

University of Mumbai



AAMS_UGS/ICD/2022-23/११

CIRCULAR:-

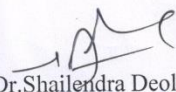
Sub:- B.Sc. (Data Science)) (CBCS).

Ref:- RB/MU-2020/CR-252/Edn-2/210, dated 16th February, 2021

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No.UG/59 of 2021 dated 21st January, 2021 relating to the Syllabus & Ordinances of B.Sc. Data Science (Sem.I & II).

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Computer Science at its meeting held on 15th June, 2022 vide item No. 1 and subsequently passed in the faculty and then by the Board of Deans at its meeting held on 5th July, 2022 vide item No. 6.15 (A) have been accepted by the Academic Council at its meeting held on 17th July, 2022 vide item No. 6.61 (A) and subsequently approved by the Management Council at its meeting held on 25th July, 2022 vide item No. 8 and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) for the **correction in the ordinance No.6606 for eligibility criteria for admission for the B.Sc. Data Science (Sem. I & II) (CBCS).**from the academic year 2021-22. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
15th September, 2022


(Dr. Shailendra Deolankar)
I/c. REGISTRAR

To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

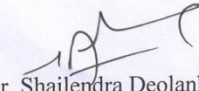
A.C/6.61 /11/07/2022
M.C./8/28/07/2022

No. AAMS_UGS/ICC/2022-23/११

15th September, 2022

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Ad-hoc Board of Studies in Computer Science,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Director, Department of Information & Communication Technology,
- 6) The Co-ordinator, MKCL.


(Dr. Shailendra Deolankar)
I/c. REGISTRAR

Copy for information and necessary action :-

1. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
2. **College Teachers Approval Unit (CTA),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA)**
5. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
6. **The Deputy Registrar, Executive Authorities Section (EA)**
He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
7. **The Deputy Registrar, PRO, Fort, (Publication Section),**
8. **The Deputy Registrar, Special Cell,**
9. **The Deputy Registrar, Fort Administration Department (FAD) Record Section,**
10. **The Deputy Registrar, Vidyanagari Administration Department (VAD),**

Copy for information :-

1. **The Director, Dept. of Information and Communication Technology (DICT), Vidyanagari,**
He is requested to upload the Circular University Website
2. **The Director of Department of Student Development (DSD),**
3. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**
4. **All Deputy Registrar, Examination House,**
5. **The Deputy Registrar, Finance & Accounts Section,**
6. **The Assistant Registrar, Administrative sub-Campus Thane,**
7. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
8. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
9. **P.A to Hon'ble Vice-Chancellor,**
10. **P.A to Pro-Vice-Chancellor,**
11. **P.A to Registrar,**
12. **P.A to All Deans of all Faculties,**
13. **P.A to Finance & Account Officers, (F & A.O),**
14. **P.A to Director, Board of Examinations and Evaluation,**
15. **P.A to Director, Innovation, Incubation and Linkages,**
16. **P.A to Director, Department of Lifelong Learning and Extension (DLLE),**
17. **The Receptionist,**
18. **The Telephone Operator,**

Copy with compliments for information to :-

19. **The Secretary, MUASA**
20. **The Secretary, BUCTU.**

University of Mumbai



Syllabus for B.Sc. (Data Science)
(Sem. – I & II)
(Choice Based Credit System)

(Introduced from the academic year 2021-22)

University of Mumbai



Syllabus for Approval

O: <u>6605</u> Title of Course	B.Sc. (Data Science)
O: <u>6606</u> Eligibility	<p>Any student who has completed HSC or equivalent in Arts / Science / Commerce / MCVC with Mathematics or Statistics as one of the subjects.</p> <p>Any student who has completed Diploma in IT / CS/ Electrical / Electronics / Mechanical / Civil / Electronics and Telecommunication / Instrumentation and allied branches from MSBTE or equivalent board.</p> <p>Any student who has completed HSC or equivalent in Arts / Science / Commerce / MCVC without Mathematics or Statistics will have to undergo a bridge course of 30 hours on Mathematics and Statistics.</p>
R: <u>9350</u> Duration of Course	3 years
R: _____ Intake Capacity	60
R: _____ Scheme of Examination	Choice Based Credit System
R: <u>9350-A</u> Standards of Passing	40%
No. of years/Semesters:	3 years - 6 Semesters
Level:	P.G. / U.G. / Diploma / Certificate (Strike out which is not applicable)
Pattern:	Yearly / Semester (Strike out which is not applicable)
Status:	Revised / New (Strike out which is not applicable)
To be implemented from Academic Year :	From Academic Year: 2021-22

Date:

Name: J.W. Bakal
Chairman of Ad-hoc BoS in
Computer Science

Signature:
Dr. Anuradha Majumdar
Dean, Science and Technology

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. This 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 decision 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

SEMESTER1

Course Code	CourseType	CourseName	Credits	Marks
USDS101	DSC	DescriptiveStatistics	2	100
USDS1P1	DSC	DescriptiveStatisticsPractical	2	50
USDS102	DSC	IntroductiontoProgramming	2	100
USDS1P2	DSC	IntroductiontoProgrammingPractical	2	50
USDS103	DSC	WebTechnology	2	100
USDS1P3	DSC	WebTechnologyPractical	2	50
USDS104	AECC	BusinessCommunicationandInformationEthics	2	100
USDS1P4	AECC	ICTPractical	2	50
USDS105	DSC	Precalculus	2	100
USDS1P5	DSC	PrecalculusTutorials	2	50
		Total	20	750

SEMESTER2

Course Code	CourseType	CourseName	Credits	Marks
USDS201	DSC	ProbabilityandDistributions	2	100
USDS2P1	DSC	ProbabilityandDistributionsPractical	2	50
USDS202	DSC	DatabaseManagement	2	100
USDS2P2	DSC	DatabaseManagementPractical	2	50
USDS203	DSC	RProgramming	2	100
USDS2P3	DSC	RProgrammingPractical	2	50
USDS204	AECC	EnvironmentalScience	2	100
USDS2P4	AECC	ProjectPresentationonDataScienceinEnvironmentalScience.	2	50
USDS205	DSC	Calculus	2	100
USDS2P5	DSC	CalculusTutorials	2	50
		Total	20	750

