PSG College of Arts & Science

An Epitome of Quality Learning

Since 1947

B.Sc.
COMPUTER SCIENCE
WITH DATA ANALYTICS

2019 - 2022

PSG College of Arts & Science

Coimbatore - 641014

DEPARTMENT OF COMPUTER SCIENCE

B.Sc. Computer Science with Data Analytics

VISION

To provide domain specialists for the data science industry

MISSION

To enable students to meet industry demand for graduates with data-driven decision making skills and analytics skills that are able to apply
data science to tackle business challenges.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Demonstrate ability to adapt to a rapidly changing environment by having learned and applied new skills and new competencies**.**

PEO 2: Acquire the spirit of compassion, kinship and commitment for National Harmony.

PEO 3: Progressively adopt and learn continuously through ICT modules.

PEO 4: The Programme focuses on a broad grasp of foundations in Data Analytics and understanding of the area of specialization**.**

PEO 5: Commit to social ethical and professional responsibilities.

PROGRAMME OUTCOMES

PO 1: Become knowledgeable in the subject of Data Analytics and apply the principles of the same to the needs of the Employer / Institution/ own Business or Enterprise.

PO 2: Gain Analytical skills in the field of Computer Science.

PO 3: Understand and appreciate professional ethics, community living and Nation Building initiatives.

PO 4: Provide insight into methods and tools for analysis and processingof the data generated by modern information systems.

PO 5: Explain basic terms in the area of Information Systems development and management, group database management systems according to their purpose, and give an insight into the statistical methods of data analysis and prediction.

PO 6: Students will demonstrate the ability to translate data into clear, actionable insights.

PO 7: An ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

PO 8: An ability to gain knowledge in big data analytics

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Apply the knowledge of Computer Analytics in the domain of Data Science, Data warehousing and Database development.

PSO 2: Solve the complex problems in the field of Data Analytics with an understanding of the societal, legal and cultural impacts of the solution.

PSO 3: Students will demonstrate the ability to think critically in making decisions based on data and deep analytics.

PSO 4: Form a part of member in a team with right attitudes.

PSG COLLEGE OF ARTS & SCIENCE
COIMBATORE - 14.
B.Sc. Computer Science with Data Analytics
SCHEME OF EXAMINATIONS
(For students admitted in June 2019 &onwards)

CODE NO.	SUBJECT	Exam Duration (Hrs)	Max. Marks			Credit points
			CA	CE	Total	
First Semester						
PART –I						
18LAU01	Tamil–I/Hindi–I/French– I	3	25	75	100	3
PART –II						
18EU01	Communicative English– I Interpersonal Communication	3	25	75	100	3
PART –III						
19DAU01	**Core Course:** Digital Electronics	3	25	75	100	3
19DAU02	**Core Course:** Problem Solving and C Programming	3	25	75	100	3
19DAU03	**Interdisciplinary Course:** Mathematical Foundation for Data Science **(MA)**	3	25	75	100	3
19DAU04	**Core Course:** Lab-I (C Programming Lab)	3	40	60	100	2
19DAU05	**Core Course:** Lab-II (Data Manipulation using Excel Lab)	3	40	60	100	2
Second Semester						
PART –I						
18LAU02	Tamil– II/Hindi– II/ French–II	3	25	75	100	3
PART –II						
18EU02	Communicative English– II Academic Communication	3	25	75	100	3
PART –III						
19DAU06	**Core Course:** Python Programming	3	25	75	100	2
19DAU07	**Core Course:** Data Structures	3	25	75	100	2
19DAU08	**Interdisciplinary Course:** Discrete Structures & Graph Theory**(MA)**	3	25	75	100	3

19DAU09	**Interdisciplinary Course:** Probability and Statistics**(ST)**	3	25	75	100	3
19DAU10	**Core Course:** Lab-III (Python Programming Lab)	3	40	60	100	1
19DAU11	**Core Course:** Lab- IV (Data Structures Lab)	3	40	60	100	1
PART –IV						
18AECU01	**Ability Enhancement Compulsory Course – I : Value Education**	-	100	-	100	2
Third Semester						
PART –III						
19DAU12	**Core Course:** Object Oriented Programming with Java	3	25	75	100	3
19DAU13	**Core Course:** Relational Database Management Systems	3	25	75	100	3
19DAU14	**Core Course:** Operating System	3	25	75	100	3
19DAU15	**Interdisciplinary Course:** Linear Algebra **(MA)**	3	25	75	100	3
19DAU16	**Interdisciplinary Course:** Applied Statistics**(ST)**	3	25	75	100	3
19DAU17	**Core Course:** Lab-V (Java Programming Lab)	3	40	60	100	2
19DAU18	**Core Course:** Lab-VI (RDBMS Lab)	3	40	60	100	2
19DAU19	**Interdisciplinary Course:** Lab-VII (Statistics Practical) (**ST**)	3	40	60	100	2
PART –IV						
18AECU02	**Ability Enhancement Compulsory Course – II:** Environmental Studies	-	100	-	100	2
Fourth Semester						
PART –III						
19DAU20	**Core Course:** R – Programming	3	25	75	100	3
19DAU21	**Core Course:** Modern Database Systems	3	25	75	100	3

19DAU22	**Core Course:** Data Mining	3	25	75	100	3
19DAU23	**Core Course:** Predictive Analytics	-	100	-	100	3
19DAU24	**Interdisciplinary Course:** Optimization Techniques **(ST)**	3	25	75	100	3
19DAU25	**Core Course:** Lab-VIII (R – Programming Lab)	3	40	60	100	2
19DAU26	**Core Course:** Lab-IX (Modern Database Systems Lab)	3	40	60	100	1
19DAU27	**Core Course:** Lab-X (Data Mining Lab)	3	40	60	100	2
PART –IV						
18SECU01	**Skill Enhancement Course–I:** Information Security	-	100	-	100	2
Students should complete the Minor Project during the Summer Vacation						
Fifth Semester						
PART –III						
19DAU28	**Core Course:** Mobile and Web Applications Development	3	25	75	100	3
19DAU29	**Core Course:** Machine Learning	3	25	75	100	3
19DAU30	**Core Course:** Computer Networks	3	25	75	100	3
19DAU31	**Core Course:** Data Visualization	-	100	-	100	3
19DAU32A/ 19DAU32B	**Discipline Specific Elective Course – I:** Software Project Management/Agile Software Engineering	3	25	75	100	4
19DAU33	**Core Course:** Lab-XI (Mobile and Web Applications Lab)	3	40	60	100	2
19DAU34	**Core Course:** Lab-XII (Machine Learning Lab)	3	40	60	100	1
19DAU35	**Core Course:** Lab-XIII (Data Visualization Lab)	3	40	60	100	2
19DAU36	**Core Course:** Minor Project	-	40	60	100	2

PART –IV						
18GECEDC	**Generic Elective Course** EDC	-	100	-	100	2
18SECU02	**Skill Enhancement Course - II Online Test -** [General Awareness]	11/2	-	100	100	2
Sixth Semester						
PART –III						
19DAU37	**Core Course:** Artificial Intelligence	3	25	75	100	3
19DAU38	**Core Course:** Mining of Massive Data	3	25	75	100	3
19DAU39	**Core Course:** Exploratory Data Analytics	3	25	75	100	3
19DAU40A / 19DAU40B	**Discipline Specific Elective Course – II:** Parallel and Distributed Computing / Internet of Things	3	25	75	100	4
19DAU41	**Core Course:** Lab-XIV (Artificial Intelligence Lab)	3	40	60	100	2
19DAU42	**Core Course:** Lab-XV (Mining of Massive Data Lab)	3	40	60	100	2
19DAU43	**Core Course:** Major Project Work	-	80	120	200	8

NCCC-Non CGPA Credit Course:(a)NCC/NSS/Sports/Dept. Activity- Extension Activity	-	2	I to VI
NCCC- Non CGPA Credit Course-(b) Career Oriented Programme (Add-on Course) / Women's Studies / Extra Paper / Certificate or Diploma course in Yoga for Youth Empowerment	-	2	I to VI
NCCC- Non CGPA Credit Course-(c) Any one **on-line course –MOOC's subjects***	1	4	I to VI
TOTAL CREDITS		**144**	

Part V	No. of Papers	Credit	Semester No.
NCCC-Non CGPA Credit Course:(a)NCC/NSS/Sports/Dept. Activity- Extension Activity	-	2	I to VI
NCCC- Non CGPA Credit Course-(b)	-	2	I to VI

Career Oriented Programme (Add-on Course) / Women's Studies / Extra Paper / Certificate or Diploma course in Yoga for Youth Empowerment			
NCCC- Non CGPA Credit Course-(c) Any one **on-line course –MOOC's subjects***	1	4	I to VI
TOTAL CREDITS		**144**	

Compulsory Components to be completed by the students		
S.No	**Component**	**To be Completed during the semester**
1	Placement Training	IV
2	Any two of the Certificate Courses provided by the Department	I - V

Course Code & Title	19DAU01 Digital Electronics		
Class	**I-B.Sc Computer Science with Data Analytics**	**Semester: I**	**Total Hrs: 48**
Course Objectives	**The Course aims** • To enable the students to gain knowledge about the number systems and coding systems. • To enable the students to understand about Logic gates and circuits. • To enable the students to understand about Boolean Algebra & its function, DeMorgans Theorems. • To facilitate the students to have knowledge on Combinational logic circuit. • To smooth the progress of learning Sequential logic circuits such as flip flop and counter.		

SYLLABUS

UNIT	Content	No. of Hours
I	**NUMBER SYSTEMS AND CODES**: Binary Number System – Binary to Decimal Conversion – Decimal to Binary Conversion – Binary Addition – Binary Subtraction – Binary Multiplication and Division – Octal Numbers – Hexadecimal Numbers – Binary Codes – Error Detecting Codes – Error Correcting Codes.	**9**
II	**LOGIC GATES AND CIRCUITS**: Boolean Algebra and Logic Gates – AND, OR, NOT, NAND, NOR, Exclusive OR – Applications of XOR Gate – The Exclusive NOR Gate – Positive and Negative Logic– Integrated Circuits.	**9**
III	**BOOLEAN ALGEBRA**: Fundamentals of Boolean Algebra – Boolean Functions – Minterms and Maxterms – Laws and Theorems of Boolean Algebra – DeMorgan's Theorem – Universal gates – Karnaugh Maps – Simplification – Don't Care Conditions – Overlapping Groups – Rolling the Map – Eliminating Redundant Groups.	**10**
IV	**COMBINATIONAL LOGIC CIRCUITS**: Introduction – Adders – The Half Adder – The Full Adder –Subtractors – BCD Adder – Multiplexers – Demultiplexers – Decoders – Encoders – Floating Point Number System – Range of Stored Numbers.	**10**

V	**SEQUENTIAL LOGIC CIRCUITS**: Flip Flops – RS Flip Flop – Clocked RS Flip Flop – D Flip Flop – JK Flip Flop – T Flip Flop – Triggering of Flip Flops – Master Slave Flip Flop – Conversion of D Flip Flop – Conversion of T Flip Flop – Transfer Circuit – Clock. **Counters and Shift Registers:** Counters – Asynchronous or Ripple Counter – Ring Counter – Twisted Ring Counter – State Diagrams and State Tables.	**10**
References	**Text Book:** **1.** Dr. K. Meena, "Principles of Digital Electronics", PHI Learning Private Limited, New Delhi, 2009. **Reference Book:** **1.** V.K. Puri, "Digital Electronic circuits and Systems", Tata McGraw-Hill Publishing company limited, 2007.	
Course Outcomes	**On completion of the course, students should be able to do** **CO1:** Convert one form of number system to another form of number system. **CO2:** Draw a circuit for any logic function. **CO3:** Use K-Map for simplification of Boolean Function. **CO4:** Analyze various types of combinational logic circuits and sequential logic circuits.	

