Academic Council: 13/04/2022
Item No:_____

Parle Tilak Vidyalaya Association's

MULUND COLLEGE OF COMMERCE (AUTONOMOUS)

|| आ नो भद्राः क्रतवो यन्तु विश्वतः ||

Syllabus for F.Y. B.Sc. Data Science

Programme: B.Sc. D.S. Code: BDS

BASED ON LEARNING OUTCOME CURRICULUM FRAMEWORK (LOCF)

Semester I & II

with effect from the academic year

2022 – 2023

AC_____
Item No:_____

Parle Tilak Vidyalaya Association's
MULUND COLLEGE OF COMMERCE (AUTONOMOUS)

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Syllabus for Approval

Sr. No.	Heading	Particulars
1.	Title of the Course	**B.Sc. (Data Science)**
2.	Eligibility for Admission	HSC or equivalent from any stream / 3 years Diploma from MSBTE or equivalent
3.	Passing Marks	40%
4.	Ordinances / Regulations (if, any)	As applicable for all B.Sc. Courses
5.	Number of years / Semesters	Three years – Six Semesters
6.	Level	~~P.G.~~ / U.G. /~~Diploma / Certificate~~ (Strike out which is not applicable)
7.	Pattern	~~Yearly /~~ Semester, Choice Based (Strike out which is not applicable)
8.	Status	New / ~~Revised~~
9.	To be implemented from Academic year	From the Academic Year **2022 – 2023**

Date: February , 2022
Name of the BoS Chairperson

Signature:_____
Dr. Hiren Dand
hiren.dand@mccmulund.ac.in

Three Year Bachelor of Science Degree in Data Science

Preamble

Data Science refers to extraction of knowledge from large volumes of data that are structured or unstructured, which is continuation of data mining and predictive analytics. It involves different categories of analytical approaches for modelling various types of business scenarios and arriving at solution and strategies for optimal decision-making in marketing, finance, operations, organizational behaviour and other managerial aspects. This new field of study breaks down into a number of different areas, from constructing big data infrastructure and configuring the various server tools that sit on top of the hardware, to performing the analysis and developing the right transformations to generate useful results.

Data Science is an interdisciplinary field that combines the magic of programming, mathematics and business. Combined with Machine Learning, it helps to identify a future trend which can be used to derive actionable insights for creating future impact. These skills will help for the role of a Data Scientist. As a Data Science aspirant, learner will be emphasising of the knowledge to share from the quantitative analysis to programming concept and extended to business intelligence. Data science can add value to any business which can use the data well.

Data Science consists of 3 parts namely:

Machine Learning: Machine Learning involves algorithms and mathematical models, chiefly employed to make machines learn and prepare them to adapt to everyday advancements.

Big Data: Everyday, we are producing so much of data in the form of clicks, orders, videos, images, comments, articles, RSS Feeds etc. These data is generally unstructured and is often called as Big Data. Big Data tools and techniques mainly help in converting this unstructured data into a structured form.

Business Intelligence: Each business has and produces too much data every day. This data when analysed carefully and then presented in visual reports involving graphs, can bring good decision making to life. This can help the management in taking the best decision after carefully delving into patterns and details the reports bring to life.

What Does a Data Scientist Do?

- Empower the management and controlling officers to make better decisions
- Direct actions based on trends, which in turn help to define new goals
- Identify opportunities
- Making decisions with quantifiable, data-driven evidence
- Test the decisions taken
- Identify and refine the target audiences
- Recruit the right talent for the organisation

Programme Specific Outcomes

- Build a strong foundation of statistics for data science.
- Use all the features and new updates of Python and R for data science.
- Perform scientific and technical computing using the Python SciPy package and its sub-packages Integrate, Optimize, Statistics, IO, and Weave.
- Gain expertise in mathematical computing using the NumPy and Scikit-Learn package
- Gain an in-depth understanding of data structure and data manipulation
- Understand and use linear and non-linear regression models and classification techniques for data analysis
- Obtain a comprehensive knowledge of supervised and unsupervised learning models such as linear regression, logistic regression, clustering, dimensionality reduction, K-NN and pipeline
- Master the concepts recommendation engine, time series modelling, gain practical mastery over principles, algorithms, and applications of Machine Learning
- Learn to analyse data using Tableau and Power BI and become proficient in building interactive dashboards
- Understand deep reinforcement learning techniques applied in Natural Language Processing
- Understand the different components of the Hadoop ecosystem and learn to work with HBase, its architecture and data storage, learning the difference between HBase and RDBMS, and use Hive and Impala for partitioning
- Understand MapReduce and its characteristics and learn how to ingest data using Sqoop and Flume

Courses

SEMESTER 1				
Course Code	**Course Type**	**Course Name**	**Credits**	**Marks**
USDS101	**CC**	Descriptive Statistics	**2**	**100**
USDS1P1	**CC Practical**	Descriptive Statistics Practical	**2**	**50**
USDS102	**CC**	Introduction to Programming	**2**	**100**
USDS1P2	**CC Practical**	Introduction to Programming Practical	**2**	**50**
USDS103	**SEC**	Web Technology	**2**	**100**
USDS1P3	**SEC Practical**	Web Technology Practical	**2**	**50**
USDS104	**AEC**	Business Communication and Information Ethics	**2**	**100**
USDS1P4	**AEC Practical**	ICT Practical	**2**	**50**
USDS105	**CC**	Precalculus	**2**	**100**
USDS1P5	**CC Tutorials**	Precalculus Tutorials	**2**	**50**
		Total	**20**	**750**
		Additional Credits Course	**2**	
		Total Credits	**22**	

SEMESTER 2				
Course Code	**Course Type**	**Course Name**	**Credits**	**Marks**
USDS201	**CC**	Probability and Distributions	**2**	**100**
USDS2P1	**CC Practical**	Probability and Distributions Practical	**2**	**50**
USDS202	**CC**	Database Management	**2**	**100**
USDS2P2	**CC Practical**	Database Management Practical	**2**	**50**
USDS203	**CC**	R Programming	**2**	**100**
USDS2P3	**CC Practical**	R Programming Practical	**2**	**50**
USDS204	**AEC**	Environmental Science	**2**	**100**
USDS2P4	**AEC Project**	Project Presentation on Data Science in Environmental Science.	**2**	**50**
USDS205	**CC**	Calculus	**2**	**100**
USDS2P5	**CC Practical**	Calculus Tutorials	**2**	**50**
		Total	**20**	**750**
		Additional Credits Course	**2**	
		Total Credits	**22**	

Table of Contents

Semester I

USDS101: Descriptive Statistics

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B. Sc. (Data Science)		Semester – I	
Course Name: Descriptive Statistics		**Course Code: USDS101**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- To understand the use of data for tabulating and analyze statistical information given in descriptive form with attributes.
- To use graphical techniques as well as to compute various measures of central tendency.
- To compute various measures of dispersion, skewness and kurtosis and to calculate range of variables and the deviation of specific data point.
- To compute the correlation coefficient for bivariate data and Calculate the simple linear regression equation for a set of data.
- To Describe and verify mathematical considerations for analyzing time series.

Unit	Details	Lectures
I	**1. Introduction to Statistics and Use in Business:** a) Meaning of Statistics as a Science, Importance of Statistics, b) Scope of Statistics : In the field of Industry, Biological Sciences, Medical Sciences, Economics Sciences, Social, Sciences, Management Sciences, Agriculture, Insurance, Information Technology, Education and Psychology. c) Statistical organizations in India and their functions: CSO, ISI, NSS, IIPS (Devnar, Mumbai), Bureau of Economics and statistics. d) Case Study **2. Types of Data and Data Condensation:** a) Method of sampling: Concept of population and sample. Finite ,Infinite population ,Notion of SRS,SRSWOR and SRSWR b) Types of Characteristics, Different types of scales: nominal, ordinal, interval and ratio scale. Linear and circular scale. c) Types of Data: Primary data, Secondary data, Collection of data and concept of a questionnaire and a schedule, Cross-sectional data, time series data, failure data, industrial data, and directional data. d) Tabulation. e) Dichotomous classification- for two and three attributes, Verification for consistency. f) Association of attributes: Yule's coefficient of association Q. Yule's coefficient of Colligation, g) Notion of a statistical population: Finite population infinite population, homogeneous population and heterogeneous population. Notion of sample, random sample and non-random sample.	**12**