Proposed Courses in Semester 3, 4, 5 and 6 (Subject to change)

SEMESTER 3				
Course Code	Course Type	Course Name	Credits	Marks
USDS301	DSC	Testing of Hypothesis	2	100
USDS3P1	DSC	SPSS Practical	2	50
USDS302	DSC	Data Structures	2	100
USDS3P2	DSC	Data Structures Practical	2	50
USDS303	SEC	Microeconomics / Principles of Management	2	100
USDS3P3	SEC	Case Studies on Microeconomics	2	50
USDS304	DSC	Data Warehousing	2	100
USDS3P4	DSC	Data Warehousing Practical	2	50
USDS305	DSC	Linear Algebra and Discrete Mathematics	2	100
USDS3P5	DSC	Tutorials on Linear Algebra and Discrete Mathematics	2	50
Total			20	750

SEMESTER 4				
Course Code	Course Type	Course Name	Credits	Marks
USDS401	DSC	Optimization Techniques	2	100
USDS4P1	DSC	Optimization Techniques Practical	2	50
USDS402	DSC	Big Data	2	100
USDS4P2	DSC	Big Data Practical	2	50
USDS403	SEC	E-Commerce and Business Ethics / Fundamental of Accounting	2	100
USDS4P3	SEC	MATLAB Practical	2	50
USDS404	DSC	Algorithms in Data Science	2	100
USDS4P4	DSC	Algorithms in Data Science Practical	2	50
USDS405	DSC	Numerical Methods	2	100
USDS4P5	DSC	Numerical Methods Practical	2	50
Total			20	750

SEMESTER5

Course Code	CourseType	CourseName	Credits	Marks
USDS501	DSC	ArtificialIntelligence	2	100
USDS5P1	DSC	ArtificialIntelligencePractical	2	50
USDS502	DSC	BusinessResearchMethods	2	100
USDS5P2	DSC	BusinessResearchMethodsPractical	2	50
USDS503	DSC	DataMining	2	100
USDS5P3	DSC	DataMiningPractical	2	50
USDS504	SEC	CampustoCorporate	2	100
USDS5P4	DSC	ProjectDissertation	2	50
Elective1(Select Anyoneof thefollowing)				
USDS505a	DSE	ReinforcementLearning	2	100
USDS505b	DSE	MarketingandRetailAnalytics		
USDS505c	DSE	SupplyChainandLogisticsAnalytics		
USDS505d	DSE	RoboticProcessAutomation		
CompulsoryPractical				
USDS5P5	DSC	DataVisualisationwithPowerBI/Ta bleau	2	50
Total			20	750

SEMESTER6

Course Code	CourseType	CourseName	Credits	Marks
USDS601	DSC	MachineLearning	2	100
USDS6P1	DSC	MachineLearningPractical	2	50
USDS602	DSC	Cloud Computing	2	100
USDS6P2	DSC	CloudComputingPractical	2	50
USDS603	SEC	InternetofThings	2	100
USDS6P3	SEC	InternetofThingsPractical	2	50
USDS604	DSC	BusinessForecasting	2	100
USDS6P4	DSC	BusinessForecastingPractical	2	50
Elective2(Select Anyoneof thefollowing)				
USDS605a	DSE	FinancialAnalytics	2	100
USDS605b	DSE	SocialMediaAnalytics		
USDS605c	DSE	KnowledgeManagement		
USDS605d	DSE	DataSecurityandCompliance		
Compulsory(ProjectImplementation)				
USDS6P5	DSC	ProjectImplementation	2	100
Total			20	800

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Semester I

muquestionpapers.com

USDS101:DescriptiveStatistics

B.Sc.(Data Science)		Semester–I	
CourseName:DescriptiveStatistics		CourseCode:USDS101	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

CourseObjectives:

- To understand the use of data for tabulating and analyzing 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	<p>1.Introduction to Statistics and Use in Business:</p> <p>a) Meaning of Statistics as a Science, Importance of Statistics,</p> <p>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.</p> <p>c) Statistical organizations in India and their functions: CSO, ISI, NSS, IIPS (Devnar, Mumbai), Bureau of Economics and statistics.</p> <p>d) Case Study</p> <p>2.Types of Data and Data Condensation:</p> <p>a) Methods of sampling: Concept of population and sample. Finite, Infinite population, Notion of SRS, SRSWOR and SRSWR</p> <p>b) Types of Characteristics, Different types of scales: nominal, ordinal, interval and ratio scale. Linear and circular scale.</p> <p>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, failed data, industrial data, and directional data.</p> <p>d) Tabulation.</p> <p>e) Dichotomous classification - two and three attributes, Verification for consistency.</p> <p>f) Association of attributes: Yule's coefficient of association Q. Yule's coefficient of Colligation,</p> <p>g) Notion of a statistical population: Finite population infinite population, homogeneous population and heterogeneous population. Notion of a sample, random sample and non-random sample.</p>	12