Course Code & Title	19DAU02 Problem Solving and C Programming		
Class	I-B.Sc Computer Science with Data Analytics	Semester: I	Total Hrs:48
Course Objectives	**The Course aims** • To acquire problem solving skills • To be exposed to the programming in C. • To be familiar with looping, functions and arrays concepts • To learn to use strings, functions, pointers, structures and unions in C. • To learn basic concepts about files and preprocessor.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Problem Solving:**The Problemsolving Aspect-Top-downDesign-Implementation of Algorithms-Program Verification-The Efficiency of Algorithms-The Analysis of Algorithms.**FundamentalAlgorithms :**Exchanging the values of two variables- Counting-Summation of a Set of Numbers-Factorial Computation-Reversing the digits of an Integer**.** **Factoring Methods :**Finding the Square root of a Number-The Smallest divisor of an Integer- Generating Prime Numbers**.**	10
II	**Introduction To C:** The C Character Set – Identifiers and Keywords – Data Types – Constants – Variables and Arrays – Declarations – Expressions – Statements – Symbolic Constants. **Operators And Expressions:** Arithmetic Operators – Unary Operators – Relational and Logical Operators – Assignment Operators – The Conditional Operator-Bitwise operator.	9
III	**Input And Output Statements:** Single Character Input – Single Character Output – Entering Input Data – Writing Output Data – The Gets and Puts Function. **Control Statements:** Branching – Looping – Nested Control Structures – Switch Statement – Break Statement – Continue Statement – Comma Operator – GOTO Statement. **Arrays:** Defining an Array – Passing Arrays to Functions – Multidimensional Arrays.	9
IV	**Functions:** Defining a Function – Accessing a Function – Function Prototypes – Passing Arguments to a Function – Recursion. **Program Structure:** Storage Classes – Atomic Variables – Global Variables- Static Variables. **Strings:** Defining a String – NULL Character – Initialization of Strings – Reading & Writing a String – Processing a String .	10
V	**Pointers:** Pointer Declarations – Passing Pointers to a Function – Dynamic Memory Allocation – Array of Pointers. **Structures And Unions:** Definition of Structures – User- Defined Data Types – Structures and Pointers – Passing Structures to Functions – Unions. **File Handling:** Opening and Closing a File – Reading and Writing a Data File – Processing a Data File.	10

References	**Text Books:** **1.** R.G.Dromey "How to solve it by Computer",Pearson Education,2007 (Unit I). **2.** Byron Gottfried, "Programming with C" Third Edition, McGraw Hill Education (India) Pvt Ltd., 2013 **Reference Books:** **1.** Ashok N Kamthene "Programming with ANSI & Turbo C" Pearson Education,2006.
Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Design C Programs for problems. .

Course Code & Title	**19DAU03 MATHEMATICAL FOUNDATION FOR DATA SCIENCE** **(for students admitted from 2019-20 & onwards)**		
Class	BSc Computer Science with Data Analytics	**Semester**	I
Course Objectives	The Course aims • to introduce the ideas in differential calculus • to learn about definite integrals and its applications • to learn the different methods of solving Simultaneous algebraic equation. • to learn about interpolation and its formula • to introduce different methods of Numerical Differentiation and Numerical integration		

SYLLABUS

UNIT	Content	No. of Hours
I	**Differential Calculus**: The Derivative as a Function – Maximum and Minimum Values – Optimization Problems .	**10 hours**
II	**Integral Calculus**:: The Definite Integral – The Fundamental theorem of Calculus – Area between Curves – Volumes	**10 hours**
III	**Numerical methods:** Solution of System of Simultaneous Algebraic Equations: Gauss Elimination Method – Gauss Jordan Method – Gauss Jacobi Iterative Method – Gauss Seidel Iterative Method.	**9 hours**
IV	**Numerical methods:** Difference table – Interpolation –Newton's Forward Interpolation formula – Newton's Backward Interpolation Formula – Construction of polynomials – Equidistant terms with one or more missing values.	**9 hours**
V	**Numerical methods:** **Numerical Differentiation:** Newton's Forward and Newton's Backward formula to compute the Derivatives. **Numerical Integration:** The Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule.	**10 hours**
References	**Text Books:** 1. James Stewart **, "Calculus: Early Transcendentals"**, 7^{th} Edition, Cengage Learning, USA, 2012. **Unit – I: Chapter II(Sections 2.8), Chapter IV (Sections 4.1, 4.7) (Problems only)** **Unit-II: Chapter V Sections: (5.2, 5.3), Chapter VI Sections: (6.1,6.2) (Problems only)** 2. Dr. M.K. Venkataraman "**Numerical methods in Science and Engineering**" The National Publishing Company , Reprint July 2013. **Unit – III: Chapter IV(Sections :4.1, 4.2, & 4.6)(Problems only)** **Unit – IV: Chapter V(Sections : 5.1 to 5.10, 6.1 to 6.5) (Problems only)** **Unit – V: (Sections: 9.1 to 9.3, 9.8, 9.10)(Problems only)**	

Course Outcomes	**On completion of the course, students should be able to** **CO1:** find the derivative, maximum and minimum values of a function **CO2:** evaluate the definite integrals and find area between curves **CO3:** recall the different methods used to solve simultaneous algebraic equations **CO4:** use interpolation formula to construct the polynomial **CO5:** apply various methods of numerical Differentiation and Integration

Course Code & Title	19DAU04 Lab – I (C Programming Lab)		
Class	I-B.Sc Computer Science with Data Analytics	Semester	I
Course Objectives	**The Course aims** • To provide foundation for programming, toanalyze and efficiently solve the problems using C language. • To read, understand and trace the execution of programs in C language. • To understand arrays, pointers, functions, and string handling in C. • To understand structures and file handling. • To make students to develop applications using C.		

SYLLABUS

Content
1. a)Write a C program to read the values of coefficients a, b and c of a quadratic equation $ax^2+bx+c=0$ and find roots of the equation b) The total distance traveled by vehicle in‘t’ seconds is given bydistance $=vt+1/2at^2$ where ‘v’ and ‘a’ are the initial velocity (m/sec.) and acceleration (m/sec2). Find the distance traveled at regular intervals of time given the values of ‘v’ and ‘a’. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of ‘v’ and ‘a’.
2. Implement the following: a) C program to check given string is a valid IPv4 address or not. b) C program to create your own header file. c) C program to calculate EMI.
3. a) Write a program to find separately the sum of the positive and negative integer elements of an array of size 10. Pass this array to a function called sortarray(int[]) and display the array elements into ascending order. b) Write a program to read values for two integer array variables and write a third array which has all the items of the two arrays, but in an alternating order. In other words, Given arrays ([1,2,3,4],[11,12,13,14])== Resultant array[1,11,2,12,3,13,4,14] and display the output. c) An application of function floor is rounding a value to the nearest integer. The

statement y = floor(x + 0.5); will round the number x to the nearest integer and assign the result to y. Write a C program that reads several numbers and to round each of these numbers to the nearest integer. For each number processed, print both the original number and the rounded number.
4. Develop a program that uses functions to perform the following: a) Multiplication of Two Matrices b) Transpose of a matrix. c) Find the sum of odd and even elements separately from the given matrix.
5. a) Implement the following: i. Use pointer variable to find sum of n elements in an array. ii. Display values in reverse order from an array using pointer. b) Write a C program using pointers to compute the sum, mean and standard deviation of all elements stored in an array of n real numbers.
6. a) Design and develop a C function RightShift(x ,n) that takes two integers x and n as input and returns value of the integer x rotated to the right by n positions. Assume the integers are unsigned. Write a C program that invokes this function with different values for x andn and tabulate the results with suitable headings. b) Implement the following using recursion: a) Find the GCD (greatest common divisor) of two given integers. b) Find the LCM of two given integers.
7. a) From a given paragraph perform the following using built-in functions: i. Find the total number of words. ii. Capitalize the first word of each sentence. iii. Replace a given word with another word. b) Implement the following: i. C program to trim both leading and trailing white space characters from given string. ii. C program to find highest frequency character and lowest frequency character in a string.
8. a) Generate salary slip of employees and sales commission using structures and pointers. b) Display the highest literate rate and the highest income of a state using array of structures.

9. a) Given two university information files “studentname.txt” and “usn.txt” that contains Student names and USN respectively. Write a C program to create a new file called “output.txt” and copy the content of files “studentname.txt” and “usn.txt” into output file in the sequence shown below. Display the contents of output file “output.txt” on to the screen. b) Write C program to reverse the first n characters in a file. (Note: The file name and n are specified on the command line.)	
10. Implement the following using Bitwise operators: a) Check whether a number is odd or even. b) Count leading zeros in a binary number.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Develop C programs for applications by making use of basic constructs, arrays and strings. **CO2:**Develop C programs involving functions, recursion, pointers, and structures. **CO3:**Design applications in C using File concept.

Course Code & Title	19DAU05 Lab – II (Data Manipulation Using Excel Lab)		
Class	I-B.Sc Computer Science with Data Analytics	Semester	I
Course Objectives	**The Course aims** • To familiarize with basic concepts of excel. • To understand the visualization of data. • To learn the usage of functions & simple financial, mathematical and statistical calculations.		

SYLLABUS

Content
1) Create a dataset for a grocery store which has a larger number of customer attractions.
2) Analyze the frequently purchased data by a) Women customers b) Men customers
3) Predict the clustered data from the given dataset.
4) Predict the SUM, COUNT, COUNTA, LEN, VLOOKUP, HLOOKUP and IF statement.
5) Perform the following operations A) Freeze panes B) Sorting C) Filters D) Custom Sort
6) In cells A1 and A2, type 1000 and 1500 respectively. Use auto-complete to fill cells A3-A8. Calculate the following values for cells A1-A8 using built in excel functions: a. Sum b. Maximum c. Minimum d. Average e. Median f. Standard Deviation
7) Organizing & Analyzing Datasets & Table: a.Create & modify table b.Use Subtotal features c.Work with Database Functions
8) Analyze data by: a. Creating a pivot table b. Filtering data using Slicers c. Analyzing data using Pivot Charts
9) Create a student opinion dataset and analyze it using different charts.
10) Apply Regression Analysis for particular company information.

11) Prepare a dataset for electricity consumption of a consumer for past 2 years. Find the mean, median, mode and visualize the data.	
12) With the provided data of traffic cases find the frequency distribution table.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Use the excel features to create and analyze the dataset. **CO2:** Perform calculations in spreadsheet. **CO3:**Develop decision making skill by using what-if analysis on spreadsheets.

Course Code & Title	19DAU06 Python Programming		
Class	I-B.Sc Computer Science with Data Analytics	Semester: II	Total Hrs:36
Course Objectives	**The Course aims** • To know and understand the basics of Python programming. • To able to understand the concepts of decision and control statements. • To learn the concepts of functions and strings.. • To use Python data structures – lists, tuples and dictionaries. • To understand Object Oriented Programming concepts and files in Python.		

SYLLABUS

Unit	Content	No. of Hours
I	**Introduction:** History of Python – Executing Python Programs – Commenting in Python – Internal Working of Python - Python Character Set – Token – Python Core Data Type – print() Function – Assigning Values to Variables – Multiple Assignments – input() Function – eval() Function – Formatting Numbers and Strings – Python Inbuilt Functions - Decision and Loop Control Statements.	7
II	**Functions:** Introduction – Syntax and Basics of Function – Use of a Function – Parameters and Arguments in a Function – Local and Global Scope of a variable – return Statement – Recursive Functions – Lambda function. **Strings:** Introduction – str class – Basic Inbuilt Python Functions for String – Traversing String with for and while Loop – Immutable Strings – Various String Operations.	7
III	**Lists:** Introduction – Creating Lists – Accessing the Elements of a List – Negative List Indices – List Slicing - List Slicing with Step Size – Python Inbuilt Functions for Lists – List Operator – List Comprehensions – List methods – List and Strings – Splitting a String in List – Passing and Returning List from a Function. **Tuples :** Creating Tuples - tuple() Function - Inbuilt Functions for Tuples - Indexing and Slicing - Operations on Tuples - Passing Variable Length Arguments to Tuples - Lists and Tuples - Sort Tuples - Traverse Tuples from a List - zip() Function - Inverse zip(*) Function.	7
IV	**Sets:** Creating Sets - Set in and not in Operator - Python Set Class - Set Operations. **Dictionaries:** Need of Ditionaries - Basics of Dictionaries - Creating a Dictionary - Adding and Replacing Values - Retrieving Values - Formatting Dictionaries - Deleting Items - Comparing Two Dicitonaries - Methods of Dicitonary Class - Traversing Dictionaries - Nested Dicitonaries - Traversing Nested Dictionaries.	7

	File Handling: Introduction – Need of File Handling – Text Input and Output – seek( ) Function – Binary Files.	
V	**Object-Oriented Programming: Class, Objects and Inheritance:** Defining Classes – Self-parameter and Adding Methods to a Class – Display Class Attributes and Methods – Special Class Attributes – Accessibility – Constructor and Destructor Methods – Passing an Object as Parameter to a Method – Method Overloading – Operator Overloading – Inheritance – Types of Inheritance – Using super() – Method Overriding.	8
References	**Text Book:** 1.Ashok NamdevKamthane, Amit Ashok Kamthane, "**Programming and Problem Solving with PYTHON**", McGraw Hill Education (India) Private Limited, First Edition, 2018. **Reference Books:** 1.Allen Downey, Jeffrey Elkner, Chrish Meyers, "**How to Think like a Computer Scientist- Learning with Python**", Dreamtech Press, Reprint Edition 2016. 2.Timothy A, Budd, "**Exploring Python**". McGraw Hill Education (India) Private Limited, Tenth Reprint, 2017. 3.Peter Norton et al., "**Beginning Python**", Wiley &Dreamtech Press, 2006	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Develop solutions to simple computational problems. **CO2:** Write and execute simple Python programs. **CO3:** Decompose a Python program into functions. **CO4:** Represent compound data using Python lists, tuples and dictionaries. **CO5:** Apply OOPs concepts in real-time Python applications.	