	3. Presentation of Data a) Univariate frequency distribution of discrete and continuous variables. Cumulative frequency distribution and relative frequency distribution. b) Graphical representation of frequency distribution by Histogram, frequency polygon, Cumulative frequency curve. Stem and leaf diagram c) Check sheet, Parato diagram	
II	**4. Measures of central tendencies** a) Concept of central tendency of data. Requirements of good measure b) Locational averages: Median, Mode, and Partition Values: Quartiles, Deciles, and Percentiles, Box Plot, Percentile ranks c) Mathematical averages Arithmetic mean (Simple, weighted mean, combined mean), Geometric mean, Harmonic mean d) Empirical relation between mean, median and mode e) Merits and demerits of using different measures &their applicability f) Partition Values : Quartiles, Deciles and Percentiles, Box Plot, Percentile ranks **5. Measures of Dispersion, Skewness & Kurtosis** a) Concept of dispersion. Requirements of good measure. b) Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation. c) Variance and Combined variance, raw moments and central moments and relations between them. Their properties d) Concept of Skewness and Kurtosis: Measures of Skewness: Karl Pearson's, Bowley's and Coefficient of skewness based on moments. Measure of Kurtosis	**12**
III	**6. Mean square deviation**: a) Definition, minimality property of mean square deviation (with proof), b) Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, combined variance (derivation for 2 groups), combined standard deviation, generalization for *n* groups. c) Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (C.V.)	**12**
IV	**7. Correlation and regression analysis** a) Scatter Diagram, Product moment correlation coefficient and its properties. Spearman's Rank correlation. (With and without ties) b) Concept of linear regression. Principle of least squares. Fitting a straight line by method of least squares. c) Relation between regression coefficients and correlation coefficient. d) Fitting of curves reducible to linear form by transformation. Concept and use of coefficient of determination (R^2).	**12**

	e) Fitting a quadratic curve by method of least squares. f) Case study	
V	**Time Series** a) Definition of time series .Its component. Models of time series. b) Estimation of trend by: **i)** method of Freehand curve **ii)** method of semi average **iii)** Method of Moving average iv) Method of least squares (linear trend only) c) Estimation of seasonal component by **i)** method of simple average **ii)** Ratio to moving average **iii)** Ratio to trend method d) Case Study	**12**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Statistical Methods, An Introductory Text,	Medhi J.	New Age International Ltd.	Second Edition	
2.	Basic Statistics	Agarwal B.L.	New Age International Ltd.		
3.	Theory and Problems of Statistics,	Spiegel M.R.	Tata McGraw-Hill.		
4.	Fundamentals of Statistics, Volume II	Goon A.M., Gupta M.K., Dasgupta B.	The World Press Private Limited, Calcutta.		
5.	Complete Business statistics	Aczel Sounderpandian	Tata McGraw Hill		
6.	Excel Data Analysis Modeling and simulation	Hector Gurrero	Springer	Second Edition	
7.	Data Analysis and Decision Making	Albright,Wilston,Zappe	Thomson		

Course Outcomes:

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

- To understand the use and importance of statistical data by tabulating and implementing sampling methods.
- Able to identify association between the variables as well as computing consistent and inconsistent data.
- Able to compute level of measures and apply as well as interpret data into graphs.
- Apply measure of central tendency to minimize the sum of squared deviation.
- Able to understand the basic assumption behind regression analysis and determine the model is significance as well as able to apply various techniques for the modelling.

USDS1P1: Descriptive Statistics Practical

B. Sc (Data Science)		**Semester – I**	
Course Name: Descriptive Statistics Practical		**Course Code: USDS1P1**	
Periods per week (1 Period of 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Course Objectives:

- To enhance excel based data modeling skills.
- To understand Data Conversion, data categorization, selection of appropriate data category and Collection and to utilize excel based data modeling skills.
- To compute Logical and Mathematical Averages, measures of dispersion, compute skewness, moments and kutosis and to use graph from graphical tool.
- To represent data on the graph, Cumulative frequency, subgroup of data with Histogram and subgroup of data with Histogram as well as with bar chart.
- To analyze data about the frequency of problems /Cause of problem and to use financial function.
- To compute variance, coefficient of variation, standard deviation two subgroups, correlation and co-variance.
- To implement statistical function on series of data and forecasting techniques.

List of Practical: (Can be done in MS-Excel-or any Spreadsheet)	
1.	**Introduction to Excel**
a.	Understanding Data Tools
b.	Understanding Formula Tools, insert functional library using insert function
c.	Add-Ins Analysis Tool packs
2.	**Using Formulae and Charts**
a.	Formula writing, Functions, using Cell reference
b.	Understanding Insert Tool: Chart Tools, Different types of charts and their use
3.	**Data Entry and manipulation**
a.	Tools for data entry and accuracy: Quick Access Toolbar customization, Form tool.
b.	Data Transposition to Fit Excel (as An Array).
c.	Data Conversion with the Logical IF, VLOOKUP, HLOOKUP. Pivot table, Pivot chart.
d.	Data Conversion of Text from Non–Excel Sources, Using Text To Column(From Data tool)
e.	Data Queries with Sort, Filter, and Advanced Filter Exact function data entry comparison
4.	**Data Validation**
a.	Specifying a valid range of values for a cell
b.	Specifying a list of valid values for a cell
c.	Specifying custom validations based on formula for a cell

5.	**Measures of central tendency**
a.	Calculating Mean, Median, Mode, Minimum, Maximum, range with cell reference
b.	Using Summary statistics
c.	Calculate A.M., G.M., H.M.
d.	State the Findings of all above exercise.
6.	**Measures of Dispersion, Skewness & Kurtosis**
a.	Calculate Range, Quartile Deviation, Mean absolute deviation, Standard deviation with cell reference
b.	Using summary statistics Measures of Skewness Coefficient of skewness based on moments. Measure of Kurtosis.
c.	Graphical representation of Skewness.
d.	State the Finding of exercise.
7.	**Graphical Presentation with Excel -1**
a.	Producing a Histogram
b.	Improving the Graph
c.	Producing a Cumulative Frequency Diagram
d.	Producing a Histogram of subgroups of data
8.	**Graphical Presentation with Excel – 2**
a.	Producing a bar chart of subgroups of data
b.	Perato chart
c.	Combined variance (derivation for 2 groups), Combined standard deviation.
d.	Coefficient of variation (C.V.).
9.	**Correlation**
a.	Use of formula for calculating correlation and Co-variance.
b.	Use of error checking (Using Exact( ), IF)
c.	Use of frequently used financial functions (e.g. NPV) with suitable example of correlation.
d.	State the Findings of all above exercise.
10.	**Regression analysis**
a**.**	Using Summary statistics/Cross sectional Data: Descriptive Statistic
b.	Linear Regression and visual analysis(Chart)
c.	Multiple Regression equation with coefficient standard error and visual chart
d.	State the Findings of all above exercise.

Course Outcomes:

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

- Use Microsoft Excel for business and data analytics, applying insert function library, make use of "Add-Ins Tool pack" for different statistical and mathematical function, learn to use formula and function with cell reference and able to use different types of chart suitable to the data.
- Do Data Entry and manipulation using data context, to transpose the tabular data, convert data in to tabular format and able to use the excel tools for data categorization.
- Discover Measures of central tendency by using analysis tools and formula and able state the conclusion.

- Find Measures of Dispersion, Skewness & Kurtosis by using formula, calculate statistics measures using add-ins analytical tools, Able to use graph/chart from chart tool and deriving the conclusion of the experiment.
- Display Graphical Presentation with Excel by using graph/Chart, templates to improve presentation of data, represent cumulative frequency, data analysis, understand “cause analysis”, make use of formula and analytical tools to compute combined variance and Standard Deviation and compute coefficient of variation.
- Find Correlation by applying statistical formula and analytical tool, identifying wrong data entries, make use of financial function using insert and deriving conclusion of the experiment.
- Do Regression analysis by predicting using data analysis tools, make use of forecasting techniques, Able to use multiple regression using time series data and deriving conclusion of the experiment.

USDS102: Introduction to Programming

B. Sc (Data Science)		Semester – I	
Course Name: Introduction to Programming		**Course Code: USDS102**	
Periods per week (1 Period is 50 minutes)		**5**	
Credit		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- Learn Programming fundamentals using Python
- Understand the concepts and usage data types, variables and other basic elements
- Learn about using operators and control statements in Python
- Learn about using arrays and strings in Python.
- Learn about using IPython architecture for Python.
- Introduce data Science Tools and plot data using appropriate Python visualization libraries

Unit	Details	Lectures
I	**Introduction to Python Language**: Overview, Features of Python, Execution of a Python Program, Innards of Python, Frozen Binaries, Python Interpreter, Comparison of Python with C and Java, Installing Python, Writing & Executing, IDLE **Data Types, Variables And Other Basic Elements**: Comments, Docstrings, Data types-Numeric, Compound, Boolean, Dictionary, Sets, Mapping, Basic Elements of Python, Variables **Input and Output Operations**: Input Function, Output Statements, Command Line Arguments **Control Statements:** Control Statements- Loop Statement, The else Suite, break Statement, continue Statement, pass Statement, assert Statement, return Statement	**12**
II	**Functions**: Defining & Calling a Function, Returning Results, Returning Multiple Values, Built-in Functions, Parameters and Arguments, Recursive Functions, Anonymous or Lambda Functions **Operators**: Arithmetic operators, Assignment operators, Unary minus operator, Relational operators, Logical operators, Bitwise operators, Membership operators, Identity operators, Precedence of Operators, Associativity of Operators **Arrays**: Creating Arrays, Indexing and Slicing, Basic Array Operations, Arrays Processing, Mathematical Operations on Array, Aliasing Arrays, Slicing and Indexing in NumPy Arrays, Basic Slicing. Advanced Indexing. Dimensions of Arrays, Attributes of an Array	**12**