	<p>3.PresentationofData</p> <p>a) Univariatefrequencydistributionofdiscreteandcontinuousvariables. Cumulativefrequencydistributionandrelativefrequencydistribution.</p> <p>b) Graphical representation of frequency distribution by Histogram,frequency polygon, Cumulative frequency curve. Stem and leafdiagram</p> <p>c) Checksheet,Paratodiagram</p>	
II	<p>4.Measuresofcentral tendencies</p> <p>a) Conceptofcentraltendencyof data.Requirementsforgoodmeasure</p> <p>b) Locationalaverages:Median,Mode,andPartitionValues:Quartiles, Deciles,andPercentiles,BoxPlot,Percentileranks</p> <p>c) MathematicalaveragesArithmeticmean(Simple,weightedmean,combinedmean), Geometricmean, Harmonicmean</p> <p>d) Empiricalrelationbetweenmean, medianand mode</p> <p>e) Meritsanddemeritsofusingdifferentmeasures&theirapplicability</p> <p>f) PartitionValues:Quartiles,DecilesandPercentiles,BoxPlot,Percentileranks</p> <p>5.Measuresof Dispersion,Skewness&Kurtosis</p> <p>a) Conceptofdispersion.Requirementsforgood measure.</p> <p>b) Absolute and Relative measures of dispersion: Range, QuartileDeviation,Mean absolutedevelopment, Standarddeviation.</p> <p>c) VarianceandCombinedvariance,rawmomentsandcentralmomentsand relations between them. Their properties</p> <p>d) Concept of Skewness and Kurtosis: Measures of Skewness: KarlPearson's,Bowley'sandCoefficientofskewnessbasedonmoments.MeasureofKurtosis</p>	12
III	<p>6.Meansquaredeviation:</p> <p>a) Definition, minimality property of mean square deviation (withproof),</p> <p>b) Variance and standard deviation: Definition, merits and demerits,effectofchangeoforiginandscale,combinedvariance(derivationfor 2 groups), combined standard deviation, generalization for n groups.</p> <p>c) Measuresofdispersionforcomparison:coefficientofrange,coefficient of quartile deviation and coefficient of mean deviation,coefficientofvariation (C.V.)</p>	12
IV	<p>7.Correlationandregression analysis</p> <p>a) ScatterDiagram,Productmomentcorrelationcoefficientanditsproperties.Spearman'sRankcorrelation.(Withandwithoutties)</p> <p>b) Conceptoflinearregression.Principleofleast squares.Fittingastraight lineby method ofleast squares.</p> <p>c) Relation between regression coefficients and correlationcoefficient.</p> <p>d) Fittingofcurvesreducibleto linearformbytransformation.Conceptand useofcoefficient of determination(R^2).</p>	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's significance as well as able to apply various techniques for the modelling.

USDS1P1:DescriptiveStatisticsPractical

B.Sc(DataScience)		Semester–I	
CourseName:DescriptiveStatisticsPractical		CourseCode:USDS1P1	
Periodsperweek(1Periodof50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

CourseObjectives:

- 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 kurtosis 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 function all library using insert function
c.	Add-Ins Analysis Toolpacks
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 charts suitable to the data.
- Do Data Entry and manipulation using data context, to transpose the tabular data, convert data into 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 to 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, template to improve presentation of data, represent cumulative frequency, data analysis, understand "cause analysis", make use of formula and analytical tool 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	
CourseName: Introduction to Programming		CourseCode:USDS102	
Periodsperweek(1Period is50minutes)		5	
Credit		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

Course Objectives:

- Learn Programming fundamentals using Python
- Understand the concepts and usage of 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	<p>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</p> <p>Data Types, Variables And Other Basic Elements: Comments, Docstrings, Data types- Numeric, Compound, Boolean, Dictionary, Sets, Mapping, Basic Elements of Python, Variables</p> <p>Input and Output Operations: Input Function, Output Statements, Command Line Arguments</p> <p>Control Statements: Control Statements- Loop Statement, The else Suite, break Statement, continue Statement, pass Statement, assert Statement, return Statement</p>	12
II	<p>Functions: Defining & Calling a Function, Returning Results, Returning Multiple Values, Built-in Functions, Parameters and Arguments, Recursive Functions, Anonymous or Lambda Functions</p> <p>Operators: Arithmetic operators, Assignment operators, Unary minus operator, Relational operators, Logical operators, Bitwise operators, Membership operators, Identity operators, Precedence of Operators, Associativity of Operators</p> <p>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</p>	12

	<p>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</p>	
III	<p>Lists and Tuples: Lists, List Functions and Methods, List Operations, Tuples</p> <p>Dictionaries: Creating a Dictionary, Operators in Dictionary, Dictionary Methods, Using for Loop with Dictionaries, Operations on Dictionaries, Ordered Dictionaries</p> <p>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</p> <p>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</p>	12
IV	<p>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</p> <p>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</p>	12
V	<p>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()</p> <p>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</p>	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	1 st	2018
2.	Python Data Science Handbook	Jake VanderPlas	O'Reilly Media	1 st	2016
3.	Let Us Python	Y. Kanetkar,	BPB	1 st	2019
4.	Programming in Python 3	Mark Summerfield	Pearson Education	2 nd	2018
5.	Learning Python	Lutz M	O'Reilly-Shroff	5 th	2013
6.	Beginning Python	Magnus Lie Hetland	Apress	2 nd	2009
7.	Star Python	Star Certification	Star Certification	1 st	2018

Course Outcome:

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

- Proficiency in using and applying various data types including, string, arraylist, 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(DataScience)		Semester–I	
CourseName:IntroductiontoProgrammingPractical		CourseCode:USDS1P2	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

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 to 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 of 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(DataScience)		Semester–I	
CourseName:Web Technology		CourseCode:USDS103	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

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 JavaScript.
- Giving knowledge about transmission of data on web page using JSON Object.

