 25PDSCC8   **Hours/Week: 6**

Semester   : III   **Credits:4**

COURSE OBJECTIVES:

- To understand master healthcare data analytics techniques, including preprocessing, predictive modeling, and machine learning applications, while understanding ethical and regulatory considerations, to derive actionable insights and improve patient outcomes.

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand healthcare data, the fundamental steps for building predictive models, and the basics of pattern recognition in healthcare contexts.

CO2: Evaluate various machine learning algorithms and unprocessed healthcare data and features for analysis and prediction.

CO3: Apply techniques to reduce feature dimensionality in healthcare datasets and evaluate predictive model performance effectively.

CO4: Select and combine multiple machine learning algorithms to create ensembles for healthcare analytics, and discuss techniques for modeling linear relationships in healthcare data.

CO5: Analyze clustering algorithms relevant to healthcare data, and develop a web application embedding a machine learning model for healthcare prediction or decision support.

SYLLABUS

Unit-I: **Hours:15**

Introduction to Healthcare Analytics- Overview of healthcare data sources and formats - Importance of healthcare analytics in improving patient outcomes and operational efficiency-Ethical considerations and regulatory requirements in healthcare data analysis.

Unit-II: **Hours:20**

Data Preprocessing and Exploratory Data Analysis (EDA) in Healthcare: Data cleaning and preprocessing techniques for healthcare data- Handling missing values and outliers Exploratory data analysis techniques for understanding healthcare datasets.

Unit-III: **Hours:20**

Predictive Modeling in Healthcare: Introduction to predictive modeling techniques (Regression, Classification)- Application of predictive modeling to healthcare datasets (e.g., disease prediction, patient readmission prediction).

Unit-IV: **Hours:15**

Machine Learning Applications in Healthcare: Supervised learning algorithms for healthcare analytics (e.g., Decision Trees, Random Forest, SVM)- Unsupervised learning techniques (e.g.,Clustering for patient segmentation).

Unit-V: **Hours:20**

Deep Learning and Healthcare Data Governance: Introduction to deep learning and its applications in healthcare analytics- Ethical considerations and privacy concerns in healthcare analytics- HIPAA regulations and compliance.

BOOKS FOR STUDY:
1. Prashant Natarajan, Healthcare Analytics Made Simple, 1st Edition, 2019.
2. Wes McKinney, Python for Data Analysis, 2nd Edition, 2017.

BOOKS FOR REFERENCE:
1. Laura K. Jr. McWade, Predictive Analytics in Healthcare: A Guide to Improving
   Patient, 1st Edition, 2020.
2. Chandan K. Reddy, Charu C. Aggarwal, and Hui Liu, Machine Learning for Healthcare
   Analytics, 1st Edition, 2021.
3. Niranjan Nagarajan, Amit Sethi, and Sunil Kumar Vuppala, Deep Learning for
   Healthcare: Techniques and Applications, 1st Edition, 2023.

WEB RESOURCES:
• https://www.youtube.com/watch?v=aXoaqJqdzwE

• https://www.youtube.com/watch?v=0jWOZoTsYzI

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
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CO3	3	2	3	2	3
CO4	3	2	3	2	3
CO5	3	3	3	3	3
Weightage of course contributed to each PO	15	13	13	12	14

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title   : Core Practical – II MACHINE LEARNING - PRACTICAL

Course Code   : **25PDSCCQ2**   **Hours/Week:5**

Semester   : **III**   **Credits:5**

COURSE OBJECTIVES:

- To preprocess the data and build ML models using appropriate techniques and evaluate the model

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Apply pandas, NumPy and Matplotlib to read in , process and visualise data, implement linear classification algorithms

CO2: Compare classifiers with linear and non-linear decision boundaries, select relevant features for the model construction

CO3: Apply data compression and best practices for model evaluation and hyper parameter tuning

CO4: Select appropriate algorithms and ensemble

CO5: Apply clustering algorithms on unlabelled data, construct a web application embedding a ML model

SYLLABUS

UNIT-I :
1. Programs using NumPy and pandas
2. Visualizing using graphs
3. Perceptron learning algorithm
4. Adaline

UNIT-II :
5. Training a perceptron
6. Modelling class probabilities via logistic regression
7. Maximum margin classification with support vector machines (SVM)
8. Solving nonlinear problems using a kernel SVM
9. Decision tree

UNIT-III :

10. Unsupervised dimensionality reduction via principal component analysis
11. Supervised data compression via linear discriminant analysis
12. Using k-fold cross-validation to assess model performance
13. Debugging algorithms with learning and validation curves
14. Fine-tuning ML models via grid search
15. Implementing different performance evaluation metrics

UNIT-IV:

16. Ensemble Learning
17. Ordinary least squares linear regression model
18. Evaluating the performance of linear regression models
19. Regularised methods for regression
20. Nonlinear relationships using random forests

UNIT-V:

21. Grouping objects by similarity using k-means
22. Organising clusters as a hierarchical tree
23. Locating regions of high density via DBSCAN
24. Embedding a ML model into a Web Application

BOOKS FOR STUDY:

1. Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022.

2. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packt publishing, 2019.

BOOKS FOR REFERENCE:

1. Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python. O'Reilly Media, Inc., 2016.
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, 2010
3. Wes McKinney. Python for Data Analysis. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018

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/

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CO3	3	2	3	3	2
CO4	3	2	3	2	3
CO5	3	3	2	3	3
Weightage of coursecontributed to each PO	15	11	12	14	13

Strong – 3　　　　　Medium – 2　　　　　Low - 1

Programme Title : **M.Sc. Data Science**

Course Title **:** **Core Practical – III DATABASES FOR DATASCIENCE - PRACTICAL**

Course Code **:** **25PDSCCQ3** **Hours/Week:2**

Semester **:** **III** **Credits:1**

COURSE OBJECTIVES:

- To enable students to design, implement, and manage data using both relational and NoSQL databases by applying CRUD operations, schema design, and query techniques through hands-on experience with SQL, MongoDB, Cassandra, and Neo4j.

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Demonstrate proficiency in using SQL DDL and DML commands, and perform key operations such as backup, restore in traditional relational databases.

CO2: Integrate Python with MongoDB to implement core database operations including insertion, retrieval, update, and deletion of documents.

CO3: Apply NoSQL database concepts using column-family stores like Cassandra and graph databases like Neo4j

CO4: Evaluate the limitations of traditional RDBMS through case studies and justify the use of NoSQL alternatives for handling modern data requirements.

CO5: Design and implement a mini-project involving a custom data store that processes and manages data using appropriate database technologies learned in the course.

SYLLABUS

1) Create tables, insert records, update and delete data, apply constraints (PRIMARY KEY, FOREIGN KEY, etc.). using SQL
2) Connect to a MongoDB instance using Python.
3) Implement a menu-driven console application for MongoDB document management. to insert documents, retrieve documents using queries, update and delete documents.
4) Understand and use Apache Cassandra
5) Create keyspaces, column families (tables), insert and query data using CQL (Cassandra Query Language).
6) Explore graph databases using Neo4j to create nodes and relationships, query with Cypher, update and delete nodes.
7) Build a small application that uses a NoSQL data store for specific use-case.
8) Design schema (MongoDB or Cassandra), develop backend logic with Python, perform CRUD and aggregation, demonstrate project functionality.

TEXT BOOKS

1. Lemahieu, W., Broucke, S.vanden and Baesens, B. Principles of database management: The Practical Guide to storing, managing and analyzing big and small data. Cambridge, United Kingdom: Cambridge University Press, 2018.
2. Sadalage, P. & Fowler,NoSQL Distilled: A Brief Guide to the Emerging World of

Polyglot Persistence, Wiley Publications,1st Edition, 2022.

REFERENCE BOOKS

1. SQL for Data Scientists: A Beginner's Guide for Building Datasets for Analysis Renee M. P. Teate

2.SQL for Data Science: Data cleaning, wrangling and analytics with relational databases, Antonio Badia

3. Guy Harrison, Next Generation Database: NoSQL and big data, Apress

WEB RESOURCES

- https://www.geeksforgeeks.org/introduction-to-nosql/
- https://www.youtube.com/watch?v=RZx3xvXWR4M
- https://youtu.be/0zwYbudzaJc?si=fNEFcFYvW0AUZETj
- https://youtu.be/Otdxk0Mmdmo?si=K5GtNu9t0mhgPWJP

Mapping of Cos with Pos :

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	2	3	2
CO3	3	2	3	3	2
CO4	3	2	3	2	3
CO5	3	3	2	3	3
Weightage of course contributed to each PO	15	13	12	14	13

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title   : **ELECTIVE-V: SOCIAL NETWORK ANALYSIS**
Course Code   : **25PDSDSEC5A**   **Hours/Week:4**
Semester   : **III**   **Credits:3**

COURSE OBJECTIVES:

- To introduce the concepts and fundamentals of social network components and analysis

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand the fundamentals of social web and elements of social network analysis.

CO2: Apply and visualize the knowledge representation in social network.

CO3: Analyse the various methods in social network analysis.

CO4: Evaluate the tools and methods for analysing the social network data.

CO5: Investigate the recent potential applications and development of social network with real time case studies.

