Admission of Students and Conduct of Examinations Leading to the Award of Three Years Degree Program entitled "B. Sc. Data Science" under Credit System and As per NEP 2020 in the Faculty of Science & Technology, Direction 2023"

Whereas, The Maharashtra Public Universities Act,2016 (Maharashtra Act No. VI of 2017) (hereinafter the "Act") governs the Gondwana University, Gadchiroli (hereinafter the " University");

AND

Whereas, the National Education Policy (NEP) 2020 focuses on education and skill development as per the needs of the community and as per Maharashtra State Government Resolution of Higher and Technical Education Dipartment No. NEP-2020/Pr.kr.09/UE-3/SHIKANA, dated 20 April 2023, therefore, the University is introducing Three Years Degree Programme entitled **"B. Sc. Data Science"** under credit system and as per NEP 2020 in the Faculty of Humanities and it will be offered by the Model Degree College, a constituent college of the University;

AND

Whereas, as per provisions of section 73(1) of the Act, an ordinance is required to frame to lay down the conditions under which students can be admitted to courses of study for award of a Certificate but since, making of an ordinance is a time-consuming process and there is an urgency for introduction of Three Years Degree Programme entitled **"B. Sc. Data Science"** under credit system and as per NEP 2020 in the Faculty of Science & Technology;

Now, therefore, I, Dr. Prashant Shridhar Bokare, Vice-Chancellor of the University, in exercise of my powers under section 12(8) of the Act, do hereby issue the following Directions.

This Direction shall be called **Admission of Students and Conduct of Examinations Leading to the Award of Three Years Degree Program entitled "B. Sc. Data Science" under Credit System and as per NEP 2020 in the Faculty of Science & Technology, Direction 2023"**

1. This direction shall come into force from the date of its issuance.
2. Definitions: -In this Direction, unless the context requires otherwise, the words and phrases shall have the meaning given hereunder.

   a) "Program" means the full-time Three Years Degree Programme entitled **"B. Sc. Data Science"** "Application Form" means a form prescribed by the University for seeking admission to Program under this direction.
   b) "Competent Authority" means the Authority appointed by the Vice-Chancellor, for any specific purpose of the Program under this Direction.

f) 'Grade letter' is an index to indicate the performance of a student in particular course. It is the depiction of actual marks secured by a student by a letter, the Grade letters are as given in **Table 3.**

g) 'Grade point' is the weightage allotted to each grade letter depending on the range of marks awarded in a course.

h) "HSSC" means the Higher Secondary School Certificate (Standard XII) examination conducted by Maharashtra State Board of Secondary and Higher Secondary Education or its equivalent certificate awarded by any other recognized Board.

i) "Qualifying Examination" means an examination on the basis of which a candidate becomes eligible for admission to this Program.

3. In order to conduct the admission process for admitting students to this Program, the Vice Chancellor shall appoint the "Competent Authority".

4. Intake capacity, Eligibility for application, Admission fees, Curriculum, Examination fees for this Program will be as shown in Table 1 below:

Table: 1

Sr. No.	Subtitle	Details
1	Intake Capacity	20
2	Eligibility for application	HSSC Science
3	Admission Fees	Admission fees shall be as prescribed/ revised and notified from time to time by the University.
4	Curriculum	As specified in **Annexure-I**
5	Examination Fees	The Examination fees shall be as prescribed/ revised and notified from time to time by the University.

5. **Objectives of the Program: -**
   (a) This course aims to extraction of knowledge from large volumes of data that are structured or unstructured, which is continuation of data mining and predictive analytics.
   (b) Instill object oriented programming concepts.
   (c) Foster Problem-solving skill using data structure and enable data analysis and visualization techniques for effective information communication and computational tasks.

6. **EVALUATION OF THE PROGRAM**

The internal and university assessment of student performance shall be carrying the weightage as mentioned in the Teaching and Examination Scheme given below:

Table 2: Teaching and Examination Scheme
"B. Sc. Data Science"
Teaching & Examination Scheme
Semester - I

Sr. No.	Subject	Credit	Teaching scheme Hrs/week			Examination Scheme Total Marks The./Pra.									
			Theoy	Pra.	Total	Theory					Practical				
						Duration Hrs.	Max. Theory		Total	Min Pass	Dur. Hrs.	Max Marks		Min.Pass Marks	Total Marks
							UA	CA				UA	CA		
1	Data Structure and Algorithom using python	4	4	-	4	3	80	20	100	40	-	-	-	-	100
2	Discrete Mathematics	2	2	-	2	2	40	10	50	20	-	-	-	-	50
3	Introduction to Programming	2	2	-	2	2	40	10	50	20	-	-	-	-	50
4	Web Technology	2	2	-	2	2	40	10	50	20	-	-	-	-	50
5	Business Communication and Information Ethics	2	2	-	2	2	40	10	50	20	-	-	-	-	50
6	Environment Protection Law	2	2	-	2	-	-	50	50	20	-	-	-	-	50
	Precalculus	2	2	-	2	-	-	50	50	20	-	-	-	-	50
7	Web Technology Practical	2	-	4	4	-	-	-	-	-	2	30	20	25	50
8	ICT Practical	2	-	4	4	-	-	-	-	-	2	30	20	25	50
	Total	20	16	8	24	-	240	160	400	-	-	60	40	-	500

Semester - II

Sr. No.	Subject	Credit	Teaching scheme Hrs/week			Examination Scheme Total Marks The./Pra.									
			Theoy	Pra.	Total	Theory					Practical				
						Duration Hrs.	Max. Theory		Total	Min Pass	Dur. Hrs.	Max Marks		Min.Pass Marks	Total Marks
							UA	CA				UA	CA		
1	Data base Management System	4	4	-	4	3	80	20	100	40	-	-	-	-	100
2	R Programming	2	2	-	2	2	40	10	50	20	-	-	-	-	50
3	Data Analysis	2	2	-	2	2	40	10	50	20	-	-	-	-	50
4	Internet of Things embedded system	2	2	-	2	2	40	10	50	20	-	-	-	-	50
5	Morden Indian Language (Marathi/Hindi)	2	2	-	2	2	40	10	50	20	-	-	-	-	50
6	Project Presentation on Data Science in Environmental Science.	2	2	-	2	2	-	50	50	20	-	-	-	-	50
7	Data Base Management	2	-	4	4	-	-	-	-	-	2	30	20	25	50
8	R Programming	2	-	4	4	-	-	-	-	-	2	30	20	25	50
9	Data Base Management System	2	-	4	4	-	-	-	-	-	2	30	20	25	50
	Total	20	14	12	26	-	240	110	350	-	-	90	60	-	500

Note:
1. Th=Theory; Pr = Practical; PR=Project; INT=Internship IA = Internal Assessment UA = University Assessment.
Credit Calculations: (1) One credit would mean equivalent of 15 periods of 60 minutes each for Theory.(2) For practical /project /internship/Field work, the Credit Weightage for equivalent hours shall be 50% of that for theory. (3) The strength of Batch of Practical /Workshop / internship / Field visit / Project shall be 20. (4) 10 contact hours equals to 3 credits per semester and 6 credits for two semesters viz one year duration for Project/Field Visit/Industrial Training/Internship
*On Job Training

a. Marks to Letter Grade & Grade Point Conversion

The marks scored by the examinees in their courses/heads of passing of the program shall be converted into Letter Grade and Grade Point as per Table given below:

Table 3: Conversion of marks into letter grade and grade points

Letter Grade	Grade Point
O (out standing)	10
A+ (Excellent)	9
A (Very good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

*Note: As such, the lowest passing Grade in any passing head shall be 'P'.

a) Calculation of Grade Point Average (GPA)

The Grade Point Average (GPA) shall be calculated for the program and shall be evaluated as mentioned below:

$$GPA = \frac{\sum_{i=1}^{n}(C_i \times G_i)}{\sum_{i=1}^{n} C_i}$$

Where C_i is the number of credits of the ith course and G_i is the grade point scored by the student in the ith course.

The percentage of marks scored based on obtained GPA can be evaluated using below given formula.

$$Percentage = (GPA - 0.75) * 10$$

8. Division of Passing

The Division of Passing shall be based on GPA secured by an Examinee as shown in the Table 3 below:

Table 3: Interpretation of GPA into Division of Passing

INTERVAL OF GPA	DIVISION OF PASSING
$GPA \geq 8.25$	First with Distinction
$6.75 \leq GPA < 8.25$	First
$6.00 \leq GPA < 6.75$	Second
$5.00 \leq GPA < 6.00$	Pass

9. Declaration of result is based on the Grade Point Average (GPA) earned towards the end of the program as given in Table 3. The names of the successful examinees passing the examination as a whole in the minimum prescribed period and obtaining prescribed number of places securing the grades as per adopted credit-grade system shall be arranged in order of merit as provided in ordinance relating to examinations in general.