	Strings: Creating Strings, Functions of Strings, Working with Strings, Length of a String, Indexing & Slicing, Repeating & Concatenation of Strings, Checking Membership, Comparing Strings, Removing Spaces, Finding Substrings, Counting Substrings, Strings are Immutable, Splitting and Joining Strings, Changing Case, Checking Starting and Ending of a String, Sorting & Searching in the Strings, Formatting the Strings, Working with Characters	
III	**Lists and Tuples**: Lists, List Functions and Methods, List Operations, Tuples **Dictionaries**: Creating a Dictionary, Operators in Dictionary, Dictionary Methods, Using for Loop with Dictionaries, Operations on Dictionaries, Ordered Dictionaries **Regular Expressions**: What is a Regular Expression? Sequence Characters in Regular Expressions, Quantifiers in Regular Expressions, Special Characters in Regular Expressions, Using Regular Expression on Files, Retrieving Information from an HTML File **Date and Time in Python:** Date and Time, Date and Time Now, Combining Date and Time, Formatting Dates and Times, Finding Durations using "timedelta", Comparing Two Dates, Sorting Dates, Stopping Execution Temporarily, Knowing the Time taken by a Program, Working with Calendar Module	**12**
IV	**IPython:** Beyond Normal Python, Help and Documentation in IPython, Keyboard Shortcuts in the IPython Shell, IPython Magic Commands, Input and Output History, IPython and Shell Commands, Errors and Debugging, Profiling and Timing Code **Introduction to NumPy**: Understanding Data Types in Python, The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything In Between, Computation on Arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data: NumPy's Structured Arrays	**12**
V	**Data Manipulation with Pandas**: Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series. High-Performance Pandas: eval( ) and query( ) **Visualization with Matplotlib**: Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Ticks, Customizing Matplotlib: Configurations and Stylesheets, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap, Visualization with Seaborn	**12**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Programming through Python	M. T. Savaliya, R.K Maurya, G.M Magar	Staredu Solutions	1st	2018
2.	Python Data Science Handbook	Jake VanderPlas	O'Reilly Media	1st	2016
3.	Let Us Python	Y. Kanetkar,	BPB	1st	2019
4.	Programming in Python 3	Mark Summerfield	Pearson Education	2nd	2018
5.	Learning Python	Lutz M	O'Reilly-Shroff	5th	2013
6.	Beginning Python	Magnus Lie Hetland	Apress	2nd	2009
7.	Star Python	Star Certification	Star Certification	1st	2018

Course Outcome:

Upon the successful completion of this course, the student will be able to achive:

- Proficiency in using and applying various data types including, string, array list, tuple and dictionary.
- Ability to use regular expressions to perform complex operations in less code.
- Learning to make use of date and time in Python for various applications.
- Proficiency in using IPython architecture for Data Science Applications.
- Knowledge about use of various data science tools

USDS1P2: Introduction to Programming Practical

B. Sc (Data Science)		Semester – I	
Course Name: Introduction to Programming Practical		**Course Code: USDS1P2**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Course Objectives:

- To explore Python Programming elements for developing interactive programs.
- To gain insight about the concept of functions and to explore the data storage of similar types with their features.
- To learn about special operators, Arrays and lists and operation on them in Python.
- To explore Dictionaries, Sets, Text processing and operation on them.
- To learn about date and time module in Python
- To explore popular data science tool, packages for data visualization.

List of Practical:	
1.	**Introduction to Python Language**
a.	Write a Python program to explore various data types including numeric types, Boolean types and compound types.
b.	Write a Python program to perform Input and Output Operations.
c.	Write a Python program to demonstrate looping in python and use of break statement and continue statement
2.	**Functions**
a.	Write a Python program to define and use functions
b.	Write a Python program to demonstrate the use of Built-in Functions.
c.	Write a Python Program to implement Lambda Functions.
3.	**Arrays and String**
a.	Write a Python Program to implement arrays for storing homogeneous data items. Apply indexing and slicing operations to access elements of array.
b.	Write a Python Program to demonstrate operations and properties of string data types.
c.	Write a Python Program implement and demonstrate the use of Membership operators and Identity operators
d.	Write a Python Program to implement Numpy for handling multidimensional arrays.
4.	**List and Tuples**
a.	Write a Python Program to create list, apply various functions to it.
b.	Write a Python Program to demonstrate concept of aliasing and cloning.
c.	Write a Python Program to implement tuples for storing data. Verify the immutability property on tuples.

5.	**Dictionaries and Sets**
a.	Write a Python Program to implement Dictionary and operations on dictionaries
b.	Write a Python Program to create sets and various operations on it.
6.	**Regular Expressions**
a.	Write a Python Program for implementing various methods for searching and replacing operations.
b.	Write a Python Program for Retrieving Information from an HTML File
7.	**Date and Time**
a.	Write a Python Program to compare dates and implement calendar module
8.	**Using IPython**
a.	Using IPython and Jupyter notebook
b.	Debugging errors in IPython.
9.	**Using the NumPy Package**
a.	Programs using NumPy Package and different functions available in it.
10.	**Using the pandas package**
a.	Programs using Pandas Package and different functions available in it.

Course Outcomes:

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

- Knowledge about input and output functions in python and have ability to use loops and control their execution.
- Ability to develop modular Programs using functions and data types like string, array and list of Python.
- Ability to develop modular Programs using Date and Time of Python.
- Interact with IPython and Jupyter notebook.
- Make use of NumPy Package and different functions available in it.
- Able to write code using Pandas Package and different functions available in it.

USDS103: Web Technology

B. Sc (Data Science)		Semester – I	
Course Name: Web Technology		**Course Code: USDS103**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- Introducing the basic concepts of Internet and web design to learners.
- Providing brief knowledge about HTML5 concepts.
- Giving insight of the Page layout and navigation with HTML5.
- Making students aware about use of Tables, Forms and Media with HTML5.
- Providing knowledge of web page design using CSS.
- Teaching data validation using Java Script.
- Giving knowledge about transmission of data on web page using JSON object.

Unit	Details	Lectures
I	**Internet and the World Wide Web:** What is Internet? Introduction to internet and its applications, E-mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address, **World Wide Web (WWW):** World Wide Web and its evolution, uniform resource locator (URL), browsers – internet explorer, Netscape navigator, opera, Firefox, chrome, Mozilla. search engine, web saver – apache, IIS, proxy server, HTTP protocol **What Is Web Design?:** Defining Web Design, Web Design Themes, Learning Web Design. **User-Centered Design:** Usability, Who Are Web Users? Common User Characteristics, Memory, Response and Reaction Times, Dealing with Stimulus, Movement Capabilities, The User's World, General Types of Users, Web Conventions, Accessibility, Building a Usable Site **HTML5:** Introduction, Why HTML5? Formatting text by using tags, using lists and backgrounds, Creating hyperlinks and anchors.	**12**
II	**HTML5 Page layout and navigation:** Creating navigational aids: planning site organization, creating text based navigation bar, creating graphics based navigation bar, creating graphical navigation bar, creating image map, redirecting to another URL, creating division based layouts: HTML5 semantic tags, creating divisions, creating HTML5 semantic layout, positioning and formatting divisions. **HTML5 Tables, Forms and Media:** Creating tables: creating simple table, specifying the size of the table, specifying the width of the column, merging table cells, using tables for page layout, formatting tables: applying table borders, applying background and foreground fills, changing cell padding, spacing and alignment, creating user forms:	**12**

	creating basic form, using check boxes and option buttons, creating lists, additional input types in HTML5, Incorporating sound and video: audio and video in HTML5, HTML multimedia basics, embedding video clips, incorporating audio on web page.	
III	**Introduction to Style Sheets** : Understanding Styles, Constructing Style Rules, Creating Styles for Nested Tags, Creating Classes and IDs for Applying Styles, Applying Styles to Hyperlinks, Creating and Linking to External Style Sheets **Formatting Text by Using Style Sheets:** Specifying a Font Family, Specifying a Font Size and Color, Applying Bold and Italics, Applying Strikethrough and Underlining, Creating Inline Spans , Adjusting Spacing Between Letters **Formatting Paragraphs by Using Style Sheets:** Indenting Paragraphs, Applying a Border to a Paragraph, Specifying a Border Style, Setting Border Padding, Specifying Border Width and Color, Formatting Border Sides Individually, Setting All Border Attributes at Once, Specifying the Horizontal Alignment of a Paragraph, Specifying Vertical Space within a Paragraph **Displaying Graphics:** Selecting a Graphics Format, Preparing Graphics for Web Use, Inserting Graphics, Arranging Elements on the Page, Controlling Image Size and Padding, Hyperlinking from Graphics, Using Thumbnail Graphics, Including Alternate Text for Graphics, Adding Figure Captions	**12**
IV	**Java Script:** Introduction, Client-Side JavaScript, Server-Side JavaScript, JavaScript Objects, JavaScript Security Core JavaScript (Properties and Methods of Each) : Array, Boolean, Date, Function, Math, Number, Object, String, regExp **Document and its associated objects:** document, document object methods, Link, Area, Anchor, Image, Layer **Events and Event Handlers** : General Information about Events, Defining Event Handlers, event, onAbort, onBlur, onChange, onClick, onDblClick, onDragDrop, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove, onReset, onResize, onSelect, onSubmit, onUnload	**12**
V	**JSON**: Introduction, JSON Grammar, JSON Values, JSON Tokens, Syntax, JSON vs XML, Data Types, Objects, Arrays, Creating JSON, JSON Object, Parsing JSON, Persisting JSON, Data Interchange, JSON HTML, JSONP	**12**