Course Code & Title	19DAU07 Data Structures		
Class	**I-B.Sc Computer Science with Data Analytics**	**Semester: II**	**Total Hrs:36**
Course Objectives	• To understand the Basic Techniques of Algorithm analysis. • To learn how the choice of data structures, algorithm and design methods impacts the performance of programs. • To learn efficient searching and sorting techniques. • To understand the concepts of data structures such as Stacks, Queues and Linked list. • To know how to solve problems using data structures such as binary trees, heaps, binary search trees and writing programs for these solutions.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Basic Terminology**: Data structure, Time and space complexity – Array – Structures – Pointers – Matrices - Sparse matrices - Application – String processing.	**7**
II	**Sorting:** Bubble sort - Insertion sort - Selection sort - Merge sort - Radix sort - Quick sort - Time and Space complexity. **Searching:** Binary search - Sequential search - Hashing.	**7**
III	**Linked List:** Linked list - Dynamic memory allocation – Representation - Insertion, deletion and searching - Traversing in a list - Doubly linked list.	**7**
IV	**Stack:** Stack – Linked stack – Application – Expression - Infix-Prefix-Postfix Conversion & Evaluation - Recursion. **Queue :** Queue - Linked queue - Circular queue – Dequeue - Priority queue - Application.	**7**
V	**Trees:** Binary trees-Traversal, BST-traversing, Insertion and deletion of nodes - AVL Search Trees introduction – Application of all trees - Heap sort.	**8**
References	**Text Books:** **1**. Seymour Lipschutz – Schaum Series: "Theory and Problems of Data Structures", TMH, New Delhi, special edition 2013. **Reference Books:** 1.Horowitz, Sahini, Anderson-Freed, "Fundamentals of Data Structures in C", Orient Blackswan, 2008. 2.A.K.Sharma, "Data structures using C", Second Edition, Pearson Education,2013.	

Course Outcomes	**CO1:** Apply the knowledge of data structure concepts and the various algorithms while designing and developing software. **CO2**:Analyze the complexity and correctness of the new algorithms. **CO3:** Choose the appropriate data structure and algorithm design method for a specified application. **CO4:**. Apply and implement learned algorithm design techniques and data structures to solve problems. **CO5:** Apply algorithmic problems including Tree traversals,

Course Code & Title	19DAU08 DISCRETE STRUCTURES & GRAPH THEORY (for students admitted from 2019-20 & onwards)		
Class	BSc Computer Science with Data Analytics	**Semester**	II
Course Objectives	The Course aims • to know the concept of Mathematical logic • to learn the concept of Relations • to make the Students to learn various functions • to inculcate the knowledge in graph theory		

SYLLABUS

UNIT	Content	No. of Hours
I	**Mathematical logic:** Equivalence of formulas – Duality Law – Tautological implications – Functionally complete sets of connectives – Other connectives .Normal Forms – Disjunctive Normal forms – Conjunctive Normal Forms – Principal Disjunctive Normal forms – Principal Conjunctive Normal Forms – Ordering and Uniqueness of Normal Forms – The Theory of inference for the Statement Calculus – Rules of inference – Consistency of Premises and Indirect Method of Proof	**10 hours**
II	**Relations:** Introduction – Properties of binary relations in a set – Relation matrix on the Graph of a relation in Set – Partition and covering of a set –Equivalence Relation – Compatibility relations – Composition of binary Relations – Partial ordering.	**9 hours**
III	**Functions:** Definition and Introduction – Composition of functions – Inverse functions – Peano axioms and mathematical induction**.**	**9 hours**
IV	**Graph theory:** **Introduction:** Definition – Finite and Infinite graph – Incidence and degree – Isolated vertex ,Pendant vertex and null graph. **Paths and Circuits:** Isomorphism – Subgraphs –Walks, Paths and Circuits – Connected Graphs, Disconnected Graphs and Components– Euler Graphs – more on Euler Graphs – Hamiltonian graphs and circuits – Travelling salesman problem.	**10 hours**
V	**Graph theory:** **Trees and fundamental circuits:** Trees – Some properties of trees – Pendant vertices in a tree – Distance and Centers in a tree – Rooted and Binary trees – Spanning trees	**10 hours**
References	**Text Books:** **1.** J.P.Tremblay and R.Manohar , **" Discrete Mathematical Structures with Applications to Computer Science"** Hill Edition Reprint 2007. **Unit – I: Sections 1.2.9 to 1.2.14, 1.3.1 to 1.3.5, 1.4.2, 1.4.3** **Unit – II: Sections2.3.1 to 2.3.8** **Unit – III: Sections 2.4.1 to 2.4.3, 2.5.1** 3.Narasing Deo , **"Graph theory with application to engineering and computer science",** Prentice-Hall of India Pvt.- New Delhi-1. 2016.	

	Unit – IV: Sections 1.1 to 1.5, 2.1,2.2,2.4 to 2.6,2.8 to 2.10 **Unit – V: Sections 3.1 to 3.5,3.7** **Reference Books:** 1**.** J.K. Sharma, **"Discrete Mathematics"** 4th Edition , TRINITY Press (An imprint of Laxmi Publications pvt .Ltd.). Reprint 2015. 2. P.R.Vittal, V.Malini, **"Operations Research"** Reprint 2007.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** understand the concepts of equivalence formulas **CO2:** work with normal forms, **CO3:** understand the mathematical tools that are needed to solve optimization problems, **CO4**: model the problems in computer science using graphs and trees

Course Code & Title	19DAU10 Lab – III (Python Programming Lab)		
Class	I-B.Sc Computer Science with Data Analytics	Semester	II
Course Objectives	**The Course aims** • To understandthe basic concepts of Python. • To learn how to use conditions and loops. • To understand the concept of functions and strings. • To analyze and solve the problem using compound data. • To gain knowledge about class and files.		

SYLLABUS

Content
1. a) Develop a Python program to print the Employee pay slip using eval() function. b) Write a Python program to find the difference between the ASCII code of the any lower case letter and its corresponding uppercase letter.
2. a) Write a Python Program to demonstrate the uses of various python built-in functions.. b) Write a program to print the number of days in a month.
3. a) Generate prime numbers using Charles Babbage function. b) Read a distance in meter and a time in seconds through keyboard. Write a Python program to calculate the speed of a car in meter/second.
4.a) Create a function eval_exp(base,exp) which computes the exponent of any number. b) Write a function calc(x1,y1,x2,y2) to calculate the distance between two points represented by point(x1,y1) and (x2,y2).
5.Implement the string operations using string slicing functions.
6. Write a program to strip unwanted character from a string.
7. Consider the list with mixed type of elements, such as L1=[1,'x',4,6,90, "apple", 'a', o,4]. Create another list using comprehension which consists of only the integer element present within the list L1.
8. a)Write a function reverse(Lst) to reverse the elements of a list. b) Write a program to assign grades to students and display all the grades using keys() and get() method of a dictionary.
9.a)Write a program to demonstrate the use of super(). b) Write a Python program to perform arithmetic operations on complex numbers using method overloading.
10. Write a program to add the content of a file numbers.txt and display the sum of all numbers present in a file.

Course Outcomes	**On completion of the course, students should be able to** **CO1:**Write diversified solution using Python language. **CO2:** Solve problemsusing control statements. **CO3:** Develop programsusing Tuples, Lists and Dictionaries. **CO4:**Implement program using file handling operations.

Course Code & Title	19DAU11 Lab – IV (Data Structures Lab)		
Class	I-B.Sc Computer Science with Data Analytics	Semester	II
Course Objectives	**The Course aims** • Develop skills to design and analyze simple linear and non linear data structures. • Strengthen the ability to identify and apply the suitable data structure for the given real world problem. • Gain knowledge in practical applications of data structures. • Have ability to write computer programs to solve specific problems.		

SYLLABUS

Content	
1. a) Sort the employee names of a company using bubble sort. b) Implement insertion sort technique in an array.	
2. Sort an array using quick sort.	
3. Search an element in an array using binary search.	
4. Sort an array using merge sort.	
5. Demonstrate the selection sort results for each pass of an array element.	
6. Implement the linked list operations and count the number of nodes.	
7. Stimulate infix to prefix conversion.	
8. Solve tower of Hanoi problem using stack.	
9. Implement queue operations using linked list.	
10. Find the Smallest and Largest Elements usingBST traversal.	
Course Outcomes	**CO1:** Illustrate the behavior of data structures. **CO2:** Analyze and determine the appropriate data structure for a problem. **CO3:** Apply the necessary algorithms to solve the problems.

Course Code & Title	19DAU12 Object Oriented Programming with JAVA		
Class	II – BSc Computer Science with Data Analytics	Semester - III	Total Hours : 48
Course Objectives	**The Course aims** • To gain knowledge about java classes. • To provide knowledge about Inheritance, Packages, Interfaces and Exception handling. • To explain the basics of multithreaded programming and String operations. • To gain knowledge in Utility Classes. • To work with Event handling.		

SYLLABUS

UNIT	Content	No. of Hours
I	**An Overview of JAVA:** Object-Oriented Programming - A First Simple Program - Lexical Issues - Java Class Libraries. **Data Types:** Type Conversion and Casting - Automatic Type Promotion in Expressions. **Introducing Classes:** Class Fundamentals – Declaring Objects – Assigning Object Reference Variables – Introducing Methods – Constructors – The this Keyword – Garbage Collection – A Stack Class.	9
II	**Inheritance:** Inheritance Basics – Using Super – Creating a Multilevel Hierarchy – When Constructors Are Called – Method Overriding – Dynamic Method Dispatch – Using Abstract Classes – Using final with Inheritance – The Object Class. **Packages and Interfaces:** Packages – Packages and Member Access – Importing Packages – Interfaces. **Exception Handling:** Exception Handling Fundamentals - Exception Types - Uncaught Exceptions - Using try and catch - Multiple catch Clauses - Nested try statements - throw - throws - finally - Java's Built in Exceptions – Creating Your Own Exceptions – Using Exceptions.	10
III	**Multithreaded Programming:** The Java Thread Model - Thread Priorities - Synchronization – Inter Thread communication – Suspending, Resuming and Stopping Threads. **String Handling:** The String Constructors - String Length - Special String Operations - Character Extraction - String Comparison - Searching Strings - Modifying a String.	9
IV	**The Collections Framework:** Collections overview – The Collection Interfaces – The Collection Classes. **Applet:** The Applet Class - Two Types of Applets - Applet Basics - The Applet Class - An Applet Skeleton .- Applet Initialization and Termination - Overriding update( ) - Simple Applet Display Methods - A Simple Banner Applet - Using the Status Window - The HTML APPLET Tag - Passing Parameters to Applets - Improving the Banner Applet - getDocumentBase( ) and getCodeBase( ) - AppletContext and showDocument( ).	10
V	**Event Handling:** The Event Handling Mechanisms – The Delegation Event Model – Event Classes – Sources of Events – Events Listener Interfaces – Using the Delegation Event Model – Adapter Classes.	10

	Swing: The Swing Packages - A Simple Swing Application - Event Handling - Create a Swing Applet - Painting in Swing. **Exploring Swing:** JLabel and ImageIcon - JTextField - The Swing Buttons – Jbutton - JToggleButton - Check Boxes - Radio Buttons - JTabbedPane - JScrollPane - JList - JComboBox - Trees – Jtable.	
References	**Text Book:** 1. Herbert Schildt, "The Complete Reference JAVA ™ 2", Mc-Graw Hill Limited, Eleventh Edition, 2019. **Reference Books:** 1. Patrick Naughton, Herbert Schildt, "Java 2: The Complete Reference", Mc-Graw Hill Limited, Fifth Edition, 2007. 2. E. Balagurusamy, 'Programming with Java', Sixth Edition, Tata McGraw Hill, 2019. 3. Paul J. Deitel, Dr. Harvey M. Deitel, **"**Java How to Program", Prentice Hall; 9th edition, 2019.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Gain knowledge and design the basic problem solution using Object Oriented Programming. **CO2:** Program efficiently using Inheritance, Packages and Exception handling. **CO3:** Efficiently implement multithreading and string operations. **CO4:** Understand and implement collection framework. **CO5:** Develop effective API using AWT.	