SYLLABUS

UNIT-I   **Hours:15**

Introduction to Semantic Web and Social Networks: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis- Brief history of Social network analysis

UNIT-II   **Hours:10**

Modelling, Aggregating and Knowledge Representation: Knowledge Representation on the semantic web- Ontology and their role in the Semantic Web - Ontology languages for the Semantic Web- Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

UNIT-III **Hours:10**

Data Collection: Boundary specification – Data collection process- Information bias and issue of reliability – Archival data – Understanding SNA data – Managing SNA data

UNIT-IV **Hours:15**

Methods in social network analysis: Descriptive methods – Graph – Density- Centrality – cliques – MDS- structural equivalence – Two mode networks – Inferential methods – QAP- ERGM

UNIT-V **Hours:10**

Case studies – Evaluation of web-based social network extraction – semantic – based social network analysis in the sciences – emergent semantics

BOOKS FOR STUDY:

1. Peter Mika, "Social Networks and the Semantic Web", Springer 2007.

2. Yang, Song, Franziska B. Keller, and Lu Zheng. Social network analysis: Methods and examples. Sage Publications, 2016.

BOOKS FOR REFERENCE:

1. Guandong Xu ,Yanchun Zhang and Lin Li, -Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.

2. Dion Goh and Schubert Foo, -Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

WEB RESOURCES:

- https://bookdown.org/chen/snaEd/ch4.html

- https://www.sciencedirect.com/topics/social-sciences/social-network-analysis

- https://www.publichealth.columbia.edu/research/population-health-methods/social-network-analysis

- https://www.ibm.com/docs/en/spss-modeler/18.0.0?topic=analysis-about-social-network

Mapping of Cos with Pos :

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	2
CO2	3	3	1	1	1
CO3	3	2	3	3	2
CO4	2	2	3	2	3
CO5	3	1	2	3	1
Weightage of course contribute to each PO	**13**	**10**	**11**	**11**	**9**

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title **: ELECTIVE-V: NATURAL LANGUAGE PROCESSING**

Course Code **: 25PDSDSEC5B** Hours/Week:4

Semester **: III** Credits:3

COURSE OBJECTIVES:

- To explore the concepts and fundamentals of Natural Language Programming

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand the fundamentals of Natural Language Processing.

CO2: Apply the NLP techniques for word and syntactic analysis.

CO3: Analyze the natural language text.

CO4: Evaluate the tools and methods for understanding semantics of sentences and
    pragmatics.

CO5: Develop an innovative application using NLP components

SYLLABUS

UNIT-I
Hours:15

Introduction to NLP - Knowledge in Speech and Language Processing – Ambiguity - Models
and Algorithms- Language, Thought, and Understanding - The State of the Art - History -
Applications – Basic NLP

UNIT-II **Hours:10**

Word analysis - Regular Expressions - Words & Transducers- Survey of English
Morphology- Finite-State Morphological Parsing - Word and Sentence Tokenization- N-
grams- Counting Words in Corpora- Simple (Unsmoothed) N-grams- Training and Test Sets-
Part-of-Speech Tagging- English Word Classes- Tagsets for English- Part-of-Speech Tagging-
Rule-Based Part-of-Speech Tagging- Evaluation and Error Analysis

UNIT-I II **Hours:10**

Syntactic analysis - Formal Grammars of English- Constituency- Context-Free Grammars-
Grammar Rules for English - Treebanks - Finite-State and Context-Free Grammars -

Dependency Grammars - Parsing with Context-Free Grammars - Parsing as Search- Dynamic Programming Parsing Methods- Statistical Parsing- Probabilistic Context-Free Grammars- Probabilistic CKY Parsing of PCFGs- Learning PCFG Rule Probabilities

UNIT-IV   **Hours:15**

Semantics and pragmatics - Computational Desiderata for Representations- First-Order Logic, Computational Semantics –Syntax Driven Semantic analysis, Semantic attachments Semantic Attachments for a Fragment of English, Lexical Semantics- Word Senses, Relations between Senses, WordNet: A Database of Lexical Relations- Event Participants: Semantic Roles and Selectional Restriction

UNIT-V   **Hours:10**

Applications - Information Extraction, Question Answering and Summarization, Dialogue and Conversational Agents

BOOKS FOR STUDY:

1. Daniel Jurafsky, James H. Martin-Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

2. Patel, Ankur A., and Ajay Uppili Arasanipalai. Applied Natural Language Processing in the Enterprise. " O'Reilly Media, Inc.", 2021.

BOOKS FOR REFERENCE:

1. Breck Baldwin, -Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.

2. Richard M Reese, -Natural Language Processing with Java‖, O_Reilly Media, 2015.

3. Nitin Indurkhya and Fred J. Damerau, -Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

4. Tanveer Siddiqui, U.S. Tiwary, -Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

WEB RESOURCES:

- https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/what-is-natural-language-processing-nlp

- https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1

- https://www.oracle.com/in/artificial-intelligence/what-is-natural-language-processing/

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	3	2
CO2	2	3	3	2	3
CO3	3	2	2	1	1
CO4	1	2	1	2	2
CO5	3	3	2	3	1
Weightage of course contribute to each PO	12	11	10	11	9

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title : **EDC – II : PRINCIPLES OF INFORMATION TECHNOLOGY**

Course Code : **25PDSEDC2** **Hours/Week:3**

Semester : **III** **Credits:2**

COURSE OBJECTIVES:

To learn the basic concept, skills associated with information technology and understand data organization and information systems which support organizational needs.