Books and References:

Sr. No.	**Title**	**Author/s**	**Publisher**	**Edi^{n}**	**Year**
1.	HTML5 Step by Step	Faithe Wempen	Microsoft Press		2011
2.	Web Design The Complete Reference	Thomas Powell	TMH		2009
3.	Head First HTML 5 programming	Eric Freeman	O'Reilly		2013

4.	JavaScript 2.0: The Complete Reference	Thomas Powell and Fritz Schneider	TMH	2nd	2004
5.	Beginning JSON	Ben Smith	Apress	1st	2015

Course Outcomes:

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

- Understand the meaning of the basic terminologies of web technology and explore, use the HTML5 concepts. Understand the basic requirement of web design.
- Understand and use the Page layout, Navigation, Tables, Forms and Media features of HTML5.
- Understand and use Cascading Style sheet for beatifying the web pages.
- Understand and use the Java Script for validation of user forms in web pages.
- Understand and use the technique of transmitting data between a server and web application using JSON.

USDS1P3: Web Technology Practical

B. Sc (Data Science)		Semester – I	
Course Name: Web Technology Practical		**Course Code: USDS1P3**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Course Objectives:

Provide the hands on the HTML5, CSS, JavaScript and JSON technologies for designing the attractive webpages with dealing user data validation and transferring the values among the web pages and servers.

- Introducing basics of HTML5 to learners.
- Giving insight of the Page layout and navigation with HTML5.
- Making students aware about use of Tables, Forms and Media with HTML5.
- Providing knowledge of web page design using CSS.
- Teaching data validation using Java Script.
- Giving knowledge about transmission of data on web page using JSON object.

List of Practical:	
1.	**Use of Basic Tags:**
a.	Design a web page using different text formatting tags.
b.	Demonstrate use of Font tag with its attributes and HTML various color options in web page.
c.	Design a web page with links to different pages and allow navigation between web pages.
2.	**Navigation, list and paragraph:**
a.	Design a web page to demonstrate text-based navigation bar.
b.	Demonstrate use of lists and backgrounds in web page.
c.	Demonstrate use of paragraph and its associated tags in web page.
3.	**Lists, images and semantics:**
a.	Demonstrate use of multiple image tag in web page.
b.	Design a web page with Imagemaps.
c.	Design a web page demonstrating use of various semantics tags
4.	**Multimedia and User controls:**
a.	Design a web page with a form that uses all types of user controls.
b.	Design a web page embedding with multimedia features.
c.	Design a 3 page static website with appropriate tags and attributes.
5.	**CSS with list, links and table:**
a.	Create and use different style rules with available types of lists.
b.	Create and use different style rules with hyperlinks.
c.	Create and use different style rules with tables.

6.	**CSS with font, paragraph and types:**
a.	Create and use different style rules with font elements.
b.	Create and use different style rules with Paragraph elements.
c.	Demonstrate the use of inline, internal and external CSS in one web page.
7.	**Java Script: Validating User fields**
a.	Demonstrate the use of Document object methods.
b.	Using java script, demonstrate validating Text Input Fields, Drop-down Lists and Checkboxes.
c.	Using java script, demonstrate validating Radio buttons and Validating Multi-Select Boxes.
8.	**Java Script : Handling the events**
a.	Using java script, demonstrate the use of onAbort, onBlur, onChange, onClick, onDblClick events.
b.	Using java script, demonstrate the use of onDragDrop, onError, onFocus events.
c.	Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events.
d.	Using java script, demonstrate the use of onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove events.
e.	Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events.
f.	Demonstrate complete validation of User Registration form using appropriate fields of html and events of java script.
9.	**JSON Basics**
a.	Creating JSON
b.	Parsing JSON
c.	Persisting JSON
10.	**Working with JSON**
a.	Demonstrate use of JSON objects in array, print array on web page using document object.
b.	Read data from json file and convert it into a JavaScript object and display the data in web page using document object.
c.	Demonstrate messages formatting using JSON.

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

- Use basic tags such as font, link and text formatting tags.
- Use and apply Navigation, lists, images etc in web pages.
- Use User controls and embed Multimedia in web page.
- Use and apply CSS with list, links, fonts table etc. in web page.
- Use and apply Java Script for Validating User fields on web page.
- Create, parse and persist the JSON object and extract and use its values on web page.
- Use JSON object with arrays and message formatting on web page.

USDS104: Business Communication and Information Ethics

B. Sc (Data Science)		Semester – I	
Course Name: Business Communication and Information Ethics		**Course Code: USDS104**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- To discuss various components of communication, explain how non-verbal communication techniques enhance communication and explain the barriers to communication.
- To discuss various business activities which are essential at workplace. To explain business communication covering the structure and layout of a letter, planning of a letter and use of language.
- To explain the use of agenda and minutes for effective functioning of any organisation.
- To direct the learners' attention to the significance of effective writing and the importance and structure of reports.
- To explain to interpret information ethics (IE) as the branch of the philosophy of information that investigates, in a broad sense, the ethical impact of Information and Communication Technologies (ICTs) on human life and society.

Unit	Details	Lectures
I	**Interpretation of Communication** Basics of communication, Non-verbal communication, Barriers to communication. **Business communication at workplace** Letter components and layout, Planning a letter, Process of letter writing.	**12**
II	**Business communication at workplace** Email communication, Memos and memo reports, Employment communication. Notice, Agenda and minutes of meeting, Brochures.	**12**
III	**Report Writing:** Effective writing, Types of business reports, Structure of reports, Gathering Information.	**12**
IV	**Report Writing:** Organisation of material, writing abstracts and summaries, Writing definitions, Visual aids, User Instruction Manual.	**12**
V	**Information Ethics** Ethics after the information revolution, what is information ethics? The method of abstraction.	**12**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Professional Communication	Aruna Koneru	Tata McGraw Hill	--	2008
2.	The Ethics of Information	Luciano Floridi	Oxford University Press	--	2013
3.	Business Communication	A. C.“Buddy” Krizan, Patricia Merrier, Joyce Logan, Karen Williams	Thomson	7e	2008

Course Outcomes:

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

- Communicate effectively in non-verbal way, draft and write effective business letters.
- Effectively carryout communication activities of business by following email etiquettes, drafting memos
- Write elegant business reports and prepare user instruction manual.
- Apply the information ethics in all walks of life.
- Become a good communicator in life.

USDS1P4: ICT Practical

B. Sc (Data Science)		Semester – I	
Course Name: ICT Practical		**Course Code: USDS1P4**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Objectives:

- To help the learners become competent and confident users of ICT who can make efficient, effective and creative use of basic application software in their everyday activities.
- To encourage the learners to become critical and reflective users of ICT who can evaluate the capabilities and limitations of the technology and of social, technical, political, ethical, organisational and economical principles associated with its use.
- To prepare the learners for the society of tomorrow by making them adaptable users of ICT who have the necessary openness and flexibility of mind to be able to adjust to future changes in the technology.
- To encourage the learners to develop the appropriate social skills that are essential for co-operative and collaborative learning based around ICT.
- To empower ICT disadvantaged learners by ensuring sufficient access for those learners who have little out-of-school opportunities to use the technology

List of Practical:	
1.	**Word Processor**: Using word processor for letters, documentation and reports with proper formatting and advanced features.
2.	**Presentation Software:** Using presentation software for preparing elegant presentations with voice and videos and giving different effects to make it more interesting and catchy.
3.	**Using Google docs and forms**
4.	**Using online collaboration and video conferencing tools**
5.	**Using screen recording and audio tools**
6.	**Using video editing tools**
7.	**Using Google Maps, Google Street view, Bing Maps**
8.	**Using Social Media (Facebook, Instagram, Twitter, Linkedin, youtube, snapchat, reddit, quora, dig, Pintrest, flipboard, Wordpress, Tumblr, Medium) for business and learning**

9.	**Using plagiarism software**
10.	**Using ICT in governance, agriculture and healthcare**

Course Outcomes:

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

- Effective use the ICT software for different purposes in all walks of life.
- Develop the appropriate personal skills that are essential for independent learning based around ICT
- Develop their potential to their fullest by facilitating the acquisition of knowledge; by helping the learner concentrate on higher order cognitive tasks rather than on lower order routine tasks and by positively affecting the attitude of the learner towards further learning
- Facilitate better communication between the learners thereby promoting greater social understanding and harmony
- Effectively use the ICT in governance, agriculture and healthcare.