10. Provisions with respect to grace marks for passing in a particular course/ head of passing and improvement of Division (Higher Class) and getting Distinction in any course shall be as per relevant Direction/Ordinance of the University.

11. An examinee who does not qualify in examination or remain absent for the examination, shall be eligible to appear in the same re-examination, on payment of re-examination fee and such other fees as may be prescribed from time to time, within 30 days from the date of result.

12. Successful examinees who secure minimum prescribed registered credits (120) for the program duration shall be entitled to receive a Degree of full time Three Years Degree Programme entitled **"B. Sc. Data Science"** in the Faculty of Science & Technology signed by the Vice Chancellor of the University on payment of prescribed fees.

13. In the event of any query regarding interpretation/application of any provision of this direction, the Director of Board of Examinations and Evaluation shall refer the matter for the decision of the Dean of the Faculty of Science & Technology or alternatively to the Board of Deans if found necessary.

14. For any other matter pertaining to this Program and its final award which is beyond the purview of this Direction, it shall be referred to the Vice-Chancellor and that the decision of the Vice-Chancellor shall be final and binding on all the concerned.

Place: Gadchiroli

Date: /   /2023

(Dr. Prashant S. Bokare)

Vice-Chancellor

Gondwana University Gadchiroli

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 behavior 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 inter disciplinary field that combines the magic of programming, mathematics and business. Combined with Machine Learning, I the lps to identify a future trend which can be used to derive actionable in sights for creatin future impact. These skills will help for the role of a Data Scientist. Asa Data Science aspirant, learner will beem phasising 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 algorithm sand mathematical models, chiefly employed to make machines learn and prepare them to adapt to every day advancements.

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

Business Intelligence: Each business has and produces too much data every day. This data when analysed carefully and then presente dinvisual report sinvolving 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 thereports 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 inturn help to define new goals
- Identify opportunities
- Making decisions with quantifiable, data-driven evidence
- Test the decisions taken
- Identify and refine the target audiences
- Recruit their ghttalent for the organisation

Programme Specific Outcomes

- Buildastrongfoundation ofstatisticsfordata science.
- UseallthefeaturesandnewupdatesofPythonandR fordatascience.
- PerformscientificandtechnicalcomputingusingthePythonSciPypackageanditssub-packagesIntegrate, Optimize, Statistics, IO,andWeave.
- GainexpertiseinmathematicalcomputingusingtheNumPyandScikit-Learnpackage
- Gainanin-depthunderstanding ofdatastructureanddata manipulation
- Understandanduselinearandnon-linearregressionmodelsandclassificationtechniquesfor data analysis
- Obtain a comprehensive knowledge of supervised and unsupervised learning modelssuch as linear regression, logistic regression, clustering, dimensionality reduction, K-NNandpipeline
- Master the concepts recommendation engine, time series modelling, gain practicalmasteryoverprinciples,algorithms,and applicationsof MachineLearning
- Learn to analyse data using Tableau and Power BI and become proficient in buildinginteractivedashboards
- UnderstanddeepreinforcementlearningtechniquesappliedinNaturalLanguageProcessing
- Understand the different components of the Hadoop ecosystem and learn to work withHBase, its architecture and data storage, learning the difference between HBase andRDBMS, and useHiveandImpalaforpartitioning
- UnderstandMapReduceanditscharacteristicsandlearnhowtoingestdatausingSqoopandFlume

Semester – I

1.Data Structure and Algorithm Using Python

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Introduce the fundamental concept of Python programming to the students
2. Understand various data structures in Python and write algorithms and programs using them
3. Compare alternative implementations of data structures with respect to performance
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, andhashing

Course Outcomes:

On completion of the course, students will be able to:

CO1	Write programs using basic concepts of Python Programming
CO2	Implement algorithms for arrays, linked structures, stacks, queues, trees, and graphs
CO3	Write programs that use arrays, linked structures, stacks, queues, trees, and graphs
CO4	Compare and contrast the benefits of dynamic and static data structures implementation
CO5	Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Contents:

Unit 1: Introduction to Programming   [07 Hours]

Introduction to Programming, Why Programming, What is a Program? Problem Solving, Algorithms and Data Structure Introduction to Programming, Variables, Data Types, Input-Output Statements, Indentation, Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressionsand order of evaluations.

Control Flow- if, if-elif-else, for, while break, continue, pass Collections- String, Lists, Tuples, Dictionaries, Sets, Map

Unit 2: Functions & Object Oriented Programming using Python   [07   Hours]

Functions- Built-in and User defined functions, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables, Recursions Need for OOP, Classes and Objects, OOP Concepts, Constructor, Class Diagram,Encapsulation, Statics, Relationship, Inheritance, and Abstract Classes, Exception Handling

Unit 3: Data Structures in Python   [07 Hours]

ADT- Defining the ADT, Using the ADT, Pre conditions and post conditions

Introduction to Data Structures, Types of Data Structures, Arrays- Need for array, Array ADT,Implementing array, 2 D arrays, Linked Structures- Singly Linked List & Operations with algorithms, Application-Polynomials, Doubly Linked Lists, Circular Linked List Stacks- Stack ADT, Implementing the stack- using Python List and using a linked list, StackApplications- Evaluating Postfix expressions Queues- Queue ADT, Implementing the queue- using Python List and using a linked list,Priority Queue, Applications of Queues

Unit 4: Non-Linear Data Structures in Python   [07   Hours]

Binary Trees- Tree Structure, Properties, Implementation, Tree Traversals, Heaps-Definition, Implementation, Heap Sort Binary Search Trees- Operations and Algorithms (searching, insertion, deletion, min, max),AVL Tree-Insertions, deletions, implementation Hash Tables- Hashing techniques, Hash functions, Applications

Unit 5: Searching & Sorting Algorithms and Analysis   [08 Hours]
Search Algorithms- Linear Search Algorithm, Binary Search Algorithm,

Comparison Sort Algorithms- Introduction, Selection Sort, Insertion Sort, Bubble Sort,Merge Sort, Quick Sort

Algorithmic Techniques-Algorithm Technique- Greedy Approach, Dynamic Programming, Complexity Analysis of Algorithms- Introduction, Analysis of Algorithms, Big-O Notation, Evaluating the Python List.

Text Books / Reference Books
1. Data Structures and Algorithms Using Python, Rance D. Necaise
2. Python for Everybody, Exploring Data Using Python 3, Dr. Charles R. Severance
3. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser.

2. Discrete Mathematics

The purpose of the course is to familiarize the prospective learners with mathematical structures that are fundamentally discrete. This course introduces sets and functions, forming and solving recurrence relations and different counting principles. These concepts are useful to study or describe objects or problems in computer algorithms and programming languages.

Expected Learning Outcomes:
1)   To provide overview of theory of discrete objects, starting withrelations and partially ordered sets.
2)   Study about recurrence relations, generating function and operationson them. Give an understanding of graphs and trees, which are widely used insoftware.
3)   Provide basic knowledge about models of automata theory and the corresponding formal languages.

Unit I :
Recurrence Relations
(a)   Functions: Definition of function. Domain, co domain and the range ofa function. Direct and inverse images. Injective, surjective and bijective functions. Composite and inverse functions.
(b)   Relations: Definition and examples. Properties of relations , Partial Ordering sets, Linear Ordering Hasse Daigrams, Maximum and Minimum elements, Lattices
(c)   Recurrence Relations: Definition of recurrence relations, Formulating recurrence relations, solving recurrence relations- Back tracking method, Linear homogeneous recurrence relations with constant coefficients. Solving linear homogeneous recurrence relations with constant coefficients of degree two when characteristic equation has distinct roots and only one root, Particular solutions of non linear homogeneous recurrence relation, Solution of recurrence relation by the method of generation functions, Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi, Intersection of lines in a plane, Sorting Algorithms.

Unit II
Counting Principles, Languages and Finite State Machine
(a)   Permutations and Combinations: Partition and Distribution of objects, Permutation with distinct and indistinct objects, Binomial numbers, Combination with identities : Pascal Identity, Vandermonde's Identity, Pascal triangle, Binomial theorem, Combination with indistinct objects.
(b)   Counting Principles: Sum and Product Rules, Two-way counting, Treediagram for solving counting problems, Pigeonhole Principle (without

proof); Simple examples, Inclusion Exclusion Principle (Sieve formula) (Without proof).