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand the basics of information technology.

CO2: Gain the knowledge of Hardware and Software technologies.

CO3: Learn the method of organizing data.

CO4: Assess the role of Information Science to an organization.

CO5: Understanding the role of IT in organizations.

SYLLABUS

UNIT-I:
Hours:9

Business Environment: Business and Information technology – business in the information age about information technology–what is an information system– Information Technology in the Modern Organization

UNIT-II: **Hours:9**

Computer Hardware: Significance of Hardware – Central Processing Unit– Computer Memory – Computer Hierarchy – Input Technologies – Output Technologies. Computer Software: Software History and Significance–System Software–Application Software– Software issues–Programming languages–Enterprise Software.

UNIT-III: **Hours:9**

Managing Organizational Data And Information: Basics of Data arrangement and Access Traditional file environment – modern approach: database management systems – logical data models – data warehouses – Networks– Internet- Evolution of the Internet –Operation of

the Internet– WWW-Intranets and Extranets.

UNIT-IV: **Hours:9**

Functional, Enterprises, and Inter Organizational Systems: Information system to support business functions – transaction processing information systems – accounting and finance system – marketing and sales system – production and operations management system – Integrated information system and enterprises resource planning–inter organizational/Global information system. –Electronic Commerce.

UNIT-V: **Hours:9**

Information Systems Development: Information system planning–Traditional systems development life cycle – alternative methods for system development –system development outside the IS department – building Internet and Intranet applications –Implementing: Ethics, Impacts and Security.

BOOKS FOR STUDY:

1. Turban, Rainer, Potter "Introduction to Information Technology," Second edition, Wiley India, 2007.

BOOKS FOR REFERENCE:

1. V. Rajaraman, -Introduction to Information Technology, ‖Prentice Hall of India,2007.

WEB RESOURCES:

- **https://smallbusiness.chron.com/information-technology-its-role-modern-organization-1800.html**
- **https://ecampusontario.pressbooks.pub/infosysbus/chapter/chapter-12-the-ethical-and-legal-implications-of-information-systems/**

Mapping of Cos with Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	1	3	3	2	2
CO2	3	3	2	2	2
CO3	2	3	3	2	1
CO4	3	1	2	3	2
CO5	3	3	3	2	1
Weightage of course contribute to each PO	12	13	13	11	8

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title   : **CLOUD COMPUTING**

Course Code   : **25PDSCC9**   Hours/Week:**6**

Semester   : **IV**   Credits:**5**

COURSE OBJECTIVES:

- To provide an understanding of how cloud computing evolved, its acceptance world-wide and integral part of several organization

COURSE OUTCOME:

On completion of the course the students will be able to

   CO1: Understand the models, principles, and benefits of Cloud Computing

   CO2: Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.

   CO3: Identify the applications of Cloud Computing

   CO4: Analyse the security aspects of Cloud Computing

   CO5: Evaluate the importance of message passing and map reduce in Cloud Computing

SYLLABUS

UNIT I: **Hour:15**

Introduction to Cloud Computing: Introduction – History - Fundamentals of Cloud computing – characteristics - Advantages and Disadvantages- Comparison of traditional and cloud computing paradigms- Evaluating the impact and economics - Business drivers- Future of cloud. Services and Deployment model: Cloud deployment models - Cloud service models – Cloud infrastructure mechanisms - Cloud service management

UNITII: **Hour:15**

Cloud Computing Architecture: Cloud computing architecture - Design principle - Life cycle (CCLC) -Reference architecture - Load balancing approach - Mobile cloud computing (MCC) - Case study of oracle cloud management. Virtualization: Understanding - Adoption – Techniques – Working of Virtualizaton - Kernel-based virtual machine (KVM) – VMware – VirtualBox – Citrix - Types of virtualization - Virtualisation in cloud

UNIT III: **Hour: 20**

Service Oriented Architecture: Objectives - SOA foundation - Web services and SOA - SOA communication - SOA components - SOA Infrastructure - Need of SOA - Business Process Management (BPM) – Services of BPM. Cloud Computing Applications: Introduction - Google App Engine - Google Apps - Google Cloud Data store - Dropbox Cloud - Apple iCloud - Microsoft Windows Azure Cloud - Amazon Web Services (AWS).