USDS105: Precalculus

B. Sc (Data Science)		Semester – I	
Course Name: Precalculus		**Course Code: USDS105**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- To master the number fundamentals, equations and different types of mathematical functions.
- To review and explain the trigonometry and gain expertise trigonometric identities.
- To understand analytical trigonometry and inverse functions.
- To give the detailed knowledge about complex numbers, vectors and matrices.
- To understand the conics, sequences and series and

Unit	Details	Lectures
I	**Fundamentals:** Real Numbers, Exponents and Radicals, Algebraic Expressions, Rational Expressions, Equations, Modeling with Equations, Inequalities, Coordinate Geometry, Graphing Calculators; Solving Equations and Inequalities Graphically, Lines, Making Models Using Variation. **Functions:** What is function? Graphs of Functions, Getting Information from the Graph of a Function, Average Rate of Change of a Function, Transformations of Functions, Combining Functions, One-to-One Functions and Their Inverses. **Polynomial and Rational Functions:** Quadratic Functions and Models, Polynomial Functions and Their Graphs, Dividing Polynomials, Real Zeros of Polynomials, Complex Numbers, Complex Zeros and the Fundamental Theorem of Algebra, Rational Functions.	**12**
II	**Exponential and Logarithmic Functions:** Exponential Functions, The Natural Exponential Function, Logarithmic Functions, Laws of Logarithms, Exponential and Logarithmic Equations, Modelling with Exponential and Logarithmic Functions. **Trigonometric Functions: Unit Circle Approach:** The Unit Circle, Trigonometric Functions of Real Numbers, Trigonometric Graphs, Inverse Trigonometric Functions and Their Graphs, Modelling Harmonic Motion **Trigonometric Functions: Right Triangle Approach:** Angle Measure, Trigonometry of Right Triangles, Trigonometric Functions of Angles, Inverse Trigonometric Functions and Right Triangles, The Law of Sines, The Law of Cosines.	**12**
III	**Analytic Trigonometry:** Trigonometric Identities, Addition and Subtraction Formulas, Double-Angle, Half-Angle, and Product-Sum Formulas, Basic Trigonometric Equations, More Trigonometric Equations	**12**

	Sinusoidal Functions: A special class of functions, Sketching a sinusoidal graph, Functions not in standard sinusoidal form, sinusoidal behaviour. **Inverse Circular Functions:** Solving three equations, inverse Circular functions, applications, solving trigonometric equations	
IV	**Polar Coordinates and Parametric Equations:** Polar Coordinates, Graphs of Polar Equations, Polar Form of Complex Numbers; De Moivre's Theorem, Plane Curves and Parametric Equations **Vectors in Two and Three Dimensions:** Vectors in Two Dimensions, The Dot Product, Three-Dimensional Coordinate Geometry, Vectors in Three Dimensions, The Cross Product, Equations of Lines and Planes **Systems of Equations and Inequalities:** Systems of Linear Equations in Two Variables, Systems of Linear Equations in Several Variables, Matrices and Systems of Linear Equations, The Algebra of Matrices, Inverses of Matrices and Matrix Equations, Determinants and Cramer's Rule, Partial Fractions, Systems of Nonlinear Equations, Systems of Inequalities	**12**
V	**Conic Sections:** Parabolas, Ellipses, Hyperbolas, Shifted Conics, Rotation of Axes, Polar Equations of Conics **Sequences and Series:** Sequences and Summation Notation, Arithmetic Sequences, Geometric Sequences, Mathematics of Finance, Mathematical Induction, The Binomial Theorem **Limits: A Preview of Calculus:** Finding Limits Numerically and Graphically, Finding Limits Algebraically, Tangent Lines and Derivatives, Limits at Infinity; Limits of Sequences, Areas	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Year
1.	Precalculus–Mathematics for Calculus	James Stewart, Lothar Redlin, Saleem Watson	Cengage Learning	2013
2.	Precalculus	David H. Collingwood, K. David Prince, Matthew M. Conroy	Free Software Foundation	2011
3.	Precalculus Demystified	Rhonda Huettenmueller	Tata McGrawHill	2005
4.	Contemporary Precalculus: A Graphing Approach	Thomas W. Hungerford, Douglas J. Shaw	Thomson Higher Education	2009

Course Outcomes:

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

- Apply the knowledge of numbers, graph and functions in real life.
- Apply trigonometry in modelling real life problems.
- Use analytic trigonometry and inverse circular functions to solve variety of problems.
- Apply complex numbers theory to different domains, use vectors and matrices to solve real life problems.
- Identify different types of conics from equations, understand sequences and series and basics of limits and derivatives.

USDS1P5: Precalculus Tutorials

B. Sc (Data Science)		**Semester – I**	
Course Name: Prrcalculus Tutorials		**Course Code: USDS1P5**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Tutorial Examination**	**2½**	**30**
	Internal	**--**	**20**

***10 Tutorials based on the Precalculus (USDS105) theory should be conducted.**

Semester II

USDS201: Probability and Distributions

B. Sc (Data Science)		Semester – II	
Course Name: Probability and Distributions		**Course Code: USDS201**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- To explore about random variables and implement various distribution functions
- To familiarize with concepts of probability and learn implementation of different types of probabilities.
- Learn and implement the concept of expectation, related theorems and generating functions
- To know the concept and implementation of discrete distributions including Bernoulli, Binomial and power series distributions
- To get acquainted with theory and practical implementation of concepts of continuous distributions

Unit	Details	Lectures
I	**Theory of Probability:** Introduction, history, different terms, mathematical tools, Axiomatic approach to probability, Mathematical notation, multiplication aw and conditional probability, Bayes theorem, Geometric probability.	**12**
II	**Random Variables and Distribution Functions:** Random Variable, distribution function, discrete random variable, continuous random variable, joint probability law, transformation of one-dimensional random variable, transformation of two-dimensional random variable	**12**
III	**Mathematical Expectation and Generating Functions:** Mathematical expectation, Expectation of a Function of a Random Variable, Addition Theorem of Expectation, Multiplication Theorem of Expectation, Expectation of a Linear Combination of Random Variables, Covariance, Variance of a Linear Combination of Random Variables, Moments of Bivariate Probability Distributions, Conditional Expectation and Conditional Variance, Moment Generating Function, Cumulants, Characteristic Function, Chebychev's Inequality, Convergence in- Probability, Weak Law of Large Numbers, Borel Canteli Lemma, Probability Generating Function	**12**
IV	**Theoretical Discrete Distributions:** Introduction, Bernoulli Distribution, Binomial Distribution, Poisson Distribution, Negative Binomial Distribution, Geometric Distribution, Hypergeomeiric Distribution, Multinomial Distribution, Discrete Uniform Distribution, Power Series Distribution	**12**
V	**Theoretical Continuous Distributions:** Rectangular or Uniform Distribution, Normal Distribution, Gamma Distribution, Beta Distribution of First Kind, Beta Distribution of Second Kind, The Exponential Distribution, Laplace Double Exponential Distribution,	**12**

	Weibul Distribution, Cauchy Distribution, Central Limit Theorem, Compound Distributions, Pearson\s Distributions, Variate Transformations, Order Statistics, Truncated Distributions	

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Fundamentals of Mathematical statistics	S. C, Gupta and V. K. Kapoor	S. Chand and Sons	Tenth	2002
2.	Applied Statistics and Probability for Engineers	Douglas C. Montgomery and George C. Runger	Wiley	Sixth	2014
3.	Probability, Statistics, and Stochastic Processes	Peter Olofsson and Mikael Andersson	Wiley	Second	2012

Course Outcomes:

After completion of the course, a student should be able to use spreadsheet/excel:

- Organize, manage and present data
- Analyse statistical data graphically using frequency distributions and cumulative frequency distributions
- Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.
- Translate real-world problems into probability models.
- Derive the probability density function of transformation of random variables.
- Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.