(c)　　　　Languages, Grammars and Machines: Languages, regular Expression and Regular languages, Finite state Automata, grammars, Finite state machines, Gödel numbers, Turing machines.

Unit III

Graphs and Trees

(a)　　　　Graphs : Definition and elementary results, Adjacency matrix, path matrix, Representing relations using diagraphs, Warshall's algorithm - shortest path, Linked representation of a graph, Operations on graph with algorithms - searching in a graph; Insertion in a graph, Deleting from a graph, Traversing a graph- Breadth-First search and Depth-First search.

(b)　　　　Trees: Definition and elementary results. Ordered rooted tree, Binary trees, Complete and extended binary trees, representing binary trees in memory, traversing binary trees, binary search tree, Algorithms for searching and inserting in binary search trees, Algorithms for deleting in a binary search tree

Text books:

1.　　　　Discrete Mathematics and Its Applications, Seventh Edition by Kenneth H. Rosen, McGraw Hill Education (India) Private Limited. (2011)

2.　　　　Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.

3.　　　　Data Structure Seymor Lipschutz, Schaum's out lines, McGraw-Hill Inc.

Additional References:

1.　　　　Elements of Discrete Mathematics: C.L. Liu , Tata McGraw- HillEdition .

2.　　　　Concrete Mathematics (Foundation for Computer Science): Graham,Knuth, Patashnik Second Edition, Pearson Education.

3.　　　　Discrete Mathematics : Semyour Lipschutz, Marc Lipson, Schaum'sout lines, McGraw - Hill Inc.

4.　　　　Foundations in Discrete Mathematics: K.D. Joshi, New Age Publication, New Delhi.

2- Discrete Mathematics

3.Introduction to Programming
CourseObjectives:
- Learn Programming fundamental susing Python
- Understandthe conceptsandusagedatatypes,variablesandotherbasicelements
- Learn aboutusingoperatorsand controlstatementsinPython
- Learn aboutusingarraysandstringsinPython.
- Learn aboutusingIPythonarchitectureforPython.
- Introduce data Science Tools and plot data using appropriate Python visualizationlibraries

Unit	Details	Lectures
I	**Introduction to Python Language**: Overview, Features of Python,Execution of a Python Program, Innards of Python, Frozen Binaries,Python Interpreter, Comparison of Python with C and Java, InstallingPython,Writing & Executing, IDLE	12
	Data Types, Variables AndOther BasicElements: Comments,Docstrings,Data types-Numeric, Compound, Boolean, Dictionary,Sets,Mapping,BasicElementsofPython, Variables	
	Input and Output Operations: Input Function, Output Statements,CommandLineArguments	
	Control Statements: Control Statements- Loop Statement, The elseSuite, break Statement, continue Statement, pass Statement, assertStatement,returnStatement	
II	**Functions**:Defining&CallingaFunction,ReturningResults,Returning MultipleValues,Built-inFunctions,ParametersandArguments,RecursiveFunctions,Anonymo usorLambdaFunctions	12
	Operators:Arithmeticoperators,Assignmentoperators,Unaryminusop erator,Relationaloperators,Logicaloperators,Bitwiseoperators, Membership operators, Identity operators, Precedence ofOperators,Associativity ofOperators	
	Arrays:CreatingArrays,IndexingandSlicing,BasicArrayOperations, Arrays Processing, Mathematical Operations on Array,AliasingArrays,SlicingandIndexinginNumPyArrays,Basic Slicing. Advanced Indexing. Dimensions of Arrays, Attributes of anArray	

	Strings:CreatingStrings,FunctionsofStrings,WorkingwithStrings,Len gth of a String, Indexing & Slicing, Repeating& ConcatenationofStrings,CheckingMembership,ComparingStrings,Re movingSpaces,FindingSubstrings,CountingSubstrings,StringsareImm utable,SplittingandJoiningStrings,ChangingCase,Checking Starting and Ending of a String, Sorting & Searching in the Strings,FormattingtheStrings, Working withCharacters	

III	**ListsandTuples**:Lists,ListFunctionsandMethods,ListOperations,Tuples	12	
	Dictionaries:CreatingaDictionary,OperatorsinDictionary,Dictionary Methods,UsingforLoopwithDictionaries,OperationsonDictionaries,OrderedDictionaries		
	RegularExpressions:WhatisaRegularExpression?SequenceCharacte rsinRegularExpressions,QuantifiersinRegularExpressions,SpecialCha ractersinRegularExpressions,UsingRegular Expression on Files, Retrieving Information from an HTMLFile		
	Date and Time in Python: Date and Time, Date and Time Now,Combining Date and Time, Formatting Dates and Times, FindingDurationsusing"timedelta",ComparingTwoDates,SortingDate s, StoppingExecutionTemporarily,KnowingtheTimetakenbyaProgram, Working withCalendar Module		
IV	**IPython:**BeyondNormalPython,HelpandDocumentationinIPython, Keyboard Shortcuts in the IPython Shell, IPython MagicCommands,InputandOutputHistory,IPythonandShellCommand s,ErrorsandDebugging, Profiling andTiming Code	12	
	Introduction to NumPy: Understanding Data Types in Python, TheBasics of NumPy Arrays, Computation on NumPy Arrays: UniversalFunctions,Aggregations:Min,Max,andEverythingInBetwee n,ComputationonArrays:Broadcasting,Comparisons,Masks,and Boolean Logic, FancyIndexing, Sorting Arrays, Structured Data:NumPy'sStructured Arrays		
V	**Data Manipulation with Pandas**: Introducing Pandas Objects, DataIndexingandSelection,OperatingonDatainPandas,HandlingMissi ng Data, Hierarchical Indexing, Combining Datasets: Concatand Append, Combining Datasets: Merge and Join, Aggregation andGrouping, Pivot Tables, Vectorized String Operations, Working withTimeSeries. High-PerformancePandas: eval()and query()	12	
	Visualization with Matplotlib: Simple Line Plots, Simple ScatterPlots, Visualizing Errors, Density and Contour Plots, Histograms,Binnings,andDensity,CustomizingPlotLegends,Customiz ingColorbars,MultipleSubplots,TextandAnnotation,CustomizingTick s,CustomizingMatplotlib:ConfigurationsandStylesheets, Three-DimensionalPlottinginMatplotlib,GeographicDatawithBasemap,Visu alizationwith Seaborn		

BooksandReferences:

Sr.No.	Title	Author/s	Publisher	Edition	Year
1.	Programming throughPython	M. T. Savaliya, R.KMaurya,G.MMagar	StareduSolutions	1st	2018
2.	PythonDataScience Handbook	JakeVanderPlas	O'Reilly Media	1st	2016
3.	LetUsPython	Y.Kanetkar,	BPB	1st	2019
4.	Programming in Python3	MarkSummerfield	Pearson Education	2nd	2018
5.	LearningPython	LutzM	O'Reilly-Shroff	5th	2013
6.	BeginningPython	MagnusLieHetland	Apress	2nd	2009
7.	StarPython	StarCertification	StarCertification	1st	2018

CourseOutcome:

Uponthesuccessfulcompletion of thiscourse, thestudentwill beable to achive:

- Proficiencyinusingandapplyingvariousdatatypesincluding,string,arraylist,tupleanddictionary.
- Abilitytouseregularexpressionstoperform complexoperationsinlesscode.
- LearningtomakeuseofdateandtimeinPythonforvariousapplications.
- ProficiencyinusingIPythonarchitectureforDataScienceApplications.
- Knowledgeabout useofvariousdatasciencetools

4-Web Technology

CourseObjectives:

- Introducingthebasicconceptsof Internetandweb designtolearners.
- Providingbrief knowledgeaboutHTML5 concepts.
- Givinginsight of thePagelayout andnavigationwith HTML5.
- Makingstudentsawareaboutuseof Tables, Forms andMediawith HTML5.
- Providingknowledgeofweb pagedesign using CSS.
- TeachingdatavalidationusingJavaScript.
- Givingknowledgeabouttransmissionofdataonweb pageusing JSONobject.