Unit	Details	Lectures
I	<p>Internet and the World Wide Web: What is Internet? Introduction to internet and its applications, E-mail, telnet, FTP, e-commerce, videoconferencing, 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 server – apache, IIS, proxy server, HTTP protocol</p> <p>What Is Web Design?: Defining Web Design, Web Design Themes, Learning Web Design.</p> <p>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</p> <p>HTML5: Introduction, Why HTML5? Formatting text by using tags, using lists and backgrounds, Creating hyperlinks and anchors.</p>	12
II	<p>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.</p> <p>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</p>	12

	forms:	
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	creating basic form, using checkboxes 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	<p>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</p> <p>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</p> <p>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</p> <p>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</p>	12
IV	<p>JavaScript: Introduction, Client-Side JavaScript, Server-Side JavaScript, JavaScript Objects, JavaScript Security</p> <p>Core JavaScript (Properties and Methods of Each) : Array, Boolean, Date, Function, Math, Number, Object, String, RegExp</p> <p>Document and its associated objects: document, document object methods, Link, Area, Anchor, Image, Layer</p> <p>Events and Event Handlers: General Information about Events, Defining Event Handlers, event, onAbort, onBlur, onChange, onClick, onDoubleClick, onDragDrop, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove, onReset, onResize, onSelect, onSubmit, onUnload</p>	12
V	<p>JSON: Introduction, JSON Grammar, JSON Values, JSON Tokens, Syntax, JSON vs XML, Data Types, Objects, Arrays, Creating JSON, JSONObject, Parsing JSON, Persisting JSON, Data Interchange, JSON HTML, JSONP</p>	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 HTML5 programming	Eric Freeman	O'Reilly		2013

4.	JavaScript 2.0: The Complete Reference	Thomas Powell and Fritz Schneider	TMH	2 nd	2004
5.	Beginning JSON	Ben Smith	Apress	1 st	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 beautifying the web pages.
- Understand and use the JavaScript 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(DataScience)		Semester–I	
CourseName:WebTechnologyPractical		CourseCode:USDS1P3	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

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 webpages 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 JavaScript.
- 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 webpage.
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 webpage.
c.	Demonstrate use of paragraph and its associated tags in webpage.
3.	Lists, images and semantics:
a.	Demonstrate use of multiple image tag in web page.
b.	Design a web page with Image maps.
c.	Design a web page demonstrating use of various semantic 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 webpage.
7.	JavaScript: Validating User fields
a.	Demonstrate the use of Document object methods.
b.	Using javascript, demonstrate validating Text Input Fields, Drop-down Lists and Checkboxes.
c.	Using javascript, demonstrate validating Radiobuttons and Validating Multi-Select Boxes.
8.	JavaScript : Handling the events
a.	Using javascript, demonstrate the use of onAbort, onBlur, onChange, onClick, onDoubleClick events.
b.	Using javascript, demonstrate the use of onDragDrop, onError, onFocus events.
c.	Using javascript, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events.
d.	Using javascript, demonstrate the use of onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove events.
e.	Using javascript, 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 javascript.
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 webpage using document object.
b.	Read data from json file and convert it into a JavaScript object and display the data in webpage 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 webpages.
- Use User controls and embed Multimedia in webpage.
- Use and apply CSS with list, links, font style etc. in webpage.
- Use and apply JavaScript for Validating User fields on webpage.
- Create, parse and persist the JSON object and extract and use its values on webpage.
- Use JSON Object with arrays and message formatting on webpage.

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	75
	Internal	--	25

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 carry out 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:ICTPractical

B.Sc(DataScience)		Semester–I	
CourseName:ICTPractical		CourseCode:USDS1P4	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

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:

- Effectively 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(DataScience)		Semester– I	
CourseName:Precalculus		CourseCode:USDS105	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

CourseObjectives:

- Tomasterthenumberfundamentals, equationsanddifferenttypesofmathematicalfunctions
- Toreview andexplainthetrigonometryandgainexpertise trigonometricidentities.
- Tounderstandanalyticaltrigonometryandinverse functions.
- Togivethedetailed knowledgeaboutcomplexnumbers, vectorsandmatrices.
- Tounderstandtheconics, sequencesandseriesand

Unit	Details	Lectures
I	<p>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.</p> <p>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.</p> <p>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.</p>	12
II	<p>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.</p> <p>Trigonometric Functions: Unit Circle Approach: The Unit Circle, Trigonometric Functions of Real Numbers, Trigonometric Graphs, Inverse Trigonometric Functions and Their Graphs, Modelling Harmonic Motion</p> <p>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.</p>	12
III	<p>Analytic Trigonometry: Trigonometric Identities, Addition and Subtraction Formulas, Double-Angle, Half-Angle, and Product-Sum Formulas, Basic Trigonometric Equations, More Trigonometric Equations</p>	12

	<p>Sinusoidal Functions: A special class of functions, Sketching a sinusoidal graph, Functions not in standard sinusoidal form, sinusoidal behaviour.</p> <p>Inverse Circular Functions: Solving three equations, inverse Circular functions, applications, solving trigonometric equations</p>	
IV	<p>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</p> <p>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</p> <p>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</p>	12
V	<p>Conic Sections: Parabolas, Ellipses, Hyperbolas, Shifted Conics, Rotation of Axes, Polar Equations of Conics</p> <p>Sequences and Series: Sequences and Summation Notation, Arithmetic Sequences, Geometric Sequences, Mathematics of Finance, Mathematical Induction, The Binomial Theorem</p> <p>Limits: A Preview of Calculus: Finding Limits Numerically and Graphically, Finding Limits Algebraically, Tangent Lines and Derivatives, Limits at Infinity; Limits of Sequences, Areas</p>	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 McGraw Hill	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 number 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:PrecalculusTutorials

B.Sc(DataScience)		Semester– I	
CourseName:Prccalculus Tutorials		CourseCode:USDS1P5	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	TutorialExamination	2½	50
	Internal	--	--

*10Tutorialsbased onthePrecalculus(USDS105)theoryshouldbeconducted.