Course Code & Title	19DAU13 Relational Database Management Systems		
Class	II BSc Computer Science with Data Analytics	Semester: III	Total Hrs: 48
Course Objectives	**The Course aims** • To learn the fundamental concepts of databases. • To depict a database system using ER diagram and make a study of SQL commands. • To manipulate data in SQL. • To understand the concepts in PL/SQL. • To realize the concepts of procedures and triggers.		

SYLLABUS

UNIT	Content	No. of Hours
I	**INTRODUCTION:** Purpose of Database System - View of Data - Database Languages - Relational Databases – Database Design – Data Storage and Querying - Transaction Management - Database Architecture – Database Users and Administrators. **RELATIONAL DATABASES:** Structure of Relational Databases – Database Schema – Keys – Relational Query Languages – Relational Operations.	10
II	**DATABASE DESIGN AND THE E-R MODEL:** The Entity-Relationship Model – Constraints – Entity-Relationship Diagrams. **RELATIONAL DATABASE DESIGN:** Normalization – Decomposition Using Functional Dependencies. **INTERACTIVE SQL:** Invoking SQL * plus- Data manipulation in Database Management Systems – Oracle Data Types – Two Dimension Matrix Creation- Insertion of data into tables- Updating the contents of a table – Deletion operations.	11
III	**SQL :** The many faces of the Select command- Modifying the structure of the table – Removing/Deleting/Dropping tables - Data constraints - Computations in expression lists used to select data - Logical operations – Range searching – Pattern matching – Oracle functions – Grouping data from tables in SQL – Manipulating dates in SQL.	9
IV	**DATA MANIPULATION:** Joins – Sub queries. Indexes – Views – Sequences- Granting permissions- Revoking the permissions given – Creation of reports in SQL* plus. **PL/SQL:** Introduction – Execution – PL/SQL syntax, Oracle transaction locks – Cursors.	9
V	**STORED PROCEDURES:** Introduction - Creating Stored Procedures – An application using a Procedure - Deleting a Stored Procedures- Difference between stored Procedures and stored functions. **DATABASE TRIGGERS:** Types of Triggers – Creating Triggers – Deleting Triggers.	9

References	**Text Books:** 1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2017 (Unit I, II). 2. Ivan Bayross, "Commercial Application Development Using ORACLE Developer 2000", BPB Publication, New Delhi, 2007 (Unit III - V). **Reference Books:** 1. Ramez Elmasri, Shamkant B.Navathe, "Fundamentals of Database Systems", Pearson Education Asia, Seventh Edition, Reprint 2017. 2. Nilesh Shah, "Database Systems Using Oracle", PHI Learning Private Limited, New Delhi, 2014.
Course Outcomes	**On completion of the course, students will be able to** **CO1:** Recognize the database systems concept. **CO2:** Recognize the relational concepts and constraints. **CO3:** Implement data manipulation commands. **CO4:** Gain knowledge about procedures and triggers in PL/SQL. **CO5:** Conceptualize the components involved in object oriented databases.

Course Code & Title	19DAU14 Operating System		
Class	II BSc Computer Science with Data Analytics	Semester: III	Total Hrs : 48
Course Objectives	**The Course aims** • To understand the main components of an OS & their functions. • To study the process management and scheduling. • Recognize what deadlock is and how it can occur when giving mutually exclusive access to multiple resources. • To understand Memory management techniques & virtual memory concepts • To understand the concepts of file Operations, Allocation.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Operating Systems**: Introduction - Operating-System Structures - Operating - System Services - User and Operating-System - Interface - System Calls - System Services - Linkers and Loaders.	10
II	**Process Management**: Processes - Process Concept - Process Scheduling - Operations on Processes - Inter process Communication IPC in Shared-Memory Systems - IPC in Message-Passing Systems. **CPU Scheduling**: Basic Concepts - Scheduling Criteria - Scheduling Algorithms.	10
III	**Deadlocks:** System Model - Deadlock in Multithreaded Applications - Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock.	9
IV	**Main Memory:** Background - Contiguous Memory Allocation - Paging - Structure of the Page Table - Swapping. **Memory Management:** Virtual Memory - Background - Demand Paging - Page Replacement – Thrashing.	9
V	**File System:** File-System Interface - File Concept - Access Methods - Directory Structure. **File-System Implementation:** File-System Structure - File-System Operations - Directory Implementation - Allocation Methods - Free-Space Management. **I/O Systems:** Overview - I/O Hardware - Application I/O Interface - Kernel I/O Subsystem.	10
References	**Text Book:** 1.Abraham Silberschalz, Peter B Galvin, G.Gagne, "Operating System Concepts", 10th Edition, John Wiley & Sons Inc, 2018. **Reference Books:** 1. Andrew S Tanenbaum and Herbert Bos, "Modern Operating Systems", Prentice Hall of India, New Delhi, 2015. 2. William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, 2018.	

Course Outcomes	**On Completion of the Course the Students should be able to** **CO1:** Describe the important computer system resources and the role of operating system in their management policies. **CO2:** Understand the process management policies and scheduling of processes by CPU. **CO3:** Understand the Mutual exclusion, Deadlock detection in operating system. **CO4:** Describe and analyze the memory management and its allocation policies. **CO5:** Realize the file mechanism in operating systems

Course Code & Title	19DAU15 LINEAR ALGEBRA (for students admitted from 2019-20 & onwards)		
Class	B.Sc Computer Science with Data Analytics	**Semester**	III
Course Objectives	The Course aims • to know the concept of Vector spaces • to learn the concept of Inner Product Spaces • to introduce the Theory of Matrices		

SYLLABUS

UNIT	Content	No. of Hours
I	**Vector spaces:** Introduction – Definition and Examples –Subspaces – Linear Transformation – Span of a set	**9 hours**
II	**Vector spaces:** Linear Independence – Basis and Dimension – Rank and Nullity – Matrix of Linear Transformation	**10 hours**
III	**Inner Product Spaces:** Introduction – Definition and examples – Orthogonality – Orthogonal Complement	**10 hours**
IV	**Theory of Matrices:** Introduction – Algebra of Matrices – Types of Matrices – The Inverse of a Matrix –Elementary Transformation –Rank of a Matrix.	**9 hours**
V	**Theory of Matrices**: Simultaneous Linear Equations-Characteristic Equation and Cayley Hamilton Theorem –Eigen Values and Eigen Vectors.	**10 hours**
References	**Text Books:** Arumugam.S ,Isaac.A.T **"Modern Algebra"** Scitech Publications 2014 edition **Unit – I: Section(5.0 to 5.4)** **Unit – II: Section (5.5 to 5.8)** **Unit – III: Section(6.0 to 6.3)** **Unit – IV: Section(7.0 to 7.5)** **Unit – V: Section(7.6 to 7.8)**	
Course Outcomes	**On completion of the course, students should be able** **CO1:** to understand the concept of Subspaces, Linear Transformation and Span of a set. **CO2:** to work with Basis , Dimension and to find Rank & Nullity. **CO3:** to understand Inner Product Spaces **CO4:** to Find Inverse of a Matrix & Rank of a Matrix by elementary transformations. **C05 :**to solve Simultaneous Linear Equations and to find Eigen Values and Eigen vectors.	

Course Code & Title	19DAU16	APPLIED STATISTICS	
Class	II B.Sc Computer Science with Data Analytics	Semester	**III**

Course Objectives:

The course aims to

- Solve the past data related to a variable and to fit a suitable model.
- Highlight the important logic and methodology for calculation of various index numbers.
- Develop an understanding of Statistical Quality Control.
- Learn the various methods of sampling techniques.
- Develop the basic statistics using excel functions and data analysis tools.

SYLLABUS

UNIT	CONTENT	No. of Hours
I	Sampling Techniques: Definition – Methods of sampling – Probability sampling: Simple random sampling (SRS) with and without replacement – Selection of SRS using lottery method and random number table method – Stratified random sampling – Systematic sampling and Clustering sampling. Non-probability sampling: Convenience sampling, Judgment sampling and Quota sampling – Sampling errors (Concepts only).	10
II	Time series - meaning uses and its components –Trend: Estimation of Trend – Moving average method and method of least square – Simple problems - Seasonal variations: Measuring seasonal variations - Simple average method only.	10
III	Index Numbers - Definition – Uses – Construction of Unweighted and weighted Index – Laspeyre's, Paasche's, Fisher's index numbers – Time reversal and factor reversal tests - Cost of living Index number - Simple problems.	8
IV	Theory of Statistical Quality Control (SQC) - Concept, uses, construction and interpretation of Mean, Range, p, np and C charts- Simple problems.	10
V	Statistics using Excel: Statistical functions – Measure of Central tendency: AVERAGE, AVERAGEA, MEDIAN, MODE. Measure of Dispersion: MIN, MAX, QUARTILE, VAR, VARP, STDEV, STDEVP, SKEW, Distributions: BINOMDIST, POISSON.DIST, NORMDIST, NORMINV. Time series: FORECAST TREND, SLOPE and INTERCEPT. Data Analysis using Excel: Descriptive Statistics – t-Test: Two-sample (equal and unequal variance) for mean, Paired two samples for mean, Z-test: Two-sample for means – ANOVA – Correlation – Regression – Moving average.	10

References:

Text Books:

1. "Fundamental of Applied Statistics", S.C. Gupta and V. K. Kapoor, Sultan Chand & Sons publishers, New Delhi, 2012.
2. "Business Statistics", S.P. Gupta and M.P. Gupta, Sultan Chand & Sons publishers, New Delhi, 2015.
3. "Statistics Theory and Practice", R.S.N. Pillai and Bhagavathi, Sultan Chand & Company Ltd, New Delhi, 7th Revised edition 2008.
4. "Statistical Methods", S.P. Gupta, Sultan Chand & Sons publishers, New Delhi, 28th edition, 2017.
5. "Computer Applications in Business and Management", Ananthi Sheshasayee and Sheshayee, Margam Publication, Chennai, 2014.

Reference Books:

1. "Introductory Statistics", Prem . S. Mann, 6th edition, John Wiley & Sons, 2007.
2. "Introductory Statistics. A step by step approach", Allan Bluman, 7th edition, McGraw-Hill, 2009.

Course Outcomes:

On completion of the course, students should be able to

- Understand the concept of time series data and methods used to forecast the future.
- Construct and interpret index numbers.
- Understand the various statistical functions used to identify the processing product with in the control or not.
- Know the examined lots of products are free of defectives.
- Apply various sampling techniques in real life business problems.
- Execute the statistical functions and data analysis tools in excel.

Course Code & Title	19DAU17 Lab – V(Java Programming Lab)		
Class	II-BSc Computer Science with Data Analytics	Semester	III
Course Objectives	**The Course aims** • To provide, to analyze and efficiently solve the problems using Java language**.** • To understand Exception handling, User defined exceptions. • To familiarize multithreading • To learn and understand AWT.		