Unit	Details	Lectures
I	**Internet and the World Wide Web:** What is Internet? Introduction tointernet and its applications, E-mail, telnet, FTP, e-commerce, videoconferencing,e-business.Internetserviceproviders,domainnameserver,internet address, **WorldWide Web(WWW):**WorldWide Webanditsevolution,uniformresourcelocator(URL),browsers–internetexplorer,Netscapenavigator, opera, Firefox, chrome, Mozilla. search engine, web saver –apache,IIS, proxy server, HTTP protocol **What Is Web Design?:**Defining Web Design, Web Design Themes,LearningWeb Design. **User-Centered Design:** Usability, Who Are Web Users? CommonUser Characteristics, Memory, Response and Reaction Times, Dealingwith Stimulus, Movement Capabilities, The User's World, GeneralTypesofUsers,WebConventions,Accessibility,BuildingaUsable Site**HTML5:** Introduction, Why HTML5? Formatting text by using tags,usinglists andbackgrounds, Creatinghyperlinks and anchors.	12
II	**HTML5Page layoutandnavigation:**Creatingnavigationalaids:planning site organization, creating text based navigation bar, creatinggraphicsbasednavigationbar,creatinggraphicalnavigationbar,creatingimagemap,redirectingtoanotherURL,creatingdivisionbasedlayouts: HTML5 semantic tags, creating divisions, creating HTML5semanticlayout, positioning and formatting divisions. **HTML5 Tables, Forms and Media:** Creating tables: creating simpletable,specifyingthe size of the table,specifyingthe widthof thecolumn, merging table cells, using tables for page layout, formattingtables: applying table borders, applying background and foregroundfills,changingcellpadding,spacingandalignment,creatinguser	12

	creatingbasicform,usingcheckboxesandoptionbuttons,creatinglists,additionalinputtypesinHTML5,Incorporatingsoundandvideo:audioand video in HTML5, HTML multimedia basics, embedding videoclips,incorporating audio on web page.	
III	**Introduction to Style Sheets** : Understanding Styles, ConstructingStyle Rules, Creating Styles for Nested Tags, Creating Classes and IDsforApplyingStyles,ApplyingStylestoHyperlinks,CreatingandLinkingto External StyleSheets **Formatting Text by Using Style Sheets:** Specifying a Font Family,Specifying a Font Size and Color, Applying Bold and Italics, ApplyingStrikethroughand Underlining, CreatingInline Spans ,AdjustingSpacing BetweenLetters**FormattingParagraphsbyUsingStyleSheets:**IndentingParagraphs,ApplyingaBordertoaParagraph,SpecifyingaBorderStyle,SettingBorderPadding,SpecifyingBorderWidthandColor,FormattingBorderSidesIndividually,SettingAllBorderAttributesatOnce,Specifyingthe HorizontalAlignmentofaParagraph,SpecifyingVerticalSpacewithin aParagraph **DisplayingGraphics:**SelectingaGraphicsFormat,PreparingGraphics for Web Use, Inserting Graphics, Arranging Elements on thePage,ControllingImageSizeandPadding,HyperlinkingfromGraphics, Using ThumbnailGraphics,IncludingAlternate Text forGraphics,AddingFigure Captions	12
IV	**JavaScript:**Introduction,Client-SideJavaScript,Server-SideJavaScript,JavaScript Objects, JavaScriptSecurity Core JavaScript (Properties and Methods of Each) : Array, Boolean,Date,Function, Math, Number, Object, String, regExp **Document and its associated objects:** document, document objectmethods,Link, Area, Anchor,Image, Layer **EventsandEventHandlers:**GeneralInformationaboutEvents,Defining Event Handlers, event, onAbort, onBlur, onChange, onClick,onDblClick,onDragDrop,onError,onFocus,onKeyDown,onKeyPress,onKeyUp,onLoad,onMouseDown,onMouseMove,onMouseOut ,onMouseOver,onMouseUp,onMove,onReset,onResize,onSelect, onSubmit, onUnload	12
V	**JSON**: Introduction, JSON Grammar, JSON Values, JSON Tokens,Syntax, JSON vs XML, Data Types, Objects, Arrays, Creating JSON,JSONObject,ParsingJSON,PersistingJSON,DataInterchange,JSONHTML,JSONP	12

BooksandReferences:

Sr. No.	Title	Author/s	Publisher	Edi^n	Year
1.	HTML5Step byStep	FaitheWempen	MicrosoftPress		2011
2.	Web Design TheCompleteReference	ThomasPowell	TMH		2009
3.	HeadFirstHTML5programming	EricFreeman	O'Reilly		2013
4.	JavaScript 2.0: TheCompleteReference	Thomas Powelland FritzSchneider	TMH	2nd	2004
5.	BeginningJSON	BenSmith	Apress	1st	2015

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- Understandthemeaningofthebasicterminologiesofwebtechnologyandexplore,usetheHTML5 concepts. Understand thebasicrequirement ofwebdesign.
- UnderstandandusethePagelayout,Navigation,Tables, FormsandMediafeaturesofHTML5.
- UnderstandanduseCascadingStyle sheet forbeatifyingthewebpages.
- Understand and usethe JavaScriptforvalidation ofuser formsin web pages.
- Understandandusethetechniqueoftransmittingdatabetweenaserverandwebapplicationusing JSON

5-Business Communication and Information Ethics

Course Objectives:

- Todiscussvariouscomponentsofcommunication,explainhownon-verbalcommunicationtechniquesenhancecommunicationandexplainthebarrierstocommunication.
- To discuss various business activities which are essential at workplace. To explainbusiness communication covering the structure and layout of a letter, planning of aletteranduseof language.
- Toexplaintheuseofagendaandminutesforeffectivefunctioningofanyorganisation.
- Todirectthelearners'attentiontothesignificanceofeffectivewritingandtheimportanceand structure of reports.
- To explain to interpret information ethics (IE) as the branch of the philosophy ofinformation that investigates, in a broad sense, the ethical impact of Information andCommunicationTechnologies (ICTs) on humanlifeand society.

Unit	Details	Lectures
I	**InterpretationofCommunication** Basicsofcommunication,Non-verbalcommunication,Barrierstocommunication. **Businesscommunicationatworkplace** Lettercomponentsandlayout,Planningaletter,Processofletterwriting.	12
II	**Businesscommunicationatworkplace** Emailcommunication,Memosandmemoreports,Employment communication. Notice, Agenda and minutes of meeting,Brochures.	12
III	**ReportWriting:** Effectivewriting,Typesofbusinessreports,Structureofreports,GatheringInformation.	12
IV	**ReportWriting:** Organisationofmaterial,writingabstractsandsummaries,Writingdefinitions,Visual aids, User InstructionManual.	12
V	**InformationEthics** Ethicsaftertheinformationrevolution,whatisinformationethics?The method ofabstraction.	12

BooksandReferences:

Sr.No.	Title	Author/s	Publisher	Edition	Year
1.	ProfessionalCommunication	ArunaKoneru	TataMcGrawHill	--	2008
2.	The Ethics ofInformation	LucianoFloridi	OxfordUniversity Press	--	2013
3.	BusinessCommunication	A. C."Buddy" Krizan,Patricia Merrier, JoyceLogan,KarenWilliams	Thomson	7e	2008

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- Communicateeffectivelyinnon-verbalway,draftandwriteeffectivebusinessletters.
- Effectivelycarryoutcommunicationactivitiesofbusinessbyfollowingemailetiquettes,drafting memos
- Writeelegant businessreports andprepareuser instruction manual.
- Applytheinformation ethicsin allwalks oflife.
- Becomeagoodcommunicatorin life.

6. Environmental Protection Law

UNIT 1: CONSTITUTIONAL PERSPECTIVE

Fundamental Rights – Article 14 (Right to equality, non-arbitr ary and non-discriminatory treatment), Article 19(1)(g) (Freedom to carry on trade or business), Article 21 (Right to life, livelihood and wholesome environment) and Article 32 (Right to Constitutional remedies); Directive Principles of State Policy – Article 47, 48-A; Fundamental Duty – Article 51-A(g); Article 226 (Powers of High Courts); Public Interest Litigation – Nature – Non-Adversarial, Collaborative, Co-operative and Investigative;

UNIT 2: PREVENTION AND CONTROL OF WATER AND AIR POLLUTION

The Water (Prevention and Con trol of Pollution) Act, 1974 – Wa t er Pollution – Meaning; Central and State Pollution Control Boards –Constitution, Powers and Functions; Water Pollution Control Areas; Samples of Effluents – Procedure; Cons ent Requirement – Procedure, Grant/Refusal, Withdrawal, Review, Appeals, Revision ; Restraint Order; Citizen Suit Provision; Offences and Penalties; The Water Cess (Prevention and Control of Pollution) Act, 1977

The Air (Prevention and Control of Pollution) Act, 1981- Air Pollution – Meaning, Causes and Effects; Central and State Pollution Control Boards – Functions; Air Pollution Control Area; Consent Requirement – Procedure, Grant/Refusal, Withdrawal; Restraint Orders; Citizen Suits; Noise Pollution (Regulation and Control) Rules, 2000; Offences/Penalties; Vehicular pollution