Semester II

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USDS201:Probabilityand Distributions

B.Sc(DataScience)		Semester–II	
CourseName:ProbabilityandDistributions		CourseCode:USDS201	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

CourseObjectives:

- Toexploreaboutrandomvariablesandimplement variousdistributionfunctions
- Tofamiliarizewithconceptsofprobabilityandlearnimplementationofdifferentsofprobabilities.
- Learnandimplementtheconceptofexpectation,relatedtheoremsandgeneratingfunctions
- ToknowtheconceptandimplementationofdiscretedistributionsincludingBernoulli,Binomial and power series distributions
- Togetacquaintedwiththeoryandpracticalimplementationofconceptsofcontinuousdistributions

Unit	Details	Lectures
I	TheoryofProbability: Introduction,history,differentterms,mathematical tools, Axiomatic approach to probability, Mathematicalnotation,multiplicationawandconditionalprobability,Bayestheorem, Geometricprobability.	12
II	Random Variables and Distribution Functions: Random Variable,distributionfunction,discreterandomvariable,continuousrandomvariable,jointprobabilitylaw,transformationofone-dimensionalrandomvariable,transformationoftwo-dimensionalrandomvariable	12
III	MathematicalExpectationandGeneratingFunctions: Mathematical expectation, Expectation of a Function of a Random Variable,AdditionTheoremofExpectation,MultiplicationTheoremofExpectation,ExpectationofaLinearCombinationofRandomVariables, Covariance, Variance of a Linear Combination of RandomVariables,MomentsofBivariateProbabilityDistributions,ConditionalExpectation and Conditional Variance, Moment Generating Function,Cumulants,CharacteristicFunction,Chebychev'sInequality, Convergence in- Probability, Weak Law of Large Numbers, BorelCanteliLemma, ProbabilityGenerating Function	12
IV	TheoreticalDiscreteDistributions: Introduction,BernoulliDistribution ,BinomialDistribution,PoissonDistribution,NegativeBinomialDistribution,GeometricDistribution,HypergeomeiricDistribution, Multinomial Distribution, Discrete Uniform Distribution,PowerSeries Distribution	12
V	TheoreticalContinuousDistributions: RectangularorUniformDistribution,NormalDistribution,GammaDistribution,BetaDistribution of First Kind,Beta Distribution of Second Kind, TheExponentialDistribution,LaplaceDoubleExponentialDistribution,	12

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

B.Sc(DataScience)		Semester–II	
CourseName:ProbabilityandDistributionsPractical		CourseCode:USDS2P1	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

CourseObjectives:

- Toprovidestudentswiththefoundationsofprobabilisticandstatisticalanalysismostlyusedin varied applications in engineeringand science
- Topracticallylearnthetheory conceptsandapplyin realtime

ListofPractical: (Can bedoneinMS-Excel-oranySpreadsheet)	
1	IntroductiontoProbability:
a	Formulate and apply Bayes' Theorem Calculations for problems like The "Two-Supplier Example". [Hint: Use Prior Probabilities and Conditional Probabilities tocomputeJoint and PosteriorProbabilities.]
b	Design spreadsheet to demonstrate the association Between Two Variables byComputingtheCovarianceandCorrelationCoefficient.[Hint:UseCOVARandCORREL)]
2	DiscoverProbabilityusingformulas:
a	Designandspreadsheetexperimenttocomputetheprobabilityusingthegeometricdistributionformula.
b	CreateaspreadsheetapplicationtocomputetheConditionalProbability.Also determinetheprobabilitythatarandomlychosenevent.
3	Random VariablesandDistributionFunctions:
a	CreateaspreadsheetapplicationtoComputetheExpectedValue,Variance,andStandardDeviation
b	CreateaspreadsheetapplicationtoComputeBinomialProbabilities.[HintUseBINOMDIST]
4	ProbabilityDistributionandLaw:
a	CreateaspreadsheetapplicationtoPoissonProbabilityDistribution.[Hint:UsePOISSON]
b	Createaspreadsheetapplicationtoimplement jointprobabilitylaw.
5	MathematicalExpectationandChebychev'sTheorem:
a	Createa spreadsheetapplicationtocompute theexpectationof aFunctionof aRandomVariable
b	CreateaspreadsheetapplicationtoapplyChebychev's Theorem.

6	Conditional Expectation and Generating Functions:
a	Create spreadsheet application to compute Conditional Expectation and Conditional Variance.
b	Create 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 spreadsheet application for computing probabilities and z values for the standard normal distribution. [Use NORMSDIST and NORMSINV]
b	Create spreadsheet application for computing probabilities for the exponential probability distribution. [Hint: Use EXPONDIST]
10	Theoretical Continuous Distributions 2:
a	Create spreadsheet application for demonstrating Weibull Distribution to obtain a model for data sets. [Hint: Use WEIBULL.DIST]
b	Create spreadsheet 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:DatabaseManagement

B.Sc(DataScience)		Semester–II	
CourseName:DatabaseManagement		CourseCode:USDS202	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

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	<p>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</p> <p>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</p> <p>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.</p>	12
II	<p>Advanced Data Modeling: The Extended Entity Relationship Model, Entity Clustering, Entity Integrity: Selecting Primary Keys, Design Cases: Learning Flexible Database Design</p> <p>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</p>	12
III	<p>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</p>	12

IV	<p>AdvancedSQL:DataDefinitionCommands,CreatingTableStructures, Altering Table Structures, Data Manipulation Commands,VirtualTables:CreatingaView,Sequences,ProceduralSQL, EmbeddedSQL</p> <p>DatabaseDesign:TheInformationSystem,TheSystemsDevelopmentLifeCycle,TheDatabaseLifeCycle,ConceptualDesign,DBMSSoftwareSelection,LogicalDesign,PhysicalDesign,DatabaseDesignStrategies,Centralized versus DecentralizedDesign</p>	12
V	<p>Transaction Management and Concurrency Control: What Is aTransaction?ConcurrencyControlwithLockingMethods,ConcurrencyControlwithTimeStampingMethods,ConcurrencyControlwithOptimisticMethods,ANSILevelsofTransactionIsolation,DatabaseRecovery Management</p> <p>Database Performance Tuning and Query Optimization: DatabasePerformance-Tuning Concepts, Query Processing, Indexes and QueryOptimization, Optimizer Choices, SQL Performance Tuning, QueryFormulation,DBMSPerformanceTuning,QueryOptimizationExamples</p> <p>Database Administration and Security: Data as a Corporate Asset,The Need for a Database and Its Role in an Organization, Introductionof a Database:SpecialConsiderations,The Evolutionof DatabaseAdministration,TheDatabaseEnvironment'sHumanComponent,Security,DatabaseAdministrationTools,DevelopingaDataAdministration Strategy, The DBA's Role in the Cloud, The DBA atWork:Using Oracle forDatabase Administration</p>	12