List of Practical	
1. Calculate mathematical constant 'e' using the formula e=1+1/2!+1/3!+..... Up to 5.	
2. Implement multilevel inheritance by applying various access controls to its data members and methods.	
3. Demonstrate use of implementing interfaces.	
4. Implement the concept of importing classes from user defined package and creating packages.	
5. Create a customized exception and also make use of all the 5 exception keywords.	
6. Implement the concept of Exception Handling using predefined exception.	
7. Implement the concept of Exception Handling by creating user defined exceptions.	
8. Illustrate the concept of threading using Thread Class.	
9. In a Multi thread environment, implement join() and isAlive() functions.	
10. Create a multithreaded producer and consumer application.	
11. Practice String class and its methods.	
12. Implements bank transactions using user defined exception.	
13. a) Write a JAVA program to paint like paint brush in applet. b) Write a JAVA program to display analog clock using Applet.	
14. Write a java program that connects to a database using JDBC and does add, delete, modify and retrieve operations.	
15. a) Write a JAVA program to build a Calculator in Swings. b). Write a JAVA program to display the digital watch.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Solve problems using exception handling and multithreading. **CO2:** Analyze and implement AWT **CO3:** Develop java programs using threads.

Course Code & Title	19DAU18 Lab – VI (RDBMS Lab)		
Class	II-BSc Computer Science with Data Analytics	Semester	III
Course Objectives	**The Course aims** • To understand the fundamentals of relational and object-oriented database systems • To understand the techniques in developing databases for real time applications. • To be familiar with PL/SQL commands.		

	LIST OF PRACTICALS
1	Create a database and perform DDL commands create, alter, drop, rename and truncate.
2	Create a database. Write a query to create primary constraints with column level with naming convention.
3	Create a database. Write a query to create default and check constraints.
4	Execute the date and string functions in SQL.
5	Create two tables named sales and orders. Combine the records in two tables using joins.
6	Write a query to update multiple records from students table.
7	Implement PL/SQL program for Bonus calculation.
8	Create a cursor to select the five highest paid employees from the employee table.
9	Prepare an employee payroll of a company using Stored Functions.
10	Implement Trigger for student data.
Course Outcomes	**On completion of the course, students will be able to** **CO1**: Implement programs using object oriented database systems. **CO2**: Construct programs in PL/SQL with real time applications. **CO3**: Gain knowledge about PL/SQL commands.

Course Code & Title	19DAU19	STATISTICS PRACTICAL	
Class	II BSc Computer Science with Data Analytics	Semester	**III**

Course Objectives:

To Course aims to

- Train the student to gain Knowledge in statistical software (SPSS) packages for problem solving.
- Introduce the basic functions of SPSS.
- Train the students for making graphs and diagrams.
- Provide the students with the skills to use SPSS for processing and analyzing statistical data sets.
- Train the students to process data and generate outputs.

SYLLABUS

Introduction - Sample files – Opening a Data file – Running an Analysis – viewing Results – Creating Charts – Multiple Response (define variable sets) – Transform (Recode into same variable, Recode into different variable).Selected Cases, Split file.

Graph (Bar, Line, Dot, Pie Charts) - Descriptive Statistics (Frequency, Descriptive, Crosstabs) – Correlation (Bivariate, Multiple) – Regression (Linear, Multiple) Compare Means (One-Sample t-test, Independent-Sample t-test, One-Way ANOVA) - Non-Parametric Test (Chi-Square test for Homogeneity).

References:

Text Books:

1. "SPSS in Simple Steps", Smruti Bulsari, Sanjay Sinha Kiran Pandya, Dreamtech Press, 2011.
2. "Discovering Statistics using IBM SPSS Statistics", Andy Field, SAGE Publications Limited; Fourth edition, 2003.
3. "Performing Data Analysis Using IBM SPSS", 1st Edition, Lawrence S. Meyers, Glenn C. Gamst, A. J. Guarino, Publisher: Wiley; 1 edition, 2013.

Reference Books:

1. "Practical Data Analysis", Hector Cuesta, Packt Publishing Limited, (2013).
2. "Statistical Data Analysis: A PracticalGuide", Milan Meloun , Woodhead Publishing India; 1 edition, (2011).
3. "SPSS Statistics for Data Analysis and Visualization", Keith McCormick, Jesus Salcedo, Jason Verlen, Jon Peck, Andrew Wheeler, Wiley, (2017).

Course Outcomes:

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

- Use the basic functions of SPSS.
- Process data and generate statistics for some demographic variable analysis.
- Generate graphs and diagrams for given data.
- Process data and generate outputs using SPSS software.

Ex. No.	Title
1	Creating a data file
2	Defining Variable Set
3	Transform: Recode into Same Variable and Different Variable
4	Creating Chart – Bar, Pie and Scatter Plot
5	Descriptive Statistics (Descriptives and Cross Tabs)
6	Correlation (Simple and Multiple)
7	Regression (Simple and Multiple)
8	One Sample t test
9	Independent Sample t- test
10	One-Way ANOVA
11	Chi – Square test

Course Code & Title	19DAU20 R-Programming		
Class	II-BSc Computer Science with Data Analytics	Semester: IV	Total Hrs: 48
Course Objectives	**The Course aims** • To enable the students to gain basic knowledge about R. • To understand getting data in R. • To enable the students to understand about objects and date and time functions. • To facilitate the students to have knowledge on control structures and functions. • To smooth the progress of learning debugging and simulation.		

UNIT	LIST OF PRACTICALS	No. of Hours
I	**Overview of R:** R Introduction - S Introduction – S Philosophy - Back to R - Basic Features of R – Free software - Design of the R system - Limitations of R - R Resources. **R Nuts and Bolts:** Entering Input-Evaluation - R Objects – Numbers – Attributes - Creating vectors – Lists - Mixing objects - Explicit coercion - Matrices - Lists - Factors - Missing Values - Data frames - Names.	9
II	**Getting Data in and out of R:** Reading and Writing Data - Reading Data Files with read.table() - Reading in Larger Datasets with read.table - Calculating Memory Requirements for R Objects - Using the readr package. **Using Textual and Binary Formats for Storing Data:** Using dput() and dump() - Binary Formats. **Interfaces to the Outside World:** File Connections - Reading Lines of a Text File - Reading From a URL Connection.	9
III	**Subsetting R Objects:** Subsetting a Vector - Subsetting a Matrix - Subsetting Lists - Subsetting Nested Elements of a List - Extracting Multiple Elements of a List - Partial Matching - Removing NA Values. **Vectorized Operations**: Vectorized Matrix Operations. **Dates and Times :** Dates in R - Times in R - Operations on Dates and Times. **Managing Data Frames with the dplyr package:** Data Frames - The dplyr Package - dplyr Grammar - Installing the dplyr package -select, filter(),arrange(),rename(),mutate() – CONTENTS - group_by() ,%>% .	10
	Control Structures: if-else - for Loops - Nested for loops - while Loops - Repeat Loops - next, break.	10

IV	**Functions:** Functions in R - Your First Function - Argument Matching - Lazy Evaluation - The ... Argument - Arguments Coming After the Argument. **Scoping Rules of R:** A Diversion on Binding Values to Symbol - Scoping Rules - Lexical Scoping: Why Does It Matter? - Lexical vs. Dynamic Scoping - Application: Optimization - Plotting the Likelihood.	
V	**Loop Functions:** Looping on the Command Line - lapply() - sapply() - split() - Splitting a Data Frame - tapply - apply() - Col/Row Sums and Means - Other Ways to Apply - mapply() – CONTENTS - Vectorizing a Function. **Debugging:** Something's Wrong! - Figuring Out What's Wrong - Debugging Tools in R - Using traceback() - Using debug() - Using recover(). **Profiling R Code:** Using system.time() - Timing Longer Expressions - The R Profiler - Using summaryRprof(). **Simulation**-Generating Random Numbers - Setting the random number seed - Simulating a Linear Model -Random Sampling.	**10**
References	**Text Book:** **1.** Roger D. Peng, "R Programming for Data Science", Lean pub publishers, 2015. **Reference Book:** **1**. Jared P.Lander, "R for Everyone – Advanced Analytics and Graphics", Addison Wesley Data & Analytics Series, Reprint 2016.	
Course Outcomes	**On completion of the course, students should be able to :** **CO1:** Apply the knowledge of R concepts. **CO2:** To understand how to read the larger datasets in R. **CO3:** To get knowledge on managing data frames. **CO4:** Analyze and understand the control structures and functions. **CO5:** Investigate debugging and loop functions in R.	

Course Code & Title	19DAU21 Modern Database Systems		
Class	II - BSc Computer Science with Data Analytics	Semester: IV	Total Hrs:48
Course Objectives	**The Course aims** • To understand the basic Distributed Database Design. • To learn the basics of Parallel Database Systems. • To learn efficient NoSQL and Aggregate Data Models. • To understand the concepts of Hadoop, Big data • To know how to use MongoDB, Hbase, Cassandra.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Distributed Database Systems:** Distributed Database system - Promises – Complications – Design Issues – Distributed DBMS Architecture. **Distributed Database Design:** Distributed Database Design Issues – Fragmentation – Allocation.	9
II	**Parallel Database Systems:** Architecture – Parallel Data Placement – Query Processing – Load Balancing – Database Clusters.	9
III	**NOSQL:** The value of Relational databases – Application and Integration Database – The Emergence of NoSQL. Aggregate Data Models - Map-Reduce - Graph Databases.	10
IV	**Next Generation Databases:** Database Revolutions – Google, Big data and Hadoop.	10
V	Document Databases – Column Databases – In-memory Databases. **Distributed Database Patterns:** MongoDB – Hbase – Cassandra.	10
References	**Text Books:** 1.M.Tamer Ozsu, Patrick Valduriez, "Principles of Distributed Database Systems", 2011 (Unit 1, Unit 2) 2. Pramod J.Sadalage and Martin Fowler, "NoSQL Distilled – Brief Guide to the Emerging World of Polyglot Persistance", Pearson Education, 2013.(Unit 3) 3. Guy Harrison, "Next Generation Databases: NoSQL and Big Data", A press, 2015. (Unit 4, Unit 5) **Reference Books:** 1.Ramez Elmasri and Shamkrant Navathe, "Fundamentals of Database Systems", Addison Wesley, 2013. 2.Kristina Chodorow, "MongoDB: The Definitive Guide", O'Reilly Media, 2012.	
Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Apply the knowledge of Distributed Database system concepts while developing. **CO2:** Analyze the complexity of Parallel Database Systems. **CO3:** Choose the appropriate graph database. **CO4:** Investigate database revolution. **CO5:** Analyze about in-memory databases.	

Course Code & Title	19DAU22 Data Mining		
Class	II-B.Sc Computer Science with Data Analytics	Semester: IV	Total Hrs:48
Course Objectives	**The Course aims** • To understand the Basics of Data mining. • To learn how to use association rule in data mining. • To learn efficient clustering techniques. • To understand the concepts of decision trees. • To know the scope of temporal and spatial data mining.		

SYLLABUS

UNIT	Content	No. of Hours
I	**DATA MINING:** Introduction- Data mining - Data mining definitions-KDD Vs Data mining-DBMS Vs Data mining-Other related areas-DM Techniques-Other mining problems-Issues and challenges in DM-DM Application areas.	9
II	**ASSOCIATION RULE**: Introduction - Methods to discover Association rules-APriori Algorithm-Partition Algorithm-Pincer-Search Algorithm - Dynamic Item set Counting Algorithm-FP tree Growth algorithm - Eclat and dEclat-Rapid association rule mining-Incremental algorithm-Border algorithm-Generalized Association Rule.	9
III	**CLUSTERING**: Introduction-Clustering paradigms-Partitioning Algorithms-A-Medoid Algorithms - CLARA – CLARANS – Hierarchical clustering – DBSAN – BIRCH – CURE - Categorical clustering Algorithms – STIRR – ROCK - CACTUS.	10
IV	**DECISION TREES**: Decision tree – introduction -Tree construction principle-Best split-Splitting Indices-Splitting criteria-Decision tree constructing algorithms-CART-ID3-C4.5-CHAID.	10
V	**TEMPORAL AND SPATIAL DATA MINING:** Introduction of temporal data mining – temporal association rules – sequence mining. **Spatial Mining**: Spatial Mining tasks – Spatial Clustering – Spatial Trends.	10
References	**Text Book:** 1. Arun K. Pujari, "Data mining Techniques", Universities Press, Second Edition, 2010. **Reference Book:** 1 J. Han, M. Kamber, Data Mining: Concepts and Techniques, Harcourt India / Morgan Kauffman, 2011.	
Course Outcomes	**CO1:** Apply the knowledge data mining to mine the data. **CO2**: Analyze the complexity and correctness of the association rule. **CO3:** Choose the appropriate clustering algorithm for a specified application. **CO4:** Apply and implement decision tree design techniques. **CO5:** Apply temporal and spatial data mining.	