UNIT 3: ENVIRONMENTAL PRO TECTION

The Environment (Protection) Act, 1986 – Aims and Objects; Meaning of "Environment" and "Environmental Pollutant"; Powers and Functions of the Central Government; Environment Authority – Constitution; Delegation of Powers; Offences/Penalties; Effectiveness of the Act; Environmental Impact Assessment, 2006; Environmental Audit; law relating to hazardous substance and activities —issues of liabilit

UNIT 4: NATIONAL GREEN T RIBUNAL

Powers and functions of the National Green Tribunal; jurisdiction; locus standi, remedies, Powers and functions; jurisdiction; locus standi, remedies
Techi Tagi Tara v. Rajendra Singh Bhandari & Ors, Supreme Court, Civil Appeal No.1359/017, Judgement of 22 September 2017

UNIT 5: PROTECTION AND CONSERVATION OF FORESTS, BIODIVERSITY AND WILDLIFE

The Indian Forest Act, 1927; The Forest (Conservation) Act, 1980; Kinds of Forest Land - Private, Reserved, Village, Protected; Use of Forest Land for Non-Forest purposes; Rights of Tribals and Forest Dwellers—The Scheduled Tribes and Other Traditional Dwellers (Recognition of Forest Rights) Act, 2006

The Biological Diversity Act, 2002—access to biological resources and benefit sharing; Regulation of genetically modified organisms; The Manufacture, Use, Import, Export and Storage of Hazardous Micro-Organisms Genetically Engineered Organisms or Cells Rules, 1989.

Protection of Wildlife – the Wildlife (Protection) Act, 1972; Sanctuaries and National Parks; Licensing of Zoos and Parks.

Orissa Mining Corporation v Ministry of Environmetn and Forest, (2013)6 SCC 476 ..
Sansar Chand v State of Rajasthan, 2010 (10) SCC 604
Centre For Environmental Law, WWF-I v. Union of India & Others, Supreme Court, I.A.No. 100 in Writ Petition (Civil) No. 337 of 1995, decided on 15 April 2013 ....
Divya Pharmacy v Union of India, High Court of Uttarakhand, WP 3437/2016, Decided on 21 December 2018

TN Godavarman Thirumulpad v Union of India—Shomona Khanna, 'Boundaries of Forest Land: The Godavarman case and Beyond', in Sharachchandra Lele & Ajit Menon eds., Democratizing Forest Governance in India 225 (Oxford University Press, 2014).

Prescribed Legislations

- The Water (Prevention and Control of Pollution) Act, 1974
- The Air (Prevention and Control of Pollution) Act, 1981
- The Environment (Protection) Act, 1986
- The Public Liability Insurance Act, 1991
- The National Green Tribunal Act, 2010
- The Biological Diversity Act, 2002
- The Wildlife (Protection) Act, 1972
- The Forest (Conservation) Act, 1980
- The Indian Forest Act, 1927
- The Scheduled Tribes and Other Traditional Dwellers (Recognition of Forest Rights) Act, 2006.

Policies and reports

- The National Environment Policy, 2006
- The National Forest Policy, 1988
- The National Water Policy, 2012
- The Wildlife Conservation Strategy, 2002
- The World Commission on Environment and Development, Our Common Future, 1987
- IPCC Fifth Assessment Report (AR5). Synthesis Report: Climate Change 2014.

Prescribed Books

- Philippe Sands and Jacqueline Peel, Principles of International Environmental Law (4th ed., 2018).
- Shibani Ghosh ed., Indian Environmental Law: Key Concepts and Principles(2019).
- Geetanjoy Sahu, Environmental Jurisprudence and the Supreme Court: Litigation, Interpretation, Implementation (2014)
- Shyam Diwan and Armin Rosencranz, Environmental Law and Policy in India– Cases, Materials and Statutes (2nd ed., 2001)
- P. Leelakrishnan, Environmental Law Case Book (2nd ed., 2010)
- Gurdip Singh, Environmental Law in India (2nd ed 2016)
- P. Leelakrishnan, Environmental Law in India (5th ed., 2019)
- Stuart Bell & Donald Mc Gillivray, Environmental Law (7th ed., 2008)

7- Precalculus

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

Unit	Details	Lectures
I	**Fundamentals:**RealNumbers,ExponentsandRadicals,AlgebraicExpressions,RationalExpressions,Equations,ModelingwithEquations,Inequalities,CoordinateGeometry,GraphingCalculators;SolvingEquations and Inequalities Graphically, Lines, Making Models UsingVariation. **Functions:** What is function? Graphs of Functions, Getting Informationfrom the Graph of a Function, Average Rate of Change of a Function,TransformationsofFunctions,CombiningFunctions,One-to-OneFunctionsand TheirInverses. **Polynomial and Rational Functions:** Quadratic Functions and Models,Polynomial Functions and Their Graphs, Dividing Polynomials, RealZerosofPolynomials,ComplexNumbers,ComplexZerosandtheFundamentalTheorem ofAlgebra,RationalFunctions.	12
II	**Exponential and Logarithmic Functions:** Exponential Functions, TheNaturalExponentialFunction,LogarithmicFunctions,LawsofLogarithms, Exponential and Logarithmic Equations, Modelling withExponentialand LogarithmicFunctions. **Trigonometric Functions: Unit Circle Approach:** The Unit Circle,TrigonometricFunctionsofRealNumbers,TrigonometricGraphs,InverseTrigonometricFunctionsandTheirGraphs,ModellingHarmonicMotion **Trigonometric Functions: Right Triangle Approach:** Angle Measure,Trigonometry of Right Triangles, Trigonometric Functions of Angles,InverseTrigonometricFunctionsandRightTriangles,TheLawofSines,TheLaw ofCosines.	12
III	**AnalyticTrigonometry:**TrigonometricIdentities,AdditionandSubtractionFormulas,Double-Angle,Half-Angle,andProduct-SumFormulas,BasicTrigonometricEquations,MoreTrigonometricEquations	12

	SinusoidalFunctions: Aspecialclassoffunctions,Sketchingasinusoidal graph, Functions not in standard sinusoidal form, sinusoidalbehaviour. **Inverse Circular Functions:** Solving three equations, inverse Circularfunctions,applications, solving trigonometricequations	
IV	**PolarCoordinatesandParametricEquations:**PolarCoordinates,Graphs ofPolarEquations,PolarFormofComplexNumbers;DeMoivre'sTheorem, Plane Curvesand ParametricEquations **VectorsinTwoandThreeDimensions:**VectorsinTwoDimensions,TheDo tProduct,Three-DimensionalCoordinateGeometry,VectorsinThree Dimensions, The Cross Product, Equations of Lines and Planes**SystemsofEquationsandInequalities:**SystemsofLinearEquations inTwoVariables,SystemsofLinearEquationsinSeveralVariables,Matrices andSystemsof LinearEquations,TheAlgebra of Matrices,InversesofMatricesandMatrixEquations,DeterminantsandCram er'sRule,PartialFractions,SystemsofNonlinearEquations,Systemsof Inequalities	12
V	**ConicSections:**Parabolas,Ellipses,Hyperbolas,ShiftedConics,Rotationof Axes, PolarEquations of Conics **Sequences and Series:** Sequences and Summation Notation, ArithmeticSequences,GeometricSequences,MathematicsofFinance,Math ematicalInduction, TheBinomialTheorem **Limits:APreviewofCalculus:**FindingLimitsNumericallyandGraphically ,FindingLimitsAlgebraically,TangentLinesandDerivatives,LimitsatInfini ty;Limits ofSequences, Areas	12

BooksandReferences:

Sr. No.	Title	Author/s	Publisher	Year
1.	Precalculus– MathematicsforCalculus	JamesStewart,LotharRed lin,SaleemWatson	Cengage Learning	2013
2.	Precalculus	DavidH.Collingwood, K. David Prince,Matthew M. Conroy	Free SoftwareFoun dation	2011
3.	PrecalculusDemystified	RhondaHuettenmueller	TataMcGra wHill	2005
4.	ContemporaryPrecalculus:A GraphingApproach	ThomasW.Hungerford,D ouglasJ. Shaw	Thomson HigherEd ucation	2009

CourseOutcomes:
Aftercompletion ofthecourse, astudent should beable to:

- Applytheknowledgeof numbers,graphandfunctionsinreallife.
- Applytrigonometryin modellingreal lifeproblems.
- Useanalytictrigonometryandinverse circularfunctionstosolvevarietyof problems.
- Applycomplexnumberstheorytodifferentdomains,usevectorsandmatricestosolvereallife problems.
- Identifydifferenttypes of conics from equations, understand sequences and series and basics of limits and derivatives.