BooksandReferences:					
Sr.No.	Title	Author/s	Publisher	Edition	Year
1.	Fundamentals ofDatabaseSystems	ElmasriRamez andNavatheShamkantB,	PearsonEducation	6thEdition,	2010.
2.	Database SystemConcepts	Silberschatz,Korth, Sudarshan,	McGraw Hill,	5 Edition,	2006.
3.	DatabaseManagement Systems,	Ramakrishnam, Gehrke,	McGraw-Hill,		2007
4.	Murach'sMySQL	JoelMurach,	Murach,		2012

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- Studentsshouldbeabletoevaluatebusinessinformationproblem andfindtherequirementsof aproblem in terms of data.
- Studentsshouldbeabletodrawdatabasesdesigninlogicalstructureandcanidentifytheentities which exist in a system
- Studentsshouldbe able toconstructnormalizeddatabaseandfunctionaldependenciesbetweenattributes and relational algebraqueries
- Studentsshouldbeabletodesignthedatabaseschemawiththeuseofappropriatedatatypesfor storageof data in database.
- Studentsshouldbeableto create,manipulate,queryandbackupthedatabaseswithfeaturesof SQL.

USDS2P2:DatabaseManagementPractical

B.Sc(DataScience)		Semester–II	
CourseName:DatabaseManagement Practical		CourseCode:USDS2P2	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

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 a 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.	Forgiveness 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.	SimpleQuerieswithAggregate functions
d.	QuerieswithAggregate functions(groupbyandhavingclause)
6.	PerformQueriesinvolving:
a.	DateFunctions
b.	StringFunctions
c.	MathFunctions
7.	RetrievingData fromMultipleTable:
a.	JoiningTables(InnerJoins,Outer-Joins)
b.	AliasesforTableNames
8.	Subqueries:
a.	WithINclause
b.	WithEXISTSclause
c.	HandlingNULL
9.	Views:
a.	CreatingViews
b.	DroppingViews
c.	Selectingfromview
10.	DCLstatements:
a.	Grantingandrevokingpermissions

CourseOutcomes:

Aftercompletion ofthecourse,astudent shouldbeableto:

- Studentsabletodrawrelationshipdiagram.
- Studentsabletoperformvariousoperationssuchasinsert,updatedeleteandretrieve datafrom databaseusingSQLqueries.
- Studentsabletoperformalterationintablesandcanrestoreandtakebackupofthedatabase.
- Studentsabletoperformoperations using simpleSQLQuerystofetchdataandlearnsvariousaggregate functions to get single value.
- StudentsabletoperformSQLQueriesusingJOINkeywordforjoiningtwoormorettables.
- Studentsabletoperform nestedqueriesusingin,existsoperators.
- Studentsabletocreatenewtablebyjoiningoneormorettablesandlearnhowtohideattributefro m end user.
- Studentsabletorestricttheuser fromaccessingdataindatabase.

USDS203:RProgramming

B.Sc(DataScience)		Semester–II	
CourseName: RProgramming		CourseCode:USDS203	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

CourseObjectives:

- MastertheuseoftheRinteractiveenvironmentandexpandingbyinstallingRpackages
- ReadStructuredDataintoRfromvariousources
- Understandthedifferent datatypes anddatastructures inR
- Manipulatestrings,datesinR
- Understandbasicregular expressionsinR
- UnderstandbaseR graphics
- FocusonGGplot2graphicsforRandbe familiar withtrellis(lattice)graphics.

Unit	Details	Lectures
I	<p>GettingstartedwithR:RSoftware:ObtainingRandRStudio,FirstREncounter, Getting started: R as a big calculator, Assignment, Basicoperators, Help with functions and features, Quiz, A few importantpoints on R WorkingwithR</p> <p>RInterfaces- UsingRandRStudio:RSoftware,ObtainingRandRStudio,ThedefaultRinterface,RStudioInterface,ExampleDatasetsin R, R Packages, Installing new R libraries, Customizing R Start-up</p> <p>ObjectsinR:UsinglsandrmtomanagingRObjets,TypesofRObjets,AttributesofRObjets,Creatingandaccessingobjects,Modifyingelements, Quick recap, Exercise</p> <p>Reading and writing data to and from R: Importing and reading textfiles data into RStudio, Importing data using R command read.table(),Exercise,ImportingtextfilesUsingscan(),Parsingeachline–Readlines, Writing Data table from R, Exercise, Importaing Data fromother Software, Reading data from Excel into R, Import/Export fromotherstatisticalsoftware,FromaDatabaseConnection,Samplingand Creatingssimulateddata,Exercise</p>	12
II	<p>Introduction to programming and writing Functions in R: Why dowe want to write functions?, Conditional statements (if, ifelse, switch),Repetitiveexecution:ForandWhileloops,TheApplyFunctions,Exercise,Functionsforparsingtext,ProgramminginR:Moreadvanced,ViewingCodeoffunctionsfromRpackages,Exercise-Parsing Real Data - World Population Data from Wikipedia, Writingfunctions: more technical discussion -Scoping, Options for Runningmemoryor CPU intensive jobs in R, Efficient Rcoding</p> <p>IntroductiontographicsinR:TheRfunctionplot(),Exercise,Customizeplotwithlow-levelplottingcommands,Defaultparameters –par,Interactingwithgraphics,Savingplots,UsefulGraphicsResources</p>	12

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

Books and References:					
Sr.No.	Title	Author/s	Publisher	Ediⁿ	Year
1.	Introduction to Programming and Statistical Modelling in R	Aedin Culhane	HARVARD SCHOOL	1 st	2013
2.	R Data Science Quick Reference	Thomas Mailund	Apress	1 st	2019
3.	THE BOOK OF R	Tilman M. Davies	Nostarchpress	1 st	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 within 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 manipulate Data Frames and make use of Dates in R application.