Course Code & Title	19DAU23 Predictive Analytics		
Class	II-BSc Computer Science with Data Analytics	Semester: IV	Total Hrs:48
Course Objectives	**The Course aims** • To understand the basics of Predictive analysis and its challenges. • To identify and visualize data in different dimensions. • To understand the basic concepts data preparation and feature creation. • To understand the concepts of Association rules • To know how to assess predictive models.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Introduction to Predictive Analysis:** Analytics – Predictive Analytics– Business Intelligence – Predictive Analytics vs. Business Intelligence - Predictive Analytics vs. Statistics – Predictive Analytics vs. Data Mining- Challenges in using predictive analytics. Predictive Analytics Processing steps – Business understanding – Defining data for predictive modelling – Defining the target variable – Defining measures of success for predictive models.	9
II	**Understanding Data:** Single Variable Summaries- Data Visualisation in one dimension – Histograms – Multiple Variable summaries - Data Visualisation, two or higher dimensions – Value of statistical significance	9
III	**Data Preparation- Variable cleaning:** Incorrect values – consistency in Data Formats – Outliers – Multidimensional Outliers – Missing values – Fixing Missed Data **Feature creation:** Simple Variable Transformations – Fixing Skew – Binning Continuous Variables-Numeric Variable Scaling – Nominal variable transformation – Ordinal variable transformation – Data and time variable features – ZIP Code features – Multidimensional Features- Variable selection Prior to modeling - Sampling	10
IV	**Item sets:** Terminology - Parameter Settings – Frequent Item set. **Predictive Modeling:** Logistic Regression– K-Nearest Neighbor	10
V	**Predictive Modeling:** Naive Bayes - Regression models -Linear Regression. **Assessing Predictive Models:** Batch approach to model assessment – Assessing Regression models	10
References	**Text Books:** 1. Dean Abbott, "Applied Predictive Analytics - Principles and Techniques for the Professional Data Analyst", Wiley India Pvt Ltd., 2015. **Reference Books:** 1. Daniel T.Larose, Chantal D.Larose, "Data Mining and Predictive Analysis", Wiley India Pvt Ltd, 2nd Edition, 2017. 2. Max Kuhn, Kjell Johnson, "Applied Predictive Modeling", Springer, 2016.	

Course Outcomes	**On Completion of the Course the Students should be able to** **CO1:** Analyze the difference between predictive modeling with other models. **CO2:** Represent data in various statistical formats. **CO3:** Identify the methods for data cleaning. **CO4:** Analyze different Association rules and Item sets. **CO5:** Assess the predictive modeling and Linear Regression.

Course Code & Title	19DAU24	OPTIMIZATION TECHNIQUES	
Class	II B.Sc. Computer Science with Data Analytics	Semester	**IV**

Course Objectives:

The course aims to

- Understand how to translate a real-world problem into a mathematical formulation.
- Understand the basic assumptions and properties of LPP by using graphical and simplex methods.
- Structure special type of LP Problems using transportation and assignment models.
- Solve some specific problems of scheduling jobs on two or three machines.
- Realize the need to study replacement and maintenance analysis techniques.
- Learn the variety of performance measures of a queuing system.
- Construct network diagrams with the single and three time estimates of activities involved in a project.

SYLLABUS

UNIT	CONTENT	No. of Hours
I	Introduction to Optimization Techniques - Linear programming problem (LPP): Definition -Canonical form, Standard form and Formulation of a LPP- Solving LPP by Graphical and Simplex methods - Simple problems.	10
II	Transportation problem - Finding Initial Basic Feasible Solution – North West Corner Method, Least Cost Method, Vogel's Approximation Method and Optimal solution – MoDi method - Assignment Problem – Maximization, Minimization and Restricted assignment problem – Simple Problems.	10
III	Sequencing problem – Johnson's rule for n jobs – 2 machines, n job 3 machines problems – Replacement problems – Elementary replacement models - items whose efficiency deteriorates with time and value of money remains constant during a period.	8
IV	Game theory – concept of pure and mixed strategies – value of games – solving 2 person zero sum games with saddle point – solving 2X2 games without saddle point – simple problem – dominance principle – simple problem. Queuing theory – introduction – queuing system – description of Poisson queues – problem on {(M/M/1): (∞/ FIFO)} only.	10
V	Net work analysis: PERT & CPM network components and precedence relationship – critical path analysis – project scheduling with uncertain activity times – simple problem.	10

Note: 80% Problems and 20% Theory.

References:

Text Books:

1. "Operations Research An Introduction", Hamady, A. Taha (IX Edition), Dorling Kindersley, 2013.
2. "Optimization in Operations Research", Ronald L. Rardin, Perason Education Pvt Ltd, 2003.
3. "Business Statistics and Operation Research", Dr. S.P.Gupta, Dr. P.K. Gupta & Dr. ManMohan, 5th Edition, Sultan Chand & Sons publishers, 2011.

Reference books:

1. "Operations Research", J K Sharma, Macmillan Publishers India Ltd, 2017.
2. "Operations Research", S. Kalavathy, 4th Edition, Vikas Publishing house, 2013.
3. "Quantitative Methods for Business", Anderson, Sweeney Williams, Thomson Learning, 2004.
4. "Operations Research", Rathindra P. Sen, PHI Learning, 2012.

Course Outcomes:

On completion of the course, students should be able to

- Formulate OR models to solve real life problems by using graphical and simplex methods.
- Analyze the advanced methods for large scale transportation and assignment problems.
- Evaluate sequencing problems of scheduling jobs on two or three machines.
- Appreciate the use of replacement analysis in handling problems like "Staffing problem and equipment renewal problem" etc.
- Apply various methods to select optimum strategies to win the game.
- Apply various queuing models to eliminate customers/clients waiting period for service delivery.

Course Code & Title	19DAU25 Lab – VIII (R-Programming Lab)		
Class	II-BSc Computer Science with Data Analytics	Semester	IV
Course Objectives	**The Course aims** • Gain knowledge in basics of R • To understand and trace the execution in R • Understand and customize graphs • To make students to develop applications using R		

LIST OF PRACTICALS	
1.Create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.	
2. Create the system's idea of the current date with and without time.	
3. Implement any 10 built in functions in R.	
4. Create and manipulate vector in R	
5. Create and manipulate Matrix in R.	
6. Create Factors and Implement Operations on Factors.	
7. Implement operations on Data Frames.	
8. Implement operations on Lists.	
9. a. Implement Plot function in R to customize Graphs. b. Implement 3D Plot in R to customize Graphs.	
10. Create bell curve of a random normal distribution.	
11. (a) Read data from a text file saved on hard disk (b) Read data from a comma separated file (c) Read data from the Excel file (d) Read data right from internet	
12. Estimate FF3 factor model for any 3 stock's daily returns using estimation period from the beginning of January 2015 (about five years) (a) Download daily stock data from Yahoo Finance (b) Download daily FF3 factors from French data library http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html (c) Compute stock returns (d) Merge the files by date (e) Compute sample statistics including correlations (f) Estimate FF3-model for each stock	
Course Outcomes	**On completion of the course, students should be able to :** **CO1:** Develop R programs using built-in functions. **CO2:** Implement data frames and lists. **CO3:** Design applications in R using File concept.

Course Code & Title	19DAU26 Lab – IX (Modern Database Systems Lab)		
Class	II-BSc Computer Science with Data Analytics	Semester	IV
Course Objectives	**The Course aims** • Develop skills to design and analyze distributed database. • Strengthen the ability to identify and apply the suitable database for the problem • Gain knowledge in practical applications of Neo4J, Hadoop, and Hbase.		

LIST OF PRACTICALS	
1. Create a distributed Database for Bookstore.	
2. Create a Parallel Database for University Counseling.	
3. Create No-SQL database using MongoDB Library Management System.	
4. Distribution using Map-Reduce on Big Data(Hadoop)	
5. Create a database and implement the following functions using Neo4J a. count(*) b. group by c. order by d. limit **e.** join	
6. Implement column oriented database.	
7. Implement Partitioning on the tables.	
8. Create a collection using MongoDB.	
9. Create a database using Hbase for Employee management system.	
10. Create, Alter & Drop Keyspace using Cassandra.	
Course Outcomes	**On Completion of the Course the Students should be able to** **CO1:** Illustrate the behavior of distributed database. **CO2:** Apply and implement No-SQL databases. **CO3:** Analyze and determine the appropriate database for a problem.

Course Code & Title	19DAU27 Lab –X (Data Mining Lab)		
Class	II-BSc Computer Science with Data Analytics	Semester	IV
Course Objectives	**The Course aims** • To learn fundamental of data mining**.** • Designed to exercise the data mining techniques such as classification, clustering. • Demonstrate various mining algorithms on real world data.		

List of Practical	
1. Demonstrate Categorical (or nominal) attributes and the real-valued attributes.	
2. Create an Employee Table with the help of Data Mining Tool WEKA.	
3. Apply Pre-Processing techniques to the training data set of Employee Table.	
4. Perform the statistical analysis of data	
5. Demonstration of association rule mining using APriori algorithm on supermarket data.	
6. Perform the classification by decision tree induction.	
7. Create a Decision Tree, train a Decision Tree using the complete dataset as the training data. Report the model obtained after training.	
8. Load the sample dataset and run the ID3 classification algorithm.	
9. Perform the cluster analysis by k-means method using R.	
10. Perform the hierarchical clustering using R.	
11. Implement Regression Analysis using R.	
12. Implement Outlier detection using R.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Learn to execute data mining tasks using a data mining toolkit (such as WEKA) and visualize the results. **CO2:** Demonstrate the working of algorithms for data mining tasks such association classification. **CO3:** Apply various clustering algorithms on the given data set.

Course Code & Title	19DAU28 Mobile and Web Applications Development		
Class	III - BSc Computer Science with Data Analytics	Semester: V	Total Hrs:48
Course Objectives	**The Course aims** • To understand the Android UI-components, layouts, Event handling. • To build and deploy apps for mobile application using Android. • To become familiar with WordPress Terminologies. • To create a new pages and posts in WordPress. • To edit an existing WordPress page.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Getting Started With Android Programming:** Android - Android Versions - Features of Android - Architecture of Android - Android Devices in the Market - The Android Market - The Android Developer Community. **Activities, Fragments, And Intents :** Understanding Activities - Applying Styles and Themes to an Activity - Hiding the Activity Title - Displaying a Dialog Window - Displaying a Progress Dialog - Displaying a More Sophisticated Progress Dialog.	10
II	**Linking Activities Using Intents:** Resolving Intent Filter Collision - Returning Results from Intent - Passing Data Using an Intent Object. **Fragments**: Adding Fragments Dynamically - Life Cycle of a Fragment - Interactions between Fragments. **Android User Interface:** Understanding the Components of a Screen - Adapting to Display Orientation - Managing Changes to Screen Orientation - Utilizing the Action Bar. **Designing User Interface with Views:** Using Basic Views - Using Picker Views - Using List Views to Display Long Lists.	10
III	**WordPress Basics:** Exploring Basic WordPress Concepts-: Exploring the World of Open Source Software - Understanding Development and Release Cycles - Introducing the WordPress Community - Discovering Different Versions of WordPress. **WordPress Dashboard:** Customizing-Exploring Tools and Settings.	9
IV	**Publishing Your Site with WordPress:** Writing Your First Post - Examining the Difference between Posts and Pages - Uploading and Displaying Photos and Galleries - Working with Custom Fields -Using WordPress as a Content Management System.	9
V	**Customizing the Look of Your Site:** Examining the Default Theme - Finding and Installing WordPress Themes - Exploring, Customizing Theme. **WordPress Plug-in:** Installing and Activating - Exploring Plug-in Options - Modifying Existing Plug-in Code to Your Liking - Creating Simple WordPress Plug-in from Scratch.	10

References	**Text Books:** 1. Wei-Meng, "Beginning Android4 Application Development", Wrox Publication, 2012(Unit 1, Unit 2 and Unit 3). 2. Lisa Sabin-Wilson, Cory Miller, Kevin Palmer, Andrea Rennick, and Michael Torbert, "WordPress All-in-One For Dummies", Wiley Publishing, 2011(Unit 4, Unit 5). **Reference Books:** 1. Reto Meier, "Professional Android 4 Application Development", Wrox Publication, 2012. 2. Jason Coleman, Brian Messenlehner," Building Web Apps with WordPress", 2nd edition, 2019.
Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Design the apps for mobile application using Android. **CO2:** Design the android application using intents, fragments and layouts. **CO3:** Create a new pages and posts in WordPress. **CO4:** Design the pages with themes and Plug-in. **CO5:** Design the website with Photos and Galleries.