UNIT IV: **Hour: 20**

Cloud Security and Privacy: Cloud Security - Cloud CIA security model - Cloud computing security Architecture - Service provider security issues - Security issues in Virtualization - Data security in cloud – Data privacy risks - Business continuity and disaster recovery - Threats in cloud – Security techniques for threats - Cloud service level agreements (SLA): Components – Types - Cloud vendors - Quality of Cloud Services - Techniques – Migration - Trust management

UNIT V: **Hour: 20**

Cloud Computing Technologies: Cloud Computing Technologies - High performance Computing - Message Passing Interface (MPI) - MapReduce programming model -Dryad and Dryad LINQ -Eucalyptus cloud platform: Components – OpenNebula: Layers – Features – OpenStack: components - Benefits – The Apache Hadoop ecosystem. Adoption of Cloud Computing Factors affecting the adoption - Existing areas of application - Case studies - Certifications.

BOOK FOR STUDY:

1. Kant Hiran, Kamal, Ruchi Doshi, Temitayo Fagbola, Mehul Mahrishi, Cloud Computing: Master the Concepts, Architecture and Applications with Real-world examples and Case studies, BPB Publishers, 2019

BOOKS FOR REFERENCE:

1. Ben Piper and David Clinton, AWS Certified Solutions Architect Study Guide: Associate SAA-C01 Exam, Googel Book, 2019
2. Legorie Rajan Ps, Steven Porter, and Ted Hunter, Building Google Cloud Platform

Solutions: Develop Scalable Applications from Scratch and Make Them Globally Available in Almost Any Language, Packt,2019

3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, Tata McGraw Hill Education Private Limited, 2013

WEB RESOURCES:

- **https://acloudguru.com**
- **https://www.cloudcomputing-news.net/**
- **https://cloudtweaks.com/**

Mapping of COs with POs:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	2	3	3
CO3	3	3	2	3	2
CO4	3	3	2	3	3
CO5	3	3	2	3	3
Weightage of course contributed to each PO	15	15	10	15	14

Strong – 3　　　　Medium – 2　　　　Low - 1

Programme Title : **M.Sc. Data Science**

Course Title **: BIG DATA ANALYTICS**

Course Code **: 25PDSCC10** **Hours/Week:3**

Semester **: IV** **Credits:3**

COURSE OBJECTIVES:

* To introduce the concepts of big data analytics and developing a real time applications.

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand the basic concepts of big data analytics and technologies

CO2: Apply the concept of HDFS, Map reduce for storing and processing of Big data

CO3: Analyze and perform different operations on data using Pig, Hive, and Hbase

CO4: Evaluate the tools and methods for analyzing Big data analytics model

CO5: Develop real time big data analytics applications

SYLLABUS

UNIT-I: **Hour: 9**

Introduction to Big Data Analytics: Classification of Digital Data, Structured and Unstructured Data - Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics important - Data Science - Data Scientist - Terminologies used in Big Data Environments.

UNIT-II: **Hour: 9**

Big Data Technology Landscape: NoSQL, Comparison of SQL and NoSQL, Hadoop - RDBMS Versus Hadoop - Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem.

UNIT-III: **Hour: 9**

HADOOP and HDFS: Introduction to Hadoop – RDBMS vs Hadoop- distributed computing

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challenges - A Brief History of Hadoop- The Hadoop Distributed Filesystem- Processing Data with Hadoop - Anatomy of a MapReduce Works - Anatomy of a MapReduce Job Run- Job Scheduling- Shuffle and Sort- Task Execution.

UNIT-IV: **Hour: 9**

HADOOP ECO SYSTEM: Hive: Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins – Aggregations - Group by and Having - RCFile Implementation - Hive User Defined Function - Serialization and Deserialization. Pig: Introduction - Anatomy – Features – Philosophy - Use Case for Pig - Pig Latin Overview - Pig Primitive Data Types - Running Pig - Execution Modes of Pig - HDFS Commands - Relational Operators - Eval Function - Complex Data Types - Piggy Bank - User-Defined Functions - Parameter Substitution - Diagnostic Operator - Word Count Example using Pig - Pig at Yahoo! - Pig Versus Hive Hbase - HBasics, Concepts.

UNIT-V: **Hour: 9**

Case Studies: Hadoop Usage at Last.fm - Hadoop and Hive at Facebook- Nutch Search Engine- Log Processing at Rackspace – Cascading - TeraByte Sort on Apache Hadoop 601 - Using Pig and Wukong to Explore Billion-edge Network Graphs - Recent Trends in Big Data Analytics.

BOOKS FOR STUDY:

1. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, First Edition, 2015, Wiley. Chapter – 1,2,3,4,5,9 & 10

2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media Inc., 2015. Chapter – 1,3,6,11,12,13 & 16.