USDS2P3:RProgrammingPractical

B.Sc(DataScience)		Semester–II	
CourseName:RProgrammingPractical		CourseCode:USDS2P3	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	PracticalExamination	2½	50
	Internal	--	--

CourseObjectives:

- Tolearnimplementing expressionsinR
- Tolearnandimplementcontrolflowusingloops
- ToexploreandusebasicdatastructuresinR

ListofPractical:	
1.	IntroductiontoRProgrammingElements
a.	WriteanRProgramtoimplement expressions,assignment and decisionmaking
b.	Writean RProgramtodesign andimplementloops.
c.	Write a R program to demonstrate the use of essential data structures in R [Hint: Vectors, Matrix, Arrays]
2.	UsingList,DataFramesandFunctionsin R
a.	WriteanRprogramto managedataandexhibitoperationsonitusingListdatastructure
b.	WriteanRprogramtomanagedataandexhibitoperationsonitusing DataFrames
c.	Writean Rprogram to demonstratetheuseof : i. user-definedfunctions ii. built-innumericfunction,characterfunctionsetc.
3.	ImplementingStringsinR
a.	WriteanR programto storeandaccess stringin Robjects(vectors,matrix,arrays,data frames, and lists)
b.	WriteanRprogramtodemonstrate useofvariousstringmanipulation functions.[Hint: paste(), print(), noquote(), format(), cat(), toString(), sprint()]
4.	PerformingStatisticswithR-I
a.	Write an R program to apply built-in statistical functions. [Hint: mean, median, standarddeviation and others]
b.	WriteanRprogramtodemonstrateLinearandMultipleRegressionanalysis.
5.	PerformingStatisticswithR-II
a.	WriteanR programtoimplement i. NormalDistribution.[Hint:dnorm(),pnorm(),qnorm(),rnorm()] ii. BinomialDistribution:[Hint:dbinom(),pbinom(),qbinom(),rbinom()]
b.	WriteanRprogram toperformtime-seriesanalysis forthegivendata.
6.	DataVisualizationandAnalysis
a.	WriteanRprogramtolearnaboutTabulationandrelatedconcepts[Hint:ContingencyTables,SelectionofParts,Conversion,ComplexTables,CrossTabulation]

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 R MySQL 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(), Calling Handlers()]
10.	Measuring Performance
a.	Write R program to measure the performance with the help of built-in function like microbenchmark().

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 skill 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 error etc., and able to identify and handle errors in R code
- To analyze performance of the R code.

USDS204:EnvironmentalScience

B.Sc(DataScience)		Semester–II	
CourseName:Environmental Science		CourseCode:USDS204	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

CourseObjectives:

- 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	<p>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</p> <p>Natural Resources Forest Resources, Dams, Water Resources, Food Resources, Energy Resources, Land Resources</p>	12
II	<p>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</p> <p>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</p>	12
III	<p>Environmental Pollution Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Solid Waste Management, Hazardous Waste Management, Pollution Prevention, Disaster Management</p> <p>Human Population and the Environment Population Growth, Human Rights, Value Education, HIV/AIDS, Environment and Human Health, Family Welfare Programmes, Women</p>	12

	and Child Welfare, Role of Information Technology in Environment and Human Health	
IV	<p>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</p>	12
V	<p>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</p> <p>Sustainable Development Ethics, Laws of Nature, Progress, Environmental Stress, Sustainability, Self-purification and Regeneration, Action Plan, Computerization and Information Technology</p>	12

Books and References:					
Sr.No.	Title	Author/s	Publisher	Edition	Year
1.	Environmental Studies	Benny Joseph	McGraw Hill	3 rd	2017
2.	Principles of Environmental Science and Engineering	P.Venugopala Rao	PHI Learning	6 th	2014
3.	Introduction to Environmental Engineering	Gilbert M Master	Pearson	3 rd	2015
4.	Environmental Ethics: A Very Short Introduction	Robin Attfield	Oxford	1 st	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:CaseStudiesonEnvironment

B.Sc(DataScience)		Semester–II	
CourseName:CaseStudies onEnvironment		CourseCode:USDS2P4	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	TutorialExamination	2½	50
	Internal	--	--

* 10Casestudiesrelated toEnvironmentalScience(USDS204)shouldbe conducted.

USDS205: Calculus

B.Sc(DataScience)		Semester–II	
CourseName:Calculus		CourseCode:USDS205	
Periodsperweek(1Period is50minutes)		5	
Credits		2	
		Hours	Marks
EvaluationSystem	TheoryExamination	2½	75
	Internal	--	25

CourseObjectives:

- 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	6 th	2008
2.	Calculus and Analytical Geometry	George B. Thomas Jr., Ross L. Finney, Maurice D. Weir	Addison 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 a variety of problems.

USDS2P5:CalculusTutorials

B.Sc(DataScience)		Semester–II	
CourseName:CalculusTutorials		CourseCode:USDS2P5	
Periodsperweek(1Period is50minutes)		3	
Credits		2	
		Hours	Marks
EvaluationSystem	TutorialExamination	2½	50
	Internal	--	--

* 10tutorialsbasedonCalculus(USDS205)should beconducted.

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 <i>any three</i> of the following:	15
a.		
b.		
c.		
d.		
e.		
f.		
Q2	(Based on Unit 2) Attempt <i>any three</i> of the following:	15
Q3	(Based on Unit 3) Attempt <i>any three</i> of the following:	15
Q4	(Based on Unit 4) Attempt <i>any three</i> of the following:	15
Q5	(Based on Unit 5) Attempt <i>any three</i> 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.

Bridge Course on Mathematics and Statistics

The students who have not opted for Mathematics during their class 12 will have to complete the bridge course for being eligible for the admission to First Year of B.Sc. Data Science.