USDS2P1: Probability and Distributions Practical

B. Sc (Data Science)		**Semester – II**	
Course Name: Probability and Distributions Practical		**Course Code: USDS2P1**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Course Objectives:

- To provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science
- To practically learn the theory concepts and apply in real time

List of Practical: (Can be done in MS-Excel-or any Spreadsheet)	
1	**Introduction to Probability:**
a	Formulate and apply Bayes' Theorem Calculations for problems like The "Two-Supplier Example". [Hint: Use Prior Probabilities and Conditional Probabilities to compute Joint and Posterior Probabilities.]
b	Design spreadsheet to demonstrate the association Between Two Variables by Computing the Covariance and Correlation Coefficient. [Hint: Use COVAR and CORREL)]
2	**Discover Probability using formulas:**
a	Design and spreadsheet experiment to compute the probability using the geometric distribution formula.
b	Create a spreadsheet application to compute the Conditional Probability. Also **determine the probability that a randomly chosen event.**
3	**Random Variables and Distribution Functions:**
a	Create spreadsheet application to Compute the Expected Value, Variance, and Standard Deviation
b	Create a spreadsheet application to Compute Binomial Probabilities. [Hint Use BINOMDIST]
4	**Probability Distribution and Law:**
a	Create a spreadsheet application to Poisson Probability Distribution. [Hint: Use POISSON]
b	Create a spreadsheet application to implement joint probability law.
5	**Mathematical Expectation and Chebychev's Theorem:**
a	Create a spreadsheet application to compute the expectation of a Function of a Random Variable
b	Create a spreadsheet application to apply Chebychev's Theorem.

6	**Conditional Expectation and Generating Functions:**
a	Create a spreadsheet application to compute Conditional Expectation and Conditional Variance.
b	Create a spreadsheet application to demonstrate the use of Generating Functions
7	**Theoretical Discrete Distributions 1:**
a	Create spreadsheet application to demonstrate Bernoulli Distribution.
b	Create spreadsheet application to use excel function for computing hypergeometric probabilities.
8	**Theoretical Discrete Distributions 2:**
a	Create spreadsheet application to Calculate Binomial Distribution in Excel. [Hint: Use BINOM.DIST]
b	Create suitable spreadsheet application to work with Power Series Distribution.
9	**Theoretical Continuous Distributions 1:**
a	Create spread application for computing probabilities and z values for the standard normal distribution. [Use NORMSDIST and NORMSINV]
b	Create spread application for computing probabilities for the exponential probability distribution. [Hint: Use EXPONDIST]
10	**Theoretical Continuous Distributions 2:**
a	**Create spread application for** demonstrating Weibull Distribution to obtain a model for data sets. [Hint: Use **WEIBULL.DIST**]
b	**Create spread application for** demonstrating Pearson\s Distributions.

Course Outcomes:

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

- Use discrete and continuous probability distributions, including requirements, mean and variance, and making decisions.
- Define binomial outcomes and compute probability of getting X successes in N trials.
- Use the normal probability distribution including standard normal curve calculations of appropriate areas.
- Use different distributions to solve simple practical problems.

USDS202: Database Management

B. Sc (Data Science)		Semester – II	
Course Name: Database Management		**Course Code: USDS202**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives: This course concentrates the concept of the DBMS with respect to principles, design and implementation of DBMS. It aims to specify the functional and data requirements for a typical database application and to understand creation, manipulation and querying of data in databases.

- To understand Organizing, structuring and storing data
- Understand Database as Relational model
- To understand SQL to retrieve data and concept of redundancy
- To specify the functional and data requirements for a typical database application
- To understand creation, manipulation and querying of data in databases

Unit	Details	Lectures
I	**Introduction & DBMS Architecture:** Why Databases? Data versus Information, Introducing the Database, Role and Advantages of the DBMS, Types of Databases, Why Database Design Is Important, Evolution of File System Data Processing, Problems with File System Data Processing, Database Systems **Data Models** – Data Modeling and Data Models, The Importance of Data Models, Data Model Basic Building Blocks, Business Rules, The Evolution of Data Models, Degrees of Data Abstraction **Entity Relationship Model:** Entities, attributes, Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Participation, Relationship Degree, Recursive Relationships, Associative (Composite) Entities, Developing an ER Diagram, Database Design Challenges: Conflicting Goals.	**12**
II	**Advanced Data Modeling:** The Extended Entity Relationship Model, Entity Clustering, Entity Integrity: Selecting Primary Keys, Design Cases: Learning Flexible Database Design **Normalization of Database Tables:** Database Tables and Normalization, The Need for Normalization, The Normalization Process, Improving the Design, Surrogate Key Considerations, Higher-Level Normal Forms, Normalization and Database Design, Denormalization, Data-Modeling Checklist	**12**
III	**Structured Query Language (SQL):** Introduction to SQL, Basic SELECT Queries, SELECT Statement Options, FROM Clause Options, ORDER BY Clause Options, WHERE Clause Options, Aggregate Processing, Subqueries, SQL Functions, Relational Set Operators, Crafting SELECT Queries	**12**

IV	**Advanced SQL:** Data Definition Commands, Creating Table Structures, Altering Table Structures, Data Manipulation Commands, Virtual Tables: Creating a View, Sequences, Procedural SQL, Embedded SQL **Database Design:** The Information System, The Systems Development Life Cycle, The Database Life Cycle, Conceptual Design, DBMS Software Selection, Logical Design, Physical Design, Database Design Strategies, Centralized versus Decentralized Design	**12**
V	**Transaction Management and Concurrency Control:** What Is a Transaction? Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods, ANSI Levels of Transaction Isolation, Database Recovery Management **Database Performance Tuning and Query Optimization:** Database Performance-Tuning Concepts, Query Processing, Indexes and Query Optimization, Optimizer Choices, SQL Performance Tuning, Query Formulation, DBMS Performance Tuning, Query Optimization Examples **Database Administration and Security:** Data as a Corporate Asset, The Need for a Database and Its Role in an Organization, Introduction of a Database: Special Considerations, The Evolution of Database Administration, The Database Environment's Human Component, Security, Database Administration Tools, Developing a Data Administration Strategy, The DBA's Role in the Cloud, The DBA at Work: Using Oracle for Database Administration	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Fundamentals of Database Systems	Elmasri Ramez and Navathe Shamkant B,	Pearson Education	6th Edition,	2010.
2.	Database System Concepts	Silberschatz, Korth, Sudarshan,	McGraw Hill,	5 Edition,	2006.
3.	Database Management Systems,	Ramakrishnam, Gehrke,	McGraw-Hill,		2007
4.	Murach's MySQL	Joel Murach,	Murach,		2012

Course Outcomes:

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

- Students should be able to evaluate business information problem and find the requirements of a problem in terms of data.
- Students should be able to draw database design in logical structure and can identify the entities which exist in a system
- Students should be able to construct normalized database and functional dependencies between attributes and relational algebra queries
- Students should be able to design the database schema with the use of appropriate data types for storage of data in database.
- Students should be able to create, manipulate, query and back up the databases with features of SQL.

USDS2P2: Database Management Practical

B. Sc (Data Science)		Semester – II	
Course Name: Database Management Practical		**Course Code: USDS2P2**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Course Objectives: Provides the hands on the SQL language for retrieving the data from the database in different scenarios. The primary focus is to understand relational database concepts and design by using SQL.

- Identify entities and its relationship with relational model structure.
- To understand relational database using SQL and constraints implementation using create table query
- To Understand DML operations and backing of database
- To understand how to retrieve data from database and learn how to retrieve single value after performing calculations on group of values
- To understand built-in functions to perform operations on data
- To understand how to fetch data from two or more tables, which is joined to appear as single set of data
- To understand nested and larger query as advanced fetching of data
- To understand concept of virtual table.
- To understand how to control user access in a database.

List of Practical: (Can be done in Oracle / SQL Server / MySQL)	
1.	**For given scenario** Draw E-R diagram and convert entities and relationships to table.
2.	**Write SQL query for given problem statement:**
a.	Viewing all databases
b.	Creating a Database
c.	Viewing all Tables in a Database
3.	**Perform the following Operations:**
a.	Creating Tables (With and Without Constraints)
b.	Inserting/Updating/Deleting Records in a Table
c.	Saving (Commit) and Undoing (rollback)
4.	**Perform the following Operations:**
a.	Altering a Table
b.	Dropping/Truncating/Renaming Tables
c.	Backing up / Restoring a Database
5.	**Perform following:**
a.	Simple Queries with Where Operators
b.	Where with Keywords and Logical Operators

c.	Simple Queries with Aggregate functions
d.	Queries with Aggregate functions (group by and having clause)
6.	**Perform Queries involving:**
a.	Date Functions
b.	String Functions
c.	Math Functions
7.	**Retrieving Data from Multiple Table:**
a.	Joining Tables (InnerJoins, Outer-Joins)
b.	Aliases for Table Names
8.	**Subqueries:**
a.	With IN clause
b.	With EXISTS clause
c.	Handling NULL
9.	**Views:**
a.	Creating Views
b.	Dropping Views
c.	Selecting from view
10.	**DCL statements:**
a.	Granting and revoking permissions

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

- Students able to draw relationship diagram.
- Students able to perform various operations such as insert, update delete and retrieve data from database using SQL queries.
- Students able to perform alteration in tables and can restore and take backup of the database.
- Students able to perform operations using simple SQL Queries to fetch data and learns various aggregate functions to get single value.
- Students able to perform SQL Queries using JOIN keyword for joining two or more tables.
- Students able to perform nested queries using in, exists operators.
- Students able to create new table by joining one or more tables and learn how to hide attribute from end user.
- Students able to restrict the user from accessing data in database.