Course Code & Title	19DAU29 Machine Learning		
Class	III BSc Computer Science with Data Analytics	Semester -V	Total Hours: 48
Course Objectives	**The Course aims to:** • Make the Student understand the Basics of Machine learning • Know about Multivariate Data • Understand Nonparametric Methods in Machine Learning • Evaluate the Bayesian Estimation and Hidden Markov Models • Analyze of Machine Learning Experiments.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Introduction:** Machine Learning-Examples of Machine Learning Applications. **Bayesian Decision Theory:** Introduction – Classification - Losses and Risks - Discriminant Functions - Utility Theory. **Parametric Methods:** Maximum Likelihood Estimation-Evaluating an Estimator: Bias and Variance - The Bayes' Estimator - Parametric Classification – Regression - Tuning Model Complexity: Bias/Variance Dilemma - Model Selection Procedures.	10
II	**Multivariate Methods:** Multivariate Data - Parameter Estimation - Estimation of Missing Values - Multivariate Normal Distribution - Multivariate Classification - Tuning Complexity - Discrete Features - Multivariate Regression - Principal Components Analysis - Factor Analysis - Linear Discriminant Analysis – Isomap - Locally Linear Embedding-Mixture Densities.	10
III	**Nonparametric Methods:** Nonparametric Density Estimation-Generalization to Multivariate Data-Nonparametric Classification-Condensed Nearest Neighbor-Nonparametric Regression: Smoothing Models. **Linear Discrimination:** Generalizing the Linear Model- Geometry of the Linear Discriminant - Pair wise Separation-Parametric Discrimination Revisited - Gradient Descent - Logistic Discrimination-Discrimination by Regression.	9
IV	**Bayesian Estimation*:*** Estimating the Parameter of a Distribution-Bayesian Estimation of the Parameters of a Function - Gaussian Processes. **Hidden Markov Models:** Discrete Markov Processes - Hidden Markov Models - Three Basic Problems of HMMs-Evaluation Problem - Finding the State Sequence - Learning Model Parameters-Continuous Observations-The HMM with Input-Model Selection in HMM.	9

V	**Design and Analysis of Machine Learning Experiments:** Factors, Response, and Strategy of Experimentation-Response Surface Design - Randomization, Replication, and Blocking - Guidelines for Machine Learning Experiments - Cross-Validation and Resampling Methods - Measuring Classifier Performance - Hypothesis Testing - Assessing a Classification Algorithms Performance - Comparing Two Classification Algorithms - Comparing Multiple Algorithms: Analysis of Variance - Comparison over Multiple Datasets.	**10**
References	**Text Book:** **1.** Ethem Alpaydın," Introduction to Machine Learning " , The MIT Press Cambridge, Second Edition, 2010. **Reference Books:** 1. Jason Bell "Machine Learning for Big Data- Hands on for Developers and Technical Professionals", Jhon Wiley & sons , Reprint 2017. 2. Henrik Brink , Joseph W.Richards , Mark Fetherolf," Real World Machine Learning", Dreamtech Press (India) Pvt Ltd., 2017.	
Course Outcomes	**On Completion of Course, Students should be able to** **CO1 :** Able to Understand the Basics of Machine learning **CO2:** Recognize the Multivariate methods **CO3:** Implementing nonparametric methods & Linear Discrimination **CO4:** Familiarize with Bayesian Estimation & Hidden Markov Models **CO5:** Able to Analyze Machine learning experiments.	

Course Code & Title	19DAU30 Computer Networks		
Class	III BSc Computer Science with Data Analytics	Semester: V	Total Hrs: 48
Course Objectives	**The Course aims** • To build an understanding of the fundamental concepts of computer networking. • To introduce the basic taxonomy and terminology of computer networking. • To introduce advanced networking concepts. • Describe how signals are used to transfer data between nodes. • Describe how routing protocols work.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Introduction:** Uses – Network Hardware: LAN –MAN – WAN, Internetworks – Network Software: Protocol hierarchies – Design issues for the layers – Connection-Oriented and Connectionless Services– Service Primitives-Reference models: OSI – TCP/IP.	10
II	**Physical Layer:** Guided Transmission Media -Wireless Transmission - Communication Satellites – Digital Modulation and Multiplexing - Mobile Telephone System.	9
III	**Data Link Layer :** Data Link layer Design Issues - Error Detection And Correction - Elementary Data Link Protocols - Sliding Window Protocols.	10
IV	**Network Layer:** Network Layer Design Issues: Store and Forward Packet Switching - Services Provided to the Transport Layer - **Routing Algorithms:** Shortest Path Routing – Flooding - Distance Vector Routing-Broadcast Routing-Multicast Routing – Network Layer in the Internet: IP version 4 protocol – IP Addresses – IP Version 6.	10
V	**Transport Layer & Application Layer:** Transport Services - Elements of Transport Protocols – Congestion Control – Domain Name System - Electronic Mail – World Wide Web.	9
References	**Text Book:** 1. Andrew S. Tanenbaum, "Computer Networks, Fifth Edition", PHI, 5th Edition, 2013. **Reference Books:** 1. Behrouz A. Forouzan," Data Communications and Networking", Tata McGraw Hill, 4th Edition, 2012. 2. Douglas E. Comer, "Computer Networks and Internets", Pearson Education, 6th Edition, 2015.	

Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Visualize the different aspects of networks, protocols and network design models. **CO2:** Identify the hacking methods and threats to National security. **CO3:** Analyze and compare different LAN protocols. **CO4:** Compare and select appropriate routing algorithms for a network. **CO5:** Examine the important aspects and functions of network layer, transport layer and application layer in internetworking.

Course Code & Title	19DAU31 Data Visualization		
Class	III-B.Sc Computer Science with Data Analytics	Semester : V	Total Hours : 48
Course Objectives	**The Course aims** • To make the student understand Data Visualization. • To analyze the Various Visualization Techniques for Geospatial Data and Multivariate Data. • To understand the Visualization Techniques for Multivariate Data. • Basic understanding of Tableau. • To get basic understanding in Power BI		

SYLLABUS

UNIT	Content	No. of Hours
I	**Introduction**: History of Visualization - Relationship between Visualization and Other Fields - The Visualization Process - Pseudo code Conventions- The Scatter plot - The Role of the User. **Data Foundations**- Types of Data - Structure within and between Records- Data Preprocessing.	9
II	**Visualization Techniques for Spatial Data:** One-Dimensional Data - Two-Dimensional Data - Three-Dimensional Data - Dynamic Data- Combining Techniques. **Visualization Techniques for Geospatial Data:** Visualizing Spatial Data - Visualization of Point Data - Visualization of Line Data - Visualization of Area Data - Other Issues in Geospatial Data Visualization.	10
III	**Visualization Techniques for Multivariate Data:** Point - Based Techniques - Line-Based Techniques - Region-Based Techniques - Combinations of Techniques. **Visualization Techniques for Trees, Graphs, and Networks:** Displaying Hierarchical Structures - Displaying Arbitrary Graphs/Networks - Other Issues.	10
IV	**Tableau:** Creating Visual Analytics with Tableau Desktop - Connecting to Your Data - Building Your First Visualization - Creating Calculations to Enhance Your Data.	10
V	**Power BI**: Introducing Power BI - Sharing the dashboard - Understanding data refresh - Using Power BI Desktop- Getting data from services and content packs.	9

References	**Text Book:** 1. Matthew Ward, Georges Grinstein, Daniel Keim "Interactive Data Visualization- Foundations, Techniques, and Applications", A K Peters, Ltd. Natick, Massachusetts, 2010. **Reference Books:** 1. Noah Iliinsky and Julie Steele," Designing Data Visualizations", O'Reilly Media, Inc., 2011. 2. Kieran Healy, "Data Visualization – A Practical Introduction", Princeton University Press, 2019.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Know the foundations of data visualization. **CO2:** Identify spatial and geospatial data. **CO3:** Identify visualization techniques for Trees, Graphs and Networks. **CO4:** Learn visual analytic techniques using Tableau. **CO5:** Know the basics of PowerBI.

Course Code & Title	Discipline Specific Elective Course – I 19DAU32A Software Project Management		
Class	III - BSc Computer Science with Data Analytics	Semester: V	Total Hrs:48
Course Objectives	**The Course aims** • To learn the way of developing software project management. • To make a study of project planning. • To focus on project Efforts Estimation. • To learn about risk assessment. • To make a study of Managing People in Software Environment.		

SYLLABUS

UNIT	Content	No. of Hours
I	Introduction To Software Project Management - Important Of Software Project Management - Project Introduction - Software Projects Versus Other Types Of Project - Contract Management And Technical Project Management - Plans, Methods And Methodologies - Some Ways Of Categorizing Software Projects – Stakeholders - Setting Objectives/Goals/Milestones. **Project evaluation and programme management**: Introduction - A business case- Project portfolio Management - Evaluation of individual projects - Cost benefit evaluation techniques- Risk evaluation - Programme management - Managing the allocation of resources within programmes.	9
II	**Project planning: Introduction to step wise project planning :** Select project - Identify project scope and objectives - Identify project infrastructure/Architecture - Analyze project characteristics - identify Monitoring project and activities - Estimate effort for each activity - Identify activity risks - Allocate resources - Review / publicize plan - Execute plan / lower levels of planning. **Selection of an appropriate project approach:** Introduction - build or buy - Choose methodologies and technologies - Software processes and process models - Choice of process models - Structure versus speed of delivery - The waterfall model - Spiral model – Agile model - Software prototyping - Other ways of categorizing prototypes - Incremental delivery.	10
III	**Software Efforts Estimation:** Introduction - Where estimation done - Problems with over and under estimates - The basis for software estimating - Software effort estimation Techniques - Bottom up estimating - Top down approach and parametric models - Expert judgment - Estimating by analogy - Cost estimation.	10

IV	**Activity planning and Milestone Management:** Introduction - The objectives of activity planning - Project schedules - Project and activities- Sequencing and Scheduling activities - network planning models - Formulation a network model - Adding the time dimensions - Forward pass - The backward pass - Identifying the critical path - Activity float - Shortening the project duration - Identifying critical activities. **Risk Management:** Introduction - Risk - Categories of risk - A framework for dealing with risk - Risk identification - Risk assessment- risk planning - Risk management - Evaluating risks to the schedule - Applying the PERT technique - critical chain concept.	**10**
V	**Resources allocation:** Nature of Resources - Identifying Resources Requirements - Scheduling Resources - Creating Critical Path - Counting the Cost - Publishing Resource Schedule - Cost Schedules - Scheduling Sequence. **Managing People in Software Environment:** Understanding Behavior – Organizational Behavior: A background – Selecting the right person for a job – Instruction in the best methods – Motivation – The Oldham Hackman job Characteristics Model - Stress – Health and Safety – Some ethical and professional Concerns**.**	**9**
References	**Text Book:** 1. Bon Hughes , Mike coterell , Rajib mall "Software Project Management" Mc Graw Hill Education, Sixth edition, First Reprint 2018. **Reference Book:** 1. Pankraj Jalote, "Software Project Management", Pearson Education, First Reprint 2016.	
Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Understand the developing software project management **CO2:** Understand the project planning **CO3:** Understand the project Efforts Estimation **CO4:** Understand the risk assessment **CO5:** Understand the Managing People in Software Environment	