The training should be for 30 hours, 2 hours session on each of the following topics followed by examination of 75 marks with 5 marks questions on each of the following topics.

1. Measurement of Angles
2. Trigonometric Functions
3. Trigonometric Functions of compound Angles
4. Factorization Formulae
5. Linear inequations
6. Determinants
7. Logarithms
8. Sequences
9. Permutations and Combinations
10. Mathematical Induction
11. Binomial Theorem
12. Differentiation
13. Integration
14. Statistics
15. Probability

Question paper pattern:

Q I	Attempt <i>any three</i> of the following:	15
1.	Measurement of Angles	
2.	Measurement of Angles	
3.	Trigonometric Functions	
4.	Trigonometric Functions	
5.	Trigonometric Functions of compound Angles	
6.	Trigonometric Functions of compound Angles	
Q II	Attempt <i>any three</i> of the following:	15
1.	Factorization Formulae	
2.	Factorization Formulae	
3.	Linear inequations	
4.	Linear inequations	
5.	Determinants	
6.	Determinants	
Q III	Attempt <i>any three</i> of the following:	15
1.	Logarithms	
2.	Logarithms	
3.	Sequences	
4.	Sequences	
5.	Permutations and Combinations	
6.	Permutations and Combinations	
Q IV	Attempt <i>any three</i> of the following:	15
1.	Mathematical Induction	
2.	Mathematical Induction	
3.	Binomial Theorem	

4.	Binomial Theorem	
5.	Differentiation	
6.	Differentiation	
Q V	Attempt <i>any three</i> of the following:	15
1.	Integration	
2.	Integration	
3.	Statistics	
4.	Statistics	
5.	Probability	
6.	Probability	

Nominal fee can be charged for the bridge course to cover the training, examination and result declaration cost.

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Send by Dr. B. Balraj (M)

18.11.2020

B.Sc. Data Science under Computer Science

JUSHM Cotton

A/c No. 4115

M.C. Item No. 2

A/c IV/122

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1. Necessity of starting the course.

Data science can be defined as a blend of mathematics, business acumen, tools, algorithms and machine learning techniques, all of which help us in finding out the hidden insights or patterns from raw data which can be of major use in the formation of big business decisions.

In data science, one deals with both structured and unstructured data. The algorithms also involve predictive analytics in them. Thus, data science is all about the present and future. That is, finding out the trends based on historical data which can be useful for present decisions and finding patterns which can be modelled and can be used for predictions to see what things may look like in the future.

Data Science is an amalgamation of Statistics, Tools and Business knowledge. So, it becomes imperative for a Data Scientist to have good knowledge and understanding of these.

With the amount of data that is being generated and the evolution in the field of Analytics, Data Science has turned out to be a necessity for companies. To make most out of their data, companies from all domains, be it Finance, Marketing, Retail, IT or Bank. All are looking for Data Scientists. This has led to a huge demand for Data Scientists all over the globe. With the kind of salary that a company has to offer and IBM is declaring it as trending job of 21st century, it is a lucrative job for many. This field is such that anyone from any background can make a career as a Data Scientist.

2. Whether UGC has recommended to start the said course?

Yes, UGC in its recommendation and curriculum design mentions about the data science programme.

3. Whether all the courses have commenced from the academic year 2019-20?

The B.Sc. in Data Science course has commenced from the academic year 2020 - 21.

4. The courses started by University are self-financed, whether adequate number of permanent faculties are available?

The field being very new, there are faculties available in various colleges and as the Data Science is amalgamation of various fields, many of the permanent faculties are available for the course.

5. To give details regarding the duration of the course and is it possible to compress the course?

Present Duration: 3 years (Six semesters)

To give proper justice to the teaching learning, it is essential to have 3-year, 6-semester course. The contents cannot be compressed nor the duration can be reduced. Lot of practical exposure is needed and hence it cannot be compressed.

6. Intake capacity of the course and the number of admissions given in the current academic year 2020 - 21

The intake capacity per batch in any college is 60. The number of admissions given during the current academic year (2020 - 21) is _____

7. Opportunities of Employability / Employment available after undertaking these courses.

The course has extensive hands-on practical training and various job roles and recruiters are as follows:

Business Analytics Professional

A business analytics professional has the skills to make use of the information from

Opportunities of employability / employment available after undertaking these courses.

The course has extensive hands-on practical training and various job roles and recruiters are as follows:

Business Analytics Professional

A business analytics professional has the skills to make use of the information from the data to generate insights about the business. To be a data focused business analytics professional, you must know the technical components related to managing and manipulating data.

Recruiters: Walmart, Conduent, Genpact etc.

Business Intelligence Professional

A Business Intelligence Professional analyse the past trends using Data Visualization tools like Tableau, Power BI etc to develop and implement business strategies. They also monitor all the performance metrics of the company and provide insight to the respective department.

Recruiters: Accenture, ZS Associates, Sun Pharma etc.

Data Scientist

Data Scientists help build complicated data models and simulations in a Big Data environment. Focusing more on math and statistics, these data scientists have a particular interest in reading statistics and building & deploying machine learning models.

Recruiters: HDFC Bank, Amdocs, Oyo etc.

Big Data Analysts

Job responsibilities of a Big Data Analyst include collaborating with data scientists and data architects to ensure streamlined implementation of services and executing big data processes.

Recruiters: Novartis, Allertn Tech, Amazon AWS etc.

HR-Analytics Professionals

HR Analytics is the hottest trends in the industry. HR Analytics professionals are working on how to reduce employee attrition rate, finding out the best recruitment channels and solving appalling problems related to HR Function.

Recruiters: Lenskart, Mearsk, Ericsson etc.

Marketing Analytics Professionals

Due to the abundance of data in all the marketing campaign, Analytics enable the marketing professionals to evaluate the success of their marketing initiatives. This is accomplished by measuring performance.

Recruiters: Microsoft, Deloitte, Reliance etc.

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