USDS203: R Programming

B. Sc (Data Science)		Semester – II	
Course Name: R Programming		**Course Code: USDS203**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- Master the use of the R interactive environment and expanding by installing R packages
- Read Structured Data into R from various sources
- Understand the different data types and data structures in R
- Manipulate strings, dates in R
- Understand basic regular expressions in R
- Understand base R graphics
- Focus on GGplot2 graphics for R and be familiar with trellis (lattice) graphics.

Unit	Details	Lectures
I	**Getting started with R:** R Software: Obtaining R and RStudio, First R Encounter, Getting started: R as a big calculator, Assignment, Basic operators, Help with functions and features, Quiz, A few important points on R Working with R **R Interfaces - Using R and RStudio**: R Software, Obtaining R and RStudio, The default R interface, RStudio Interface, Example Datasets in R, R Packages, Installing new R libraries, Customizing R Start-up **Objects in R:** Using ls and rm to managing R Objects, Types of R objects, Attributes of R Objects, Creating and accessing objects, Modifying elements, Quick recap, Exercise **Reading and writing data to and from R:** Importing and reading text files data into RStudio, Importing data using R command read.table(), Exercise, Importing text files Using scan(), Parsing each line – Readlines, Writing Data table from R, Exercise, Importaing Data from other Software, Reading data from Excel into R, Import/Export from other statistical software, From a Database Connection, Sampling and Creating simulated data, Exercise	12
II	**Introduction to programming and writing Functions in R**: Why do we want to write functions?, Conditional statements (if, ifelse, switch), Repetitive execution: For and While loops, The Apply Functions, Exercise, Functions for parsing text, Programming in R: More advanced, Viewing Code of functions from R packages, Exercise-Parsing Real Data - World Population Data from Wikipedia, Writing functions: more technical discussion -Scoping, Options for Running memory or CPU intensive jobs in R, Efficient R coding **Introduction to graphics in R:** The R function plot(), Exercise, Customize plot with low-level plotting commands, Default parameters – par, Interacting with graphics, Saving plots, Useful Graphics Resources	12

III	**Advanced Graphics:** Advanced plotting using Trellis; ggplots2, Lattice, Examples that Present Panels of Scatterplots using xyplot(), Simple use of xyplot **Importing Data- readr:** Functions for Reading Data, File Headers, Column Types, String-based Column Type Specification, Function-based Column Type Specification Parsing Time and Dates, Space-separated Columns, Functions for Writing Data **Representing Tables – tibble:** Creating Tibbles, Indexing Tibbles	**12**
IV	**Reformatting Tables – tidyr:** Tidy Data, Gather and Spread, Complex Column Encodings, Expanding, Crossing, and Completing, Missing Values, Nesting Data **Pipelines – magrittr** : The Problem with Pipelines, Pipeline Notation, Pipelines and Function Arguments, Function Composition, Other Pipe Operations **Working with Strings – stringr:** Counting String Patterns, Splitting Strings, Capitalizing Strings, Wrapping, Padding, and Trimming, Detecting Substrings, Extracting Substrings, Transforming Strings **Working with Factors – forcats**: Creating Factors, Concatenation, Projection, Adding Levels, Reorder Levels	**12**
V	**Manipulating Data Frames – dplyr**: Selecting Columns, Filter, Sorting, Modifying Data Frames, Grouping and Summarizing, Joining Tables, Income in Fictional Countries **Working with Dates – lubridate**: Time Points, Time Zones, Time Intervals	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edi^{n}	Year
1.	Introduction to Programming and Statistical Modelling in R	Aedin Culhane	HARVARD SCHOOL	1st	2013
2.	R Data Science Quick Reference	Thomas Mailund	Apress	1st	2019
3.	THE BOOK OF R	Tilman M. Davies	No starch press	1st	2016
4.	Practical Data Science with R	NINA ZUMEL JOHN MOUNT	MANNING		2014
5.	Beginning Data Science in R	Thomas Mailund	Apress		2017

Course Outcomes:

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

- To use R Studio and explore the features for R programming.
- To use R functions and graphics with in R programming for solving problems.
- To work with advanced graphics of R, import and use the data and represent the data into tables.
- To apply formatting on table, use Pipelines in application and use strings, factors in R programme.
- To manipulating Data Frames and make use of Dates in R application.

USDS2P3: R Programming Practical

B. Sc (Data Science)		Semester – II	
Course Name: R Programming Practical		**Course Code: USDS2P3**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2½**	**30**
	Internal	**--**	**20**

Course Objectives:

- To learn implementing expressions in R
- To learn and implement control flow using loops
- To explore and use basic data structures in R

List of Practical:	
1.	**Introduction to R Programming Elements**
a.	Write an R Program to implement expressions, assignment and decision making
b.	Write an R Program to design and implement loops.
c.	Write a R program to demonstrate the use of essential data structures in R [Hint: Vectors, Matrix, Arrays]
2.	**Using List, Data Frames and Functions in R**
a.	Write an R program to manage data and exhibit operations on it using List data structure
b.	Write an R program to manage data and exhibit operations on it using Data Frames
c.	Write an R program to demonstrate the use of : i. user-defined functions ii. built-in numeric function, character functions etc.
3.	**Implementing Strings in R**
a.	Write an R program to store and access string in R objects(vectors, matrix, arrays, data frames, and lists)
b.	Write an R program to demonstrate use of various string manipulation functions. [Hint: paste(), print(), noquote(),format(), cat(), toString(), sprint()]
4.	**Performing Statistics with R-I**
a.	Write an R program to apply built-in statistical functions. [Hint: mean, median, standard deviation and others]
b.	Write an R program to demonstrate Linear and Multiple Regression analysis.
5.	**Performing Statistics with R-II**
a.	Write an R program to implement i. Normal Distribution. [Hint: dnorm(), pnorm(), qnorm(), rnorm()] ii. Binomial Distribution: [Hint: dbinom(), pbinom(),qbinom(),rbinom()]
b.	Write an R program to perform time-series analysis for the given data.
6.	**Data Visualization and Analysis**
a.	Write an R program to learn about Tabulation and related concepts [Hint: Contingency Tables, Selection of Parts, Conversion, Complex Tables, Cross Tabulation]

b.	Write an R program to demonstrate various ways of performing Graphical analysis.[Hint: Plots, Special Plots, Storing Graphics]
7.	**Object Oriented Programming in R**
a.	Write an R program to demonstrate OOP concepts, the construction and use of S3 and S4 classes
b.	Write an R program to define reference class and operations on them.
8.	**Data Interfaces in R**
a.	Write an R program to demonstrate data interface with CSV files [Hint: creating data for CSV, analyzing, writing CSV files]
b.	Write an R program to work with spreadsheet (Excel) programs. [Hint: installing, loading, verifying, creating data for xlsx file]
c.	Write an R program to manage data using XML files. [Develop data interface for maintaining Employee Information]
d.	Write an R program to demonstrate working with RMySQL Package
9.	**Handling Errors in R**
a.	Write an R program to demonstrate various error messages in R Programming
b.	Write an R program to implement Error Handling in R [Hint: warning(),stop(),try(), tryCatch(), CallingHandlers()]
10.	**Measuring Performance**
a.	Write R program to measure the performance with the help of bult-in function like mocrobechmark().

Course Outcomes:

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

- Use expression for decision making, get Knowledge of types of loops and loop control statements and able to create, access and manipulate essential data structures.
- Develop skills to manage multiple data through various options available in R.
- Use R object, simple statistical function for data analysis and Differentiate between linear and multiple regression analysis.
- Get the knowledge about various function for Normal and Binomial Distribution and able to implement and analyse data using different time intervals and multiple time series
- To create Tabulation for presentation of data and operation of them and get the knowledge about various ways of plotting data and saving them
- Get the knowledge of implementing class concept in R and able to define reference class, create objects, access and modify fields
- Get the knowledge about developing data interface for storing data in CSV files also knowledge about working with Excel files and able to interface with XML files and able to interface with MySQL, query and manipulate data in it.
- Get the insight into errors related to name errors, control structure error, connection errors etc., and able to identify and handle errors in R code
- To analyze performance of the R code.