Course Code & Title	Discipline Specific Elective Course – I 19DAU32B Agile Software Engineering		
Class	III BSc Computer Science with Data Analytics	Semester: V	Total Hrs:48
Course Objectives	**The Course aims** • To describe the unique features agile method relative to traditional software practices. • To use techniques and methodologies of agile software engineering. • To examine their applications in the real world and addresses their impacts on developing software. • To successfully manage agile projects in geographically dispersed work environments.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Agile Software Development:** Objectives – Three Perspectives on Software Engineering - Agile Manifesto - Application of Agile Software Development - Data about Agile Software Development - Agile Software Development Learning Environments. **Teamwork:** Objectives - A Role Scheme in Agile Teams-Dilemmas in Teamwork-Teamwork in learning Environments.	9
II	**Customers And Users:** The Customer-The User – Customers and Users in Learning Environments. **Time:** Time Related Problems in Software Projects - Tightness of Software Development Methods - Sustainable Pace - Time Management of Agile Projects - Time in Learning Environments. **Measures:** Need of Measures – Who Decides What is Measured-What should be Measured - When are Measure taken - How Are Measures Taken - Who takes the Measures - How are Measures Used - Measures in learning Environments.	10
III	**Quality:** The Agile Approach to Quality Assurance - Test-Driven Development - Measured TDD - Quality in Learning Environments. **Learning:** Agile Software Development Support - Learning in Learning Environments. **Abstraction:** Abstraction Levels in Agile Software Development - Abstraction in Learning Environments.	10
IV	**Trust:** Software Intangibility and Process Transparency - Game Theory Perspective in Software Development - Ethics in Agile Teams – Diversity - Trust in Learning Environments. **Globalization:** Agile Approach in Global Software Development - Application of Agile Principles in Non - Software Projects - Globalization in Learning Environments.	10

	Reflection: Reflection on Learning in Agile Software Development - Reflective Practitioner Perspective – Retrospective - Reflection in Learning Environments.	
V	**Change:** A Conceptual Framework for change Introduction –Transition to an Agile Software Development Environment - Change in Learning Environments. **Leadership:** Leaders – Coaches - Leadership in Learning Environments. **Delivery And Cyclicality:** Delivery – Cyclicality - Delivery & Cyclicality in Learning Environments.	9
References	**Text Book:** 1. Orit Hazzan, Yael Dubinsky, "Agile Software Engineering", Springer, 2nd Edition, 2014. **Reference Book:** 1. Moran, Alan, "Managing Agile: Strategy, Implementation, Organization and People", Springer, 2015.	
Course Outcomes	**On completion of the course, student should be able to :** **CO1**: Compare agile software development with traditional software Development models. **CO2**: Understand pair programming and its characteristics. **CO3**: Apply refactoring techniques. **CO4**: Identify the benefits and pitfalls of transitioning to agile. **CO5**: Apply agile practices such as test-driven development, standup meetings, and pair programming to their software engineering Practices.	

Course Code & Title	19DAU33 Lab – XI (Mobile and Web Applications Lab)		
Class	III-BSc Computer Science with Data Analytics	Semester	V
Course Objectives	**The Course aims** • To learn the basic technologies and problems of web applications development for mobile devices**.** • To understand and execute android applications. • To learn the basics of WordPress. • To learn and create plugin using wordpress.		

List of Practical	
Android Applications:	
1. Develop an application that uses GUI components, Fonts and color.	
2. Program to create and show the AlertDialog.	
3. Program to implement progress Dialog.	
4. Create an android application to implement various intents.	
5. Develop an application that uses Layout Managers.	
6. Develop a native calculator application.	
7. Develop a simple game application.	
Web Applications:	
8. Design a login page using WordPress.	
9. Using WordPress do the following: a) Add a new post b) publish the post c) Edit & delete the post.	
10. Using WordPress do the following: a) Add a new page b) Publish the page c) Edit & delete the page.	
11. Create a simple plug-in using WordPress.	
12. Design a simple website for your College.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Develop applications in android studio. **CO2:** Program different layout using layout manager. **CO3:** Create blogs and sites using WordPress.

Course Code & Title	19DAU34 Lab-XII(Machine Learning Lab)		
Class	III BSc Computer Science with Data Analytics	Semester	V
Course Objectives	**The Course aims** • To understand the programming style of machine learning • To become familiar with the ML algorithms. • To provide hands on experience with Machine language programming. • To familiarize students with interfacing of various real world problems.		

LIST OF PRACTICALS
Implement the below programs using Java or Python
1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Evaluate hypothesis for a sample dataset.
8. Artificial Neural network with back propagation (without using any libraries/APIs)
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course Outcomes	**On completion of the course, student should be able to :** • Understand the implementation procedures for the machine learning algorithms. • Design Java/Python programs for various Learning algorithms. • Apply appropriate data sets to the Machine Learning algorithms. • Identify and apply Machine Learning algorithms to solve real world problems.

Course Code & Title	19DAU35 Lab – XIII(Data Visualization Lab)		
Class	III-BSc Computer Science with Data Analytics	Semester	V
Course Objectives	**The Course aims** • To understand the concept of Tableau • To become familiar with the Work Sheets and Time Series • To provide hands on experience with Tableau. • To familiarize students with Various BI Dashboards.		

LIST OF PRACTICALS	
1. Connecting to a data source and Joining related data sources in Tableau	
2. Visualization concept using Show Me.	
3. Adding, duplicating, and renaming, reordering, clearing, and deleting on worksheets.	
4. Time series, Aggregation and Filters for Unemployment Data Statistics.	
5. Maps and Scatter plots for a sample DataSet.	
6. Table calculations, Dashboard and Storytelling using Customer Data Set.	
7. Import the legacy data from different sources such as (Excel, SqlServer, Oracle etc.) and load in the target system.	
8. Reporting/Dash boarding using powerBI.	
9. Publishing Power BI Dashboards.	
10. Data relationships and queries in PowerBI.	
Course Outcomes	**On completion of the course, student should be able to :** • Connect data source using Tableau. • Implement Maps and Scatter plots. • Apply appropriate data sets for visualization • Identify and apply Power BI Concept

Course Code & Title	19DAU37 Artificial Intelligence		
Class	III B.Sc Computer Science with Data Analytics	Semester -VI	Total Hours: 48
Course Objectives	**This course aims to** • Study the concepts of Artificial Intelligence. • Learn the methods of problem solving using Artificial Intelligence. • Study the concepts of knowledge based agents and Propositional Logic. • Understand inference in First-Order-Logic. • Appreciate various forms of learning.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Introduction to Al:** Definition - The Foundations of Artificial Intelligence – History of Artificial Intelligence – The State of Art. **Intelligent Agents:** Agents and Environments – Good Behavior: The Concept of Rationality – The Structure of Agents. **Solving Problems by Searching:** Problem-Solving Agents – Example Problems – Searching for Solutions – Uninformed Search Strategies – Informed (Heuristic) Search Strategies – Heuristic Functions.	10
II	**Adversarial Search:** Games- Optimal Decisions in Games Alpha–Beta Pruning. **Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems- Constraint Propagation: Inference in CSPs- Backtracking Search for CSPs - Local Search for CSPs.	10
III	**Knowledge, reasoning and planning:** Logical Agents - Knowledge-Based Agents - The Wumpus World - Logic-Propositional Logic: A Very Simple Logic -Propositional Theorem Proving - Effective Propositional Model Checking - Agents Based on Propositional Logic.	9
IV	**First-Order Logic:** Syntax and Semantics of First - Order Logic - Using First - Order Logic - Knowledge Engineering in First - Order Logic. **Inference in First-Order Logic:** Propositional vs. First-Order Inference - Unification and Lifting - Forward Chaining - Backward Chaining - Resolution.	10
V	**Learning**: Forms of Learning - Supervised Learning- Learning Decision Trees- Evaluating and Choosing the Best Hypothesis – The Theory of Learning- Regression and Classification with Linear Models – Artificial Neural Networks - Ensemble Learning.	9

References	**Text Book:** 1. Stuart Russel and Peter Norvig, "AI – A Modern Approach", 3rd Edition, Pearson Education 2010. **Reference Books:** 1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007. 2. Deepak Khemani "Artificial Intelligence", Tata McGraw Hill Education 2013.
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Identify problems that are amenable to solution by AI methods. C**O2**: Identify appropriate AI methods to solve a given problem. **CO3:** Formalize a given problem in the language/framework of different AI methods. **CO4:** Implement basic AI algorithms. **CO5:** Formalize a sentence in First Order Logic.

Course Code & Title	19DAU38 Mining of Massive Data		
Class	III-BSc Computer Science with Data Analytics	Semester: VI	Total Hrs:48
Course Objectives	**The Course aims** • To acquire the knowledge on Massive Data mining and MapReduce. • To be exposed to mine data streams. • To be familiar with Link analysis. • To learn advertising on the web and dimensionality reduction. • To learn basic concepts about mining social network graphs.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Data Mining and Map Reduce:** Data Mining - Statistical Limits on Data Mining- Distributed File Systems - MapReduce- Algorithms Using MapReduce- Extensions to MapReduce- The Communication Cost Model- Complexity Theory for MapReduce.	9
II	**Mining Data Streams:** The Stream Data Model- Sampling Data in a Stream- Filtering Streams- Counting Distinct Elements in a Stream- Estimating Moments - Counting Ones in a Window - Decaying Windows.	9
III	**Link Analysis:** PageRank-Efficient Computation of PageRank- Topic-Sensitive PageRank- Link Spam-Hubs and Authorities. **Advertising on the web:** Issues in On-Line Advertising-Online Algorithms-The Matching Problem - The Adwords Problem - Adwords Implementation.	10
IV	**Recommendation systems**: A Model for Recommendation systems-Content-based Recommendations-Collaborative filtering-Dimensionality reduction-The Netflix challenge. **Dimensionality reduction**: Eigen values and Eigenvectors-Principal-Component Analysis-Singular value decomposition-CUR Decomposition.	10
V	**Mining Social-Network Graphs**- Clustering of Social-Network Graphs - Direct Discovery of Communities - Partitioning of Graphs – Finding Overlapping Communities – simrank - counting Triangles - Neighborhood properties of graphs.	10
References	**Text Book:** **3.** Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge university press, Second Edition 2014. **Reference Book:** 1. James Abello, Panos M. Pardalos and Mauricio G.C. Resende(Eds.), "Handbook of Massive Data sets", Springer science, Volume 1.	
Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Implement MapReduce algorithms. **CO2:** Execute data streams. **CO3:** Design programs involving Link analysis. **CO4:** Advertise on the web and implement dimensionality reduction. **CO5:** Create applications for mining social network graphs.	

Course Code & Title	19DAU39 Exploratory Data Analytics		
Class	III – BSc Computer Science with Data Analytics	Semester : VI	Total Hours : 48
Course Objectives	**The Course aims** • To learn how to manage data frames. • To explore the basic graphs. • To expand the knowledge on Plotting system. • To gain knowledge about plotting and color in R. • To learn about ggplot2 plotting system.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Managing Data Frames with the dplyr package:** Data Frames - The dplyr Package – dplyr Grammar – dplyr package - select() - filter() - arrange() - rename() - mutate() - group_by(). **Exploratory Data Analysis:** Formulate your question - Read in your data - Check the packaging - Run str() - Top and the bottom of your data - Check "n"s - Validate with at least one external data source.	9
II	**Principles of Analytic Graphics:** Show comparisons - Show causality, mechanism, explanation, systematic structure - Show multivariate data-Integrate evidence - Describe and document the evidence. **Exploratory Graphs**: Characteristics of exploratory graphs-Air pollution in the United states-Getting the data-Simple summaries: One Dimension-Five number summary-Box plot-Histogram-Overlaying features-Bar plot-Simple summaries: Two dimensions and beyond-Multiple Box plots-Multiple Histograms- Scatter plots-Scatter plot-using color-Multiple scatter plots.	9
III	**Plotting systems:** The Base Plotting system-The Lattice system-The ggplot2 system. **Graphics Devices:** The Process of Making a Plot - Plot creation - Graphics File Devices - Multiple Open Graphics Devices – Copying plots. **The Base Plotting System**: Base Graphics - Simple Base Graphics - Base Graphics Parameters - Base Plotting Functions - Base Plot with Regression Line - Multiple Base Plots.	10
IV	**Plotting and Color in R:** Colors 1, 2, and 3 - Connecting colors with data - Color Utilities in R - colorRamp() - colorRampPalette() - RColorBrewer Package - Using the RColorBrewer palettes - The smoothScatter() function - Adding transparency. **The ggplot2 Plotting System Part I:** The Basics: qplot() – Label your data-Modifying aesthetics -Adding a geom – Histograms - Facets - Case Study: MAACS Cohort -Summary of qplot()	10
V	**The ggplot2 Plotting System Part II**: Basic Components of a ggplot2 Plot - Building Up in Layers - First Plot with Point Layer - Adding More Layers: Smooth, Facets - Modifying Geom Properties - Modifying Labels - Customizing the Smooth -Changing the Theme. **Data Analysis Case study:** Synopsis – Loading and processing the Raw Data