BOOKS FOR REFERENCE:

1. Lublinsky, Boris, Kevin T. Smith, and Alexey Yakubovich. Professional hadoop solutions. John Wiley & Sons, 2013.

2. Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley

3. Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers

WEB RESOURCES:

- https://www.ibm.com/analytics/big-data-analytics

- https://www.simplilearn.com/what-is-big-data-analytics-article

- https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics

_**Mapping of COs with POs:**

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	3	2	3	3
CO3	3	2	2	3	3
CO4	3	3	2	3	3
CO5	3	2	2	3	3
Weightage of course contributed to each PO	15	13	10	15	15

Strong – 3   Medium – 2   Low - 1

Programme Title : M.Sc. Data Science

Course Title : ELECTIVE – VI : DEEP LEARNING

Course Code : 25PDSDSEC6A   Hours/Week:4

Semester : IV   Credits:3

COURSE OBJECTIVES:
- To provide fundamental knowledge of neural networks and deep learning

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand the major technology trends in neural networks and deep learning.

CO2: Analyse neural networks and fully connected deep neural networks.

CO3: Apply neural networks and fully connected deep neural networks

CO4: Evaluate efficient (vectorized) neural networks and deep learning for real time application

CO5: Build efficient (vectorized) neural networks and deep learning for real time application

SYLLABUS

UNIT-I: Hour: 15

Introduction to Artificial Neural Networks: Neural Networks-Application Scope of Neural Networks- Fundamental Concept of ANN: The Artificial Neural Network-Biological Neural Network-Comparison between Biological Neuron and Artificial Neuron-Evolution of Neural Network. Basic models of ANN-Learning Methods-Activation Functions-Importance Terminologies of ANN.

UNIT-II :   Hour: 10

Supervised Learning Network: Shallow neural networks- Perceptron Networks-Theory-Perceptron Learning RuleArchitecture-Flowchart for training Process-Perceptron Training Algorithm for Single and Multiple Output Classes. Back Propagation Network- Theory-Architecture-Flowchart for training process -Training Algorithm-Learning Factors for Back-Propagation Network. Radial Basis Function Network RBFN: Theory, Architecture, Flowchart and Algorithm.

UNIT-III: **Hour: 10**

Convolutional Neural Network: Introduction - Components of CNN Architecture - Rectified Linear Unit (ReLU) Layer - Exponential Linear Unit (ELU, or SELU) - Unique Properties of CNN -Architectures of CNN -Applications of CNN.

UNIT-IV: **Hour: 15**

Recurrent Neural Network: Introduction- The Architecture of Recurrent Neural Network- The Challenges of Training Recurrent Networks- Echo-State Networks- Long Short-Term Memory (LSTM) - Applications of RNN.

UNIT-V: **Hour: 10**

Auto Encoder and Restricted Boltzmann Machine: Introduction - Features of Auto encoder Types of Autoencoder Restricted Boltzmann Machine- Boltzmann Machine - RBM Architecture -Example - Types of RBM.

BOOKS FOR STUDY:

1. S.N.Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley-India, 3rd Edition, 2018.
2. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka, Deep Learning using Python, Wiley-India, 1st Edition, 2019.

BOOKS FOR REFERENCE:
1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer, September 2018.
2. Francois Chollet, Deep Learning with Python, Manning Publications; 1st edition,2017
3. John D. Kelleher, Deep Learning (MIT Press Essential Knowledge series), The MIT Press, 2019.

WEB RESOURCES:
- https://onlinecourses.nptel.ac.in/noc22_cs22/preview
- https://arxiv.org/abs/1506.06579
- https://arxiv.org/abs/1605.06211
- https://cs230.stanford.edu/lecture/

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	**3**
CO2	3	3	3	2	1
CO3	3	2	2	**3**	**2**
CO4	3	3	3	2	**2**
CO5	3	**2**	3	**3**	**2**
Weightage of course contribute to each PO	**15**	**13**	**14**	**12**	**10**

Strong – 3　　　　**Medium – 2**　　　　**Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title : **ELECTIVE – VI : ARTIFICAL INTELLIGENCE AND DATA SCIECNE**

Course Code : **25PDSDSEC6B** Hours/Week:4

Semester : **IV** Credits:3

COURSE OBJECTIVES:

- To explore the approaches and principles of Artificial Intelligence (AI) algorithms, and apply them to Data Science

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Understand and identify problems that are amenable to solution by AI methods.

CO2: Analyse and apply appropriate AI methods to solve a given problem.

CO3: Analyse and formalize a given problem in the language/framework of different AI and learning methods.

CO4: Evaluate the AI methodologies and DL networks.

CO5: Develop AI framework to tackle projects in our increasingly complex world.

SYLLABUS

UNIT-I: **Hour: 15**

Artificial Intelligence: The AI Problems - The Underlying Assumptions – What is an AI Technique – The Level of the Model – Criteria for Success. Problems, Problem Spaces & Search: Defining the problem as a State Space Search – Production systems – Problem Characteristics - Production Systems Characteristics – Issues in the Design of Search Programs. Heuristic Search Techniques: Generate and Test – Hill Climbing – Best First Search – Problem Reduction - Constraint Satisfaction – Means ends Analysis.