8-Web Technology Practical

CourseObjectives:

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

- IntroducingbasicsofHTML5tolearners.
- Givinginsight of thePagelayoutand navigationwith HTML5.
- MakingstudentsawareaboutuseofTables, Forms andMediawith HTML5.
- Providingknowledgeofweb pagedesign using CSS.
- TeachingdatavalidationusingJavaScript.
- Givingknowledgeabouttransmission ofdata onweb pageusingJSONobject.

ListofPractical:	
1.	**Useof BasicTags:**
a.	Designawebpageusingdifferenttextformattingtags.
b.	DemonstrateuseofFonttagwithitsattributesandHTMLvariouscoloroptionsinwebpage.
c.	Designawebpagewithlinkstodifferentpagesandallownavigationbetweenweb pages.
2.	**Navigation,listandparagraph:**
a.	Designaweb pageto demonstrate text-basednavigationbar.
b.	Demonstrateuseoflistsandbackgroundsinwebpage.
c.	Demonstrateuseofparagraph anditsassociatedtags inwebpage.
3.	**Lists,imagesandsemantics:**
a.	Demonstrateuseofmultipleimagetagin web page.
b.	DesignawebpagewithImagemaps.
c.	Designaweb pagedemonstratinguseofvarious semanticstags
4.	**MultimediaandUsercontrols:**
a.	Designawebpagewithaformthatusesall types ofusercontrols.
b.	Designawebpage embeddingwith multimediafeatures.
c.	Designa3pagestaticwebsitewithappropriate tagsandattributes.
5.	**CSS withlist,linksandtable:**
a.	Createandusedifferentstylerules withavailabletypes oflists.
b.	Createandusedifferent styleruleswithhyperlinks.
c.	Createandusedifferent styleruleswithtables.

6.		**CSS withfont,paragraph andtypes:**
	a.	Createandusedifferentstyleruleswith fontelements.
	b.	CreateandusedifferentstyleruleswithParagraphelements.
	c.	Demonstratetheuseof inline,internaland externalCSSin onewebpage.
7.		**JavaScript:Validating Userfields**
	a.	DemonstratetheuseofDocumentobjectmethods.
	b.	Usingjavascript,demonstratevalidatingTextInputFields,Drop-downListsandCheckboxes.
	c.	Usingjavascript,demonstratevalidatingRadiobuttonsandValidatingMulti-SelectBoxes.
8.		**JavaScript :Handlingtheevents**
	a.	Usingjavascript,demonstratetheuseofonAbort,onBlur,onChange,onClick,onDblClick events.
	b.	Usingjavascript, demonstratetheuseofonDragDrop,onError, onFocusevents.
	c.	Usingjavascript,demonstratetheuseofonKeyDown,onKeyPress,onKeyUp,onLoad,onReset, onResize,onSelect, onSubmit, onUnloadevents.
	d.	Usingjavascript,demonstratetheuseofonMouseDown,onMouseMove,onMouseOut,onMouseOver, onMouseUp, onMoveevents.
	e.	Usingjavascript,demonstratetheuseofonKeyDown,onKeyPress,onKeyUp,onLoad,onReset, onResize,onSelect, onSubmit, onUnloadevents.
	f.	DemonstratecompletevalidationofUserRegistrationformusingappropriatefieldsofhtml and events of javascript.
9.		**JSONBasics**
	a.	CreatingJSON
	b.	ParsingJSON
	c.	PersistingJSON
10.		**Workingwith JSON**
	a.	DemonstrateuseofJSONobjectsinarray,printarrayonwebpageusingdocumentobject.
	b.	ReaddatafromjsonfileandconvertitintoaJavaScriptobjectanddisplaythedatainwebpage using document object.
	c.	DemonstratemessagesformattingusingJSON.

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- Usebasic tagssuchasfont, link andtext formattingtags.
- UseandapplyNavigation,lists,imagesetcinwebpages.
- UseUser controlsandembedMultimediainwebpage.
- UseandapplyCSS withlist,links, fontstableetc. inwebpage.
- UseandapplyJavaScriptforValidatingUser fieldsonwebpage.
- Create,parseandpersisttheJSON objectandextractanduseitsvalueson webpage.
- UseJSONobjectwith arraysandmessageformatting onwebpage.

9-ICT Practical

Objectives:

- TohelpthelearnersbecomecompetentandconfidentusersofICTwhocanmakeefficient,effectiveandcreativeuse of basicapplication softwareintheireverydayactivities.
- To encourage the learners to become critical and reflective users of ICT who can evaluatethecapabilitiesandlimitationsofthetechnologyandofsocial,technical,political,ethical,organisationaland economical principles associated with itsuse.
- TopreparethelearnersforthesocietyoftomorrowbymakingthemadaptableusersofICTwho have the necessary openness and flexibility of mind to be able to adjust to futurechangesin thetechnology.
- To encourage the learners to develop the appropriate social skills that are essential for co-operativeandcollaborativelearning basedaroundICT.
- To empower ICT disadvantaged learners by ensuring sufficient access for those learnerswhohavelittle out-of-school opportunities to usethe technology

ListofPractical:	
1.	**WordProcessor**:Usingwordprocessorforletters,documentationandreportswithproper formatting and advanced features.
2.	**PresentationSoftware:**Usingpresentationsoftwareforpreparingelegantpresentations with voice and videos and giving different effects to make it moreinterestingand catchy.
3.	**UsingGoogledocsandforms**
4.	**Usingonlinecollaborationandvideoconferencingtools**
5.	**Usingscreenrecordingandaudiotools**
6.	**Usingvideoeditingtools**
7.	**UsingGoogleMaps,GoogleStreetview,BingMaps**
8.	**UsingSocialMedia(Facebook,Instagram,Twitter,Linkedin,youtube,snapchat, reddit,quora,dig,Pintrest,flipboard,Wordpress,Tumblr,Medium)forbusiness and learning**
9.	**Usingplagiarismsoftware**
10.	**UsingICTingovernance,agricultureandhealthcare**

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- Effectiveusethe ICTsoftwarefordifferentpurposesinallwalksoflife.
- Developtheappropriatepersonalskillsthatareessentialforindependentlearningbasedaro u nd ICT
- Develop their potential to their fullest by facilitating the acquisition of knowledge; byhelping the learner concentrate on higher order cognitive tasks rather than on lowerorderroutinetasksandbypositivelyaffectingtheattitudeofthelearnertowardsfurtherl earning
- Facilitate better communication between the learners thereby promoting greater socialunderstandingand harmony
- EffectivelyusetheICTingovernance,agricultureandhealthcare.

1-Data base Management System

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Fundamentals of Database Management Systems and types of DBMS used in data analysis
2. Understand various ways to organize, maintain and retrieve - efficiently, and effectively – information from different DBMS
3. Design and maintenance of the database systems
4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Outcomes:

On completion of the course, students will be able to:

CO1	Master the basic concepts of relational DBMS and its types.
CO2	Perform various types of operations on relational databases using DDL, DML, DCL in SQL
CO3	Understand the concept of how non-relational databases differ from relational databases from a practical perspective.
CO4	Master the basic concepts of designing NoSQL database management system.
CO5	Able to Identify what type of NoSQL database to implement based on business requirements

Course Contents:

Unit 1: Introduction to Databases   [06 Hours]
Introduction to Data and Database, Significance of Database Management System, Various Types of DBMS- relational & non-relational, Data Independence - The Three Levels Of

Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure , Instance and schema

Unit 2: Relational Database Management System　　　　　[07　Hours]

Data Models & Types, ER to Relational Mapping , Structure Of Relational Databases, Creationand Manipulation of Database using Basic SQL(DDL, DML,DCL,TCL)

Normalization –Anomalies- Functional Dependency, Normal forms- 1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit 3: Non-Relational Database Management System　　　　　[07　Hours]

NOSQL Systems-Introduction to NoSQL, Disadvantages of NoSQL technology, NOSQL Systems, weakness of RDBMS, CAP theorem, Types of NoSQL Databases,

Key-value database-Key values database, More elements of key values database, Properties of Key-value store

Unit 4: Columnar & Document Databases　　　　　[8 Hours]

Columnar Databases with Apache Cassandra- Characteristics of a columnar database, Concepts of columnar databases, Cassandra Introduction and its use-cases, Implement a columnar database using Apache Cassandra

Introduction to Document databases, Document databases with MongoDB - Implement a document database with MongoDB

Unit 5: Graph and Future databases　　　　　[8 Hours]

Graph Databases - Graph databases, graph traversal and graph problems, graph data structures edge list, adjacency matrix, properties of graph model.