USDS204: Environmental Science

B. Sc (Data Science)		Semester – II	
Course Name: Environmental Science		**Course Code: USDS204**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- To learn and sensitize learners to their environment
- To know about natural resources, ecology and ecosystem
- To learn insights of biodiversity, pollution and its impact
- Explore about Social Issues and the Environment
- To learn about Environment Management and sustainable development

Unit	Details	Lectures
I	**Introduction to Environmental Studies** Importance of Environmental Education, Environmental Literacy, Environmental Engineering, Environmentalism, Components of Environment and their Interactions, Man and the Biosphere, Impacts of Development on Environment **Natural Resources** Forest Resources, Dams, Water Resources, Food Resources Energy Resources, Land Resources	**12**
II	**Ecology** Ecosystem, Ecosystem-Anthroposystem Comparison, Biome and Ecosystem, Energy Flow through the Ecosystem, Ecological Succession, Food Chains and Webs, Ecological Pyramids, Biological Magnification or Biomagnification, Human versus Natural Food Chains, Biogeochemical Cycles, The Water Cycle (Hydrologic Cycle), Carbon Cycle, Oxygen Cycle, , Nitrogen Cycle, Forest Ecosystems, , Grassland Ecosystems, Aquatic Ecosystems **Biodiversity** Genetic Diversity, Species Diversity, Ecosystem Diversity, Value of Biodiversity, Value of Genes, Biopiracy, Biogeographical Classification of India, India as a Mega Diverse Nation, Endemic Species of India, Threats to Biodiversity, Hotspots of Biodiversity, Endangered Species, Conservation of Biodiversity, Genetic Engineering and Biodiversity	**12**
III	**Environmental Pollution** Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Solid Waste Management, Hazardous Waste Management, Pollution Prevention, Disaster Management **Human Population and the Environment** Population Growth, Human Rights, Value Education, HIV/AIDS, Environment and Human Health, Family Welfare Programmes, Women	**12**

	and Child Welfare, Role of Information Technology in Environment and Human Health	
IV	**Social Issues and the Environment** From Unsustainable to Sustainable Development, Urban Problems Related to Energy, Water Conservation, Watershed Management, Resettlement and Rehabilitation, Environmental Ethics, Acid Rain, Ozone Layer Depletion, Greenhouse Effect, Global Warming and Climate Change, Pollution Control Boards and Control Pollution Acts in India, Nuclear Hazards and Accidents, Environmental Impact Assessment, Risk Management, Precautionary Principle, Polluter-Pays Principle, The Beneficiary-Pays Principle, Role of Non-Government Organizations, ISO 14000 Series of Environmental Management Standards, Economy and Environment	**12**
V	**Environmental Management** Environmental Impact Assessment, Methodology, Waste as a Resource,Environmental Laws, Requirements of a Contract, Environmental Legislations, Powers and Functions of Pollution Control Boards, Case Studies, Environmental Management Plan, Environmental Audit, Policies for Quality Improvement, Problems, Policy **Sustainable Development** Ethics, Laws of Nature, Progress, Environmental Stress, Sustainability, Self-purification and Regeneration, Action Plan, Computerization and Information Technology	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Environmental Studies	Benny Joseph	McGrawHill	3rd	2017
2.	Principles of Environmental Science and Engineering	P. Venugopala Rao	PHI Learning	6th	2014
3.	Introduction to Environmental Engineering	Gilbert M Master	Pearson	3rd	2015
4.	Environmental Ethics: A Very Short Introduction	Robin Attfield	Oxford	1st	2019
5.	Fundamental Concept in Environmental Studies	D.D. Mishra	S. Chand	Revised Edition	2010

Course Outcomes:

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

- Ability to recognise explain important of environment and its resources
- Knowledge about insights of ecology and biodiversity
- Recognise the cause and effects of environmental pollution and other social issues
- Knowledge about population and its impact on environment
- Insight into environment management and sustainable development.

USDS2P4: Case Studies on Environment

B. Sc (Data Science)		Semester – II	
Course Name: Case Studies on Environment		Course Code: USDS2P4	
Periods per week (1 Period is 50 minutes)		3	
Credits		2	
		Hours	Marks
Evaluation System	Tutorial Examination	2½	30
	Internal	--	20

*** 10 Case studies related to Environmental Science (USDS204) should be conducted.**

USDS205: Calculus

B. Sc (Data Science)		Semester – II	
Course Name: Calculus		**Course Code: USDS205**	
Periods per week (1 Period is 50 minutes)		**5**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Internal	**--**	**40**

Course Objectives:

- To give the insight of calculus starting with continuity and derivatives.
- To gain proficiency in integration.
- To apply derivatives and integration to various domains.
- To use polar coordinates for different conics and understand multiple integrals.
- To understand partial differentiation and differential equations.

Unit	Details	Lectures
I	**Continuity and Derivatives:** Limits at Infinity; Horizontal Asymptotes, Derivatives and Rates of Change, The Derivative as a Function. **Differentiation rules:** Derivatives of Polynomials and Exponential Functions, The Product and Quotient Rules, The Chain Rule, Implicit Differentiation, Derivatives of Logarithmic Functions, Rates of Change in the Natural and Social Sciences, Exponential Growth and Decay, Related Rates, Linear Approximations and Differentials, Hyperbolic Functions.	**12**
II	**Integrals:** Areas and distances, The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Net Change Theorem, The Substitution Rule, Integration by Parts, Trigonometric Integrals, Trigonometric Substitution, Integration of Rational Functions by Partial Fractions, Strategy for Integration, Integration Using Tables and Computer Algebra Systems, Approximate Integration, Improper Integrals.	**12**
III	**Applications of differentiation:** Maximum and Minimum Values, The Mean Value Theorem, Derivatives and Shape of a Graph, Indeterminate Forms and L'Hospital's Rule, Curve Sketching, Graphing with Calculus *and* Calculators, Optimization Problems, Newton's Method. **Applications of Integration:** Areas between Curves, Volumes, Volumes by Cylindrical Shells, Work, Average Value of a Function, Arc Length, Area of a Surface of Revolution, Applications to Physics and Engineering, Applications to Economics and Biology, Probability.	**12**
IV	**Parametric Equations and Polar Coordinates:** Curves Defined by Parametric Equations, Calculus with Parametric Curves, Polar Coordinates, Areas and Lengths in Polar Coordinates, Conic Sections, Conic Sections in Polar Coordinates. **Multiple Integrals:** Double Integrals over Rectangles, Iterated Integrals, Double Integrals over General Regions, Double Integrals in Polar Coordinates, Applications of Double Integrals, Triple Integrals,	**12**

	Triple Integrals in Cylindrical Coordinates, Triple Integrals in Spherical Coordinates, Change of Variables in Multiple Integrals	
V	**Partial Derivatives:** Functions of Several Variables, Limits and Continuity, Partial Derivatives, Tangent Planes and Linear Approximations, The Chain Rule, Maximum and Minimum Values, Lagrange Multipliers. **Differential Equations:** Modelling with Differential Equations, Direction Fields and Euler's Method, Separable Equations, Models for Population Growth, Linear Equations, Predator-Prey Systems.	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edi^{n}	Year
1.	Calculus–Early Transcendentals	James Stewart	Thomson	6th	2008
2.	Calculus and Analytical Geometry	George B. Thomas Jr., Ross L. Finney Maurice D. Weir	Addision Wesley Publishing Company	--	1998
3.	Schaum's 3000 Solved Problems in Calculus	Elliot Mendelson	Tata McGraw Hill	--	1988
4.	The Advanced Calculus Problem Solver	Staff of Research & Education Association	Research & Education Association	---	2007
5.	Calculus Made easy	Silvanus P. Thompson, Martin Gardner	PALGRAVE		1998

Course Outcomes:

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

- Quickly and easily find the derivative of a function.
- Perform integration of functions with ease.
- Apply the knowledge of derivatives and integration to different domains and obtain the results.
- Apply the knowledge of multiple integrals and polar coordinates to solve real life problems with ease.
- Use partial derivatives and differential equations to solve variety of problems.

USDS2P5: Calculus Tutorials

B. Sc (Data Science)		**Semester – II**	
Course Name: Calculus Tutorials		**Course Code: USDS2P5**	
Periods per week (1 Period is 50 minutes)		**3**	
Credits		**2**	
		Hours	**Marks**
Evaluation System	**Tutorial Examination**	**2½**	**30**
	Internal	**--**	

*** 10 tutorials based on Calculus (USDS205) should be conducted.**

Evaluation Scheme

1. **Internal Evaluation (25 Marks).**
   i. **Test: 1 Class test of 20 marks. (Can be taken online)**

Q	Attempt ***any four*** of the following:	20
a.		
b.		
c.		
d.		
e.		
f.		

   ii. **5 marks: Active participation in the class, overall conduct, attendance.**

2. **External Examination: (75 marks)**

	All questions are compulsory	
Q1	(Based on Unit 1) Attempt ***any three*** of the following:	15
a.		
b.		
c.		
d.		
e.		
f.		
Q2	(Based on Unit 2) Attempt ***any three*** of the following:	15
Q3	(Based on Unit 3) Attempt ***any three*** of the following:	15
Q4	(Based on Unit 4) Attempt ***any three*** of the following:	15
Q5	(Based on Unit 5) Attempt ***any three*** of the following:	15

3. **Practical / Tutorial Exam: 50 marks**

A Certified copy journal is essential to appear for the practical examination.

1.	Practical Question 1	20
2.	Practical Question 2	20
3.	Journal	5
4.	Viva Voce	5

OR

1.	Practical Question	40
2.	Journal	5
3.	Viva Voce	5

For Tutorial Exam, a paper of 50 marks to be solved.