UNIT-II: **Hour: 10**

Knowledge Representation Issues: Representations and Mappings – Approaches to KR – Issues in KR – The Frame Problem. Using Predicate Logic: Representing Simple Facts in Logic - Representing Instances and ISA Relationships – Computable Functions and

Predicates – Resolutions – Natural Deductions. Representing Knowledge using Rules: Procedural versus Declarative Knowledge – Logic Programming – Forward Versus Backward Reasoning – Matching – Control Knowledge. Statistical Reasoning: Probability and Bayes Theorem - Certainty Factors and Rule based Systems – Bayesian Networks – Dempsters Shafer Theory - Fuzzy Logic.

UNIT-III: **Hour: 10**

Learning: What is Learning - Rote Learning – Learning by Taking Advice – Learning by Problem Solving – Learning from Examples: Induction – Explanation based Learning – Discovery – Analogy – Formal Learning Theory – Neural Net Learning and Genetic Learning. Parallel and Distributed AI: Psychological Modelling – Parallelism in Reasoning Systems – Distributed Reasoning Systems.

UNIT-IV: **Hour: 15**

Deep Learning Frameworks and AI Methodologies: Working – Framework – programming Languages – applications – optimization – fuzzy inference systems – artificial creativity – additional AI methodologies – glimpse into the future. Building DL network using MXNet, TensorFlow and Keras: Core components – MXNet, TensorFlow and Keras in action – Summary and Visualization.

UNIT-V: **Hour: 10**

Building and optimizer based on PSO and GA: Algorithm - implementation - variants - PSO and GA in action - Framework and tips. Building an Advanced DL system: CNN – RNN. Alternative AI frameworks in DS: ELMs - CapsNets - Fuzzy logic and Fuzzy inference systems

BOOK FOR STUDY:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill2008. (Unit- 1, 2, 3)

BOOKS FOR REFERENCE:

1. Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited, 2016.

2. Prolog Programming for Artificial Intelligence (International Computer Science Series), Addison-Wesley Educational Publishers Inc; 4th edition, 2011 By Ivan Bratko.

WEB RESOURCES:

- http://www.aispace.org/index.html

- https://www.britannica.com/technology/artificial-intelligence

- https://www.sas.com/en_in/insights/analytics/what-is-artificial-intelligence.html

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	**2**	3	3	2	**2**
CO2	3	**2**	**2**	2	1
CO3	**2**	3	**2**	2	**2**
CO4	3	**2**	**2**	2	**2**
CO5	**2**	3	3	2	1
Weightage of course contribute to eachPO	**12**	**13**	**12**	**10**	**8**

Strong – 3   **Medium – 2**   **Low - 1**

Programme Title : **M.Sc. Data Science**

Course Title **: BIG DATA ANALYTICS - PRACTICAL**

Course Code **: 25PDSCCQ3** **Hours/Week:3**

Semester **: IV** **Credits:2**

COURSE OBJECTIVES:
- To introduce the concepts of big data analytics and developing a real time application.

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Configure Hadoop and perform File Management

CO2: Apply Map Reduce program to real time issues.

CO3: Critically analyze huge data set using Hadoop distributed file systems and MapReduce

CO4: Experimenting different data processing tools like Pig, Hive.

CO5: Develop real time big data analytics applications

SYLLABUS

UNIT-I :
1. Install Apache Hadoop

2. Perform setting up and Installing Hadoop in its three operating modes:

- Standalone

- Pseudo Distributed

- Fully Distributed

3. To use Web Based Tools to Manage Hadoop Set-up

UNIT-II:
4. Implement the following file management tasks in Hadoop:

- Adding files and directories

- Retrieving files

- Deleting Files

5. Develop a MapReduce program to calculate the frequency of a given word in a given file.

6. Develop a MapReduce program to find the maximum temperature in each year.

7. Develop a MapReduce program to find the grades of students.

8. Develop a MapReduce program to implement Matrix Multiplication.

9. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.

UNIT-III :

10. Develop a MapReduce to analyze weather data set and print whether the day is shinny or cool day. (National Climatic Data Centre (NCDC) Data set)

11. Develop a MapReduce program to find the number of products sold in each country by considering sales data containing fields like Tranction _Date Product Price Payment_Type Name City\State Country Account_Created Last_Login Latitude Longitude

12. Data sets from different sources as Input

13. Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data. (https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset) Sorting the data using MapReduce

14. Count the number of missing and invalid values through joining two large given datasets.

UNIT-IV :

15. Install and Run Pig then write Pig Latin scripts to sort, group, join, project and filter the data.

16. Install and Run Hive then use Hive to Create, alter and drop databases, tables, views, functions and Indexes.

17. Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin

18. Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin

19. Write queries to sort and aggregate the data in a table using HiveQL

20. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.