Implementation and systems - Reliable, maintainable and scalable, Different information systems

Future databases: Data Models and Storage- SQL- NoSQL, APIs- Return SQL, Advance Databases- PostgreSQL, RiakCouchDB, NEO4J, Redis, Future Databases— Revolution Revisited, Counter revolutionaries, Oracle HQ- Other Convergent Databases, Disruptive Database Technologies

Text Books

1. Abraham Silberchatz, Henry K.Forth, Sudharshan, "Database system Concepts" – (6th edition), McGraw Hill, 2010.
2. Guy Harrison, "Next Generation Databases", Apress, 2015.
3. Eric Redmond, Jim R Wilson, "Seven Databases in Seven Weeks", LLC. 2012

Reference Books

1. K. Pakhira, "Database Management System", Phi Learning Pvt. Ltd., 2012
2. MongoDB: The Definitive Guide, 2nd Edition , Powerful and Scalable Data Storage, By Kristina Chodorow, Publisher: O'Reilly Media
3. MongoDB Basics - EelDavid Hows,Peter Membrey,coPlugge, Publisher Apress - Ebook(free) https://it-ebooks.info/book/4527/

2-R Programming

CourseObjectives:

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

Unit	Details	Lectures
I	**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 **RInterfaces-UsingRandRStudio**:RSoftware,ObtainingRandRStudio,ThedefaultRinterface,RStudioInterface,ExampleDatasetsin R, R Packages, Installing new R libraries, Customizing R Start-up**ObjectsinR:**UsinglsandrmtomanagingRObjects,TypesofRobjects,AttributesofRObjects,Creatingandaccessingobjects,Modifyingelements, Quick recap, Exercise **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 Creatingsimulateddata,Exercise	12
II	**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 **IntroductiontographicsinR:**TheRfunctionplot(),Exercise,Customizeplotwithlow-levelplottingcommands,Defaultparameters–par,Interactingwithgraphics,Savingplots,UsefulGraphicsResources	12

III	**AdvancedGraphics:**AdvancedplottingusingTrellis;ggplots2,Lattice, Examples that Present Panels of Scatterplots using xyplot(),Simpleuseof xyplot **Importing Data- readr:** Functions for Reading Data, File Headers,Column Types, String-based Column Type Specification, Function-basedColumn TypeSpecification ParsingTimeandDates,Space-separatedColumns,FunctionsforWritingData **RepresentingTables –tibble:**CreatingTibbles,IndexingTibbles	12
IV	**ReformattingTables–tidyr:**TidyData,GatherandSpread,ComplexColumn Encodings, Expanding, Crossing, and Completing, MissingValues,Nesting Data **Pipelines – magrittr:** The Problem with Pipelines, Pipeline Notation,Pipelines and Function Arguments, Function Composition, Other PipeOperations **WorkingwithStrings–stringr:**CountingStringPatterns,SplittingStrings,CapitalizingStrings,Wrapping,Padding,andTrimming,Detecting Substrings, Extracting Substrings, Transforming Strings**WorkingwithFactors–forcats:**CreatingFactors,Concatenation,Projection,Adding Levels, Reorder Levels	12
V	**ManipulatingDataFrames–dplyr:**SelectingColumns,Filter,Sorting, Modifying Data Frames, Grouping and Summarizing, JoiningTables, Income inFictional Countries **Working with Dates – lubridate:** Time Points, Time Zones, TimeIntervals	12

BooksandReferences:

Sr.No.	Title	Author/s	Publisher	Edi^n	Year
1.	Introduction toProgramming andStatisticalModellingi nR	AedinCulhane	HARVARD SCHOOL	1st	2013
2.	RDataScienceQuickR eference	ThomasMailund	Apress	1st	2019
3.	THEBOOKOFR	TilmanM.Davies	Nostarchpress	1st	2016
4.	PracticalDataScience with R	NINA ZUMELJOHN MOUNT	MANNING		2014
5.	Beginning DataScienceinR	ThomasMailund	Apress		2017

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- TouseR StudioandexplorethefeaturesforRprogramming.
- TouseRfunctions andgraphics within Rprogramming forsolving problems.
- ToworkwithadvancedgraphicsofR,importandusethedataandrepresentthedatainto tables.
- Toapplyformattingontable,usePipelinesinapplicationandusestrings,factorsinRprogra m me.
- TomanipulatingData FramesandmakeuseofDates inRapplication.
-

3- Data Analysis

4-Internet of Things & Embedded System

Course Objectives:

4. To get the understanding of the concepts of Internet of Things
5. To enable the students to build IoT applications.
6. To understand the various protocols in IoT and Networking.
7. To develop the essential programming skill required
8.

Course Outcomes:

On completion of the course, students will be able to:

CO1	The use of concepts of IoT and its areas.
CO2	Understand the basics of C and NodeMCU
CO3	Understand the basics of Python & Raspberry Pi
CO4	Interacting with Web Services and IoT protocol
CO5	Apply the IoT in various applications.

Course Contents:

Unit-1: Introduction to IoT   [07 Hours]

Definition, characteristics of IoT, logical design of IoT, IoT communication models, IoT communication APIs: REST, Websocket, IoT Enabling Technologies: Wireless sensor networks, Cloud computing, Big data analytics, communication protocols, Embedded systems, IoT vs M2M.

Unit-2: Introduction to C and Node Mcu   [07 Hours]

C: Introduction, Data types, variable, operator, branches, loops, functions, Debugging and Optimization of C programs.

NodeMCU: 8266 Wi-Fimodule, hardware and pin diagram, Interface with Arduino IDE. Interfacing of analog and digital sensors.

Unit-3: Introduction to Python and Raspberry Pi

Python IDE, Data types, variable, operator, branches, loops, functions, List, Dictionary, Writing to a File, Reading from a File, handling exception. [08 Hours] Python:

Raspberry Pi: Models of Raspberry pi, R Pi 3 hardware, GPIO pins, operating system for R pi3, Basic of Linux commands, configuring R pi3, Interfacing of Digital and Analog sensors.

Unit-4 : Interacting with Web Services [07 Hours]

Configuring NodeMCU to connecting to server, NodeMCU interfacing with web services, configuring R pi 3 Wi-Fi and Ethernet, publishing and subscribing data from web using R pi3, interfacing R Pi 3 with twitter and whatsapp.

Unit-5: IoT Protocols [07 Hours]

UART, Wi-Fi, Ethernet, Bluetooth Low Energy (BLE), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Data Distribution Service (DDS), Advanced Message Queuing Protocol (AMQP).

Text Books:

1. Get Started With ESP8266 Programming NodeMCU Using Arduino, Up skill Learning.
2. Internet of Things with Raspberry Pi 3, ManeeshRao, pack
3. Internet of Things with ESP8266, Marco Schwartz
4. Internet of Things with Arduino Cookbook, Marco Schwartz

Reference Books:

1. Internet of Things: A Hands-On Approach- Arsheep Bahga,Vijay Madisetti
2. Raspberry Pi Cookbook for Python Programmers by Tim Cox
3. Learning Internet of Things, Peter Waher

5- Marathi / Hindi

(I) मराठी आवश्यक

गद्य विभाग:–
१. अखेरचे कीर्तन– गाडगेबाबा
२. लोकशाहीचे भवितव्य– डॉ. बाबासाहेब आंबेडकर
३. विज्ञानयुगात भारत. जयंत नारळीकर
४. भटक्या– कचरू जनार्दन गिन्हे
५. माणूस– उत्तम कांबळे

पद्य विभाग:–
१. पसायदान– ज्ञानेश्वर
२. विद्यार्थ्याप्रत– केशवसुत
३. भंगू दे काठीण्य माझे– बा. सी. मर्ढेकर
४. स्वप्नांची समाप्ती– कुसुमाग्रज
५. लेखनीच्या तलवारी– उषाकिरण आत्राम

व्यावहारिक मराठी व व्याकरण:–

१. भाषिक कौशल्य आणि व्यक्तीमत्व विकास
२. भाषा, लिपी आणि वर्णविचार

पाठ्यपुस्तक:– 'अक्षरधारा' (संपादित), राघव प्रकाशन, नागपूर.

गोंडवाना विश्वविद्यालय, गडचिरोली

(II.) हिन्दी अनिवार्य–प्रथम सत्र
Compulsory Hindi Semester-II
पाठ्कम

पाठ्यपुस्तक– साहित्य रश्मि
पाठ्यविषय– व्यावहारिक हिन्दी ज्ञान
अ–पत्र लेखन,
ब–पारिभाषिक शब्द, और देवनागरी लीपि
क–कम्प्यूटर का सामान्य परिचय।
घटकीकरण
इकाई एक– गद्य विभाग पाठयपुस्तक साहित्य रश्मि में संम्मिलित प्रथम पॉच पाठ।

1. उसने कहा था–(कहानी) चंद्रधर शर्मा गुलेरी

2. पाप के चार हथियार–(निबंध) कन्हैयालाल मिश्र 'प्रभाकर'

3 घर बाजार और कबीर–(ललित निबंध) श्रीराम परिहार

4 बाबर की ममता–(एकांकी) देवेंद्रनाथ शर्मा

5 पर्यावरण संरक्षणः हमारा नैतिक दायित्व–(लोकोपयोगी लेख) शुकदेव प्रसाद

इकाई दो– (पद्य विभाग) पाठयपुस्तक साहित्य रश्मि में संम्मिलित प्रथम पॉच कविताएँ।

1 कबीर के दोहे–कबीर (दस लोकोपयोगी दोहे)

2. प्रथम रश्मि–सुमित्रानंदन पंत

3. चार विचार–हरिवंशराय बच्चन

4. कलम और तलवार–रामधारीसिंह 'दिनकर'

5. बदली–महादेवी वर्मा

इकाई तीन– व्यावहारिक हिन्दी ज्ञान

पत्र लेखन–

1–आवेदन पत्र

2–व्यावसायिक पत्र

इकाई चार–पारिभाषिक शब्द

1. हिन्दी से अंग्रेजी पारिभाषिक शब्द और

2. अंग्रेजी से हिन्दी पारिभाषिक शब्द

3. देवनागरी लीपि का परिचय, और परिभाषा

इकाई पॉच–कम्प्यूटर का सामान्य परिचय

1 कम्प्यूटर का परिचय

2–कम्प्यूटर की विभिन्न क्षेत्रों में उपयोगिता

3–कम्प्यूटर की संरचना

(II) हिंदी आवश्यक :

6- Project Presentation on Data Science in Environmental Science.

7-Database Management Practical

Course Objectives: Provides the hands on the SQL language for retrieving the data from thedatabaseindifferentscenarios.Theprimaryfocusistounderstandrelationaldatabaseconceptsan ddesign by using SQL.

- Identifyentitiesanditsrelationshipwithrelationalmodelstructure.
- TounderstandrelationaldatabaseusingSQLandconstraintsimplementationusingcreatetab lequery
- ToUnderstandDMLoperations andbackingofdatabase
- Tounderstandhowtoretrievedatafromdatabaseandlearnhowtoretrievesinglevalueafterpe rforming calculations on group ofvalues
- Tounderstandbuilt-infunctionsto performoperationsondata
- To understandhow tofetchdata fromtwoor more tables,whichisjoinedtoappearassingleset of data
- Tounderstandnested andlarger queryasadvancedfetchingofdata
- Tounderstandconceptof virtualtable.
- Tounderstand howto controluseraccess inadatabase.

ListofPractical: (Canbedonein Oracle/SQLServer/MySQL)

1.	**Forgivenscenario**
	DrawE-Rdiagramand convertentitiesandrelationshipstotable.
2.	**WriteSQLqueryforgivenproblemstatement:**
a.	Viewingalldatabases
b.	CreatingaDatabase
c.	ViewingallTablesina Database
3.	**Perform thefollowingOperations:**
a.	CreatingTables(WithandWithoutConstraints)
b.	Inserting/Updating/DeletingRecordsinaTable
c.	Saving(Commit)andUndoing(rollback)
4.	**PerformthefollowingOperations:**
a.	AlteringaTable
b.	Dropping/Truncating/RenamingTables
c.	Backingup/RestoringaDatabase
5.	**Performfollowing:**
a.	SimpleQuerieswithWhereOperators
b.	WherewithKeywordsandLogicalOperators
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,updatedeleteandretrievedatafrom databaseusingSQLqueries.
- Studentsabletoperformalterationintablesandcanrestoreandtakebackupofthedatabase.
- Studentsabletoperformoperations usingsimpleSQLQueriestofetchdataandlearnsvariousaggregate functions to get single value.
- StudentsabletoperformSQLQueriesusingJOINkeywordforjoiningtwoormoretables.
- Studentsabletoperform nestedqueriesusingin,existsoperators.
- Studentsabletocreatenewtablebyjoiningoneormoretablesandlearnhowtohideattributefro m end user.
- Studentsabletorestricttheuser fromaccessingdataindatabase.

8-R Programming Practical

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.	WriteanRprogramtodemonstratevariouswaysofperformingGraphicalanalysis.[Hint:Plots, Special Plots, Storing Graphics]
7.		**ObjectOrientedProgramminginR**
	a.	WriteanRprogram todemonstrateOOPconcepts,the constructionanduseofS3and S4 classes
	b.	WriteanRprogramtodefinereferenceclassandoperationson them.
8.		**DataInterfacesinR**
	a.	WriteanRprogramtodemonstratedatainterface withCSVfiles[Hint:creatingdatafor 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.	WriteanR programto managedata usingXML files.[Develop datainterfaceformaintainingEmployeeInformation]
	d.	WriteanRprogramtodemonstrateworkingwithRMySQLPackage
9.		**HandlingErrorsin R**
	a.	WriteanRprogramtodemonstratevariouserror messagesinR Programming
	b.	WriteanRprogramtoimplementErrorHandlinginR [Hint:warning(),stop(),try(),tryCatch(),CallingHandlers()]
10.		**MeasuringPerformance**
	a.	Write R program to measure the performance with the help of bult-in functionlikemocrobechmark().

CourseOutcomes:

Aftercompletion ofthecourse, astudent should beable to:

- Useexpression fordecision making, getKnowledgeof typesof loops andloop controlstatementsand ableto create,accessandmanipulate essentialdatastructures.
- DevelopskillstomanagemultipledatathroughvariousoptionsavailableinR.
- Use R object, simple statistical function for data analysis and Differentiate between linear andmultipleregression analysis.
- Get the knowledge about various function for Normal and Binomial Distribution and able toimplement andanalyse datausingdifferenttimeintervalsand multipletimeseries
- To create Tabulation for presentation of data and operation of them and get the knowledgeaboutvarious ways of plotting dataand saving them
- GettheknowledgeofimplementingclassconceptinRandabletodefinereferenceclass,create objects, accessandmodifyfields
- GettheknowledgeaboutdevelopingdatainterfaceforstoringdatainCSVfilesalsoknowled geabout working with Excel files and able to interface with XML files and able to interface withMySQL,query and manipulate datain it.
- Gettheinsightintoerrorsrelatedtonameerrors,controlstructureerror,connectionerrorsetc .,andable to identify andhandle errorsin Rcode
- Toanalyzeperformanceofthe R code.

Database Management System Practical

Data Analysis Lab

List of practicals:

1. Installing R and R Studio

2. Data types, mathematical operators and functions in R.

3. Vectors, Factors, Lists, Matrix, Data Frames in R.

4. Measurement of Central Tendency Mean, Median and Mode.

5. Measurement of Variation - Range, IQR and Standard Deviation.

6. Descriptive Statistics Using psych Package.

7. One & two Sample z Test Using R

8. One & two Sample t Test Using R

9. Goodness of Fit Test Using R

10. Contingency Table Using R

11. Analysis of Variance (ANOVA) Using R

12. Central Limit Theorem Demonstration Using R

13. R Functions for Normal Distribution - rnorm, pnorm, qnorm and dnorm

14. R Functions for Binomial Distribution - rbinom, pbinom, qbinom and dbinom

15. R Functions for Poisson Distribution - rpois, ppois, qpois and dpo

Database Management System Lab

List of practical:

1. Draw E-R diagram and convert entities and relationships to relation table for a college database.

2. Perform the following:
   a) Viewing all databases,
   b) Creating a Database,
   c) Viewing all Tables in a Database,
   d) Creating Tables (With and Without Constraints),
   e) Inserting/Updating/Deleting Records in a Table,

3. Perform the following:
   a) Altering a Table,
   b) Dropping/Truncating/Renaming Tables,
   c) Backing up / restoring a Database.

4. For a given set of relation schemes, create tables and perform the following-
   a) Simple Queries,
   b) Simple Queries with Aggregate functions,
   c) Queries with Aggregate functions (group by and having clause),

5. Perform queries with Date functions and String Functions

6. Perform queries with Math Functions, Join Queries- Inner Join, Outer Join and Subqueries- With IN clause, With EXISTS clause

7. Implement a columnar database using Apache Cassandra

8. Implement a document database with MongoDB

9. Design and Implement any 5 query using MongoDB

10. Write a case study for various types of NoSQL databases.

Note:

1. Lab should be in scope of hands of experience and practice related program must
2. Add case study and Live project experience if any related contents