21. Write a program to implement combining and partitioning in hadoop to implement a custom partitioner and Combiner.

UNIT-V:

22. Analyze the sentiment for product reviews, this work proposes a MapReduce technique provided by Apache Hadoop

23. Trend Analysis based on Access Pattern over Web Logs using Hadoop.

24. Implementation of decision tree algorithms using MapReduce.

25. Implementation of K-means Clustering using MapReduce.

26. Generation of Frequent Itemset using MapReduce.

BOOKS FOR STUDY:

1. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, First Edition, 2015, Wiley.

2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media Inc., 2015.

BOOKS FOR REFERENCE:

1. Lublinsky, Boris, Kevin T. Smith, and Alexey Yakubovich. Professional hadoop solutions. John Wiley & Sons, 2013.

2. Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley

3. Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers

WEB RESOURCES:

- https://www.ibm.com/analytics/big-data-analytics
- https://www.simplilearn.com/what-is-big-data-analytics-article
- https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics

Mapping of COs with POs:

CO/ PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	2	3	3	2	1
CO3	2	2	2	2	2
CO4	3	2	3	2	2
CO5	3	3	2	2	2
Weightage of course contributed to each PO	13	13	12	10	9

Strong – 3   Medium – 2   Low - 1

Programme Title : **M.Sc. Data Science**

Course Title **: PROJECT WITH VIVA VOCE**

Course Code **: 25PDSPC** Hours/Week: 10 (P)

Semester **: IV** **Credits:7**

Programme Title : **M.Sc. Data Science**

Course Title **:** **PROFESSIONAL COMPETENCY SKILL: DATA VISUALIZAION-PRACTICAL**

Course Code **:** **25PDSPCSQ** **Hours/Week:4**

Semester **:** **IV** **Credits:2**

COURSE OBJECTIVES:

- To learn the basic functions and operations of Excel and tableau
- To explore to design, build, and deploy various charts for applications
- To comprehend, design and deploy the label and heat map
- To understand and deploy dashboard
- To understand the functions of tableau for data process

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Enable to create and apply Spread sheet and Tableau for various data processing.

CO2: Gains knowledge to create and design various visualization tools in Excel and Tableau.

CO3: Comprehend, create and deploy labels and heat map.

CO4: Enable to create and apply dashboard for various data processing.

CO5: Illustrate and apply data visualization tool for any data set

SYLLABUS

Note: Use the following Dataset

http://www.tableau.com/sites/default/files/training/global_superstore.zip

Implement the following using Excel

1. Create Pie chart for Sales and Sales % by Country (sorted in descending order)

2. Create Bar chart for Sales by Country by Year (rounded to nearest thousand and sorted by Grand Total)

3. Create Line chart for Sales by Ship Mode (First Class, Same Day, Second Class and Standard Class)

4. Create Scatter chart for Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class)

5. Create heat map for Sales by Category by Sub-Category (in thousands and sorted by sales value in descending order)

6. Design and create the label for vendor list

Implement the following using Tableau

7. Design and create the dash board.

8. Sales by Ship Mode (First Class, Same Day, Second Class and Standard Class)

9. Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class)

10. Sales by Category by Sub-Category (in thousands and sorted by sales value in descending order)

BOOKS FOR STUDY

1. J. Simon, *Excel Data Analysis: Your visual blueprint for analyzing data, charts, and PivotTables*, Indianapolis, IN, USA: Wiley, 2004.

2. C. Sinha, *Tableau for Beginners: Get CA Certified, Grow Your Career*, Independently Published, 2018.

3. D. Kusleika, *Data Visualization with Excel Dashboards and Reports*, 2nd ed., Indianapolis, IN, USA: Wiley, 2021.

BOOKS FOR REFERENCE

1. C. N. Knaflic, *Storytelling with Data: A Data Visualization Guide for Business Professionals*, Hoboken, NJ, USA: Wiley, 2015.

2. S. Wexler, J. Shaffer, and A. Cotgreave, *The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios*, Hoboken, NJ, USA: Wiley, 2017.

3. J. N. Milligan, *Learning Tableau 2022: Master Tableau to deliver insightful business results through data storytelling and visual analytics*, Birmingham, UK: Packt Publishing, 2022.

WEB RESOURCES

1. Tableau Software, "Tableau Training Videos," https://www.tableau.com/learn/training.

2. Excel Easy, "Learn Excel," https://www.excel-easy.com.

3. Dalgleish, "Contextures Excel Tips," https://www.contextures.com.

Mapping of COs with POs:

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	3	3
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	3	3
Weightage of course contributed to each PO	15	15	15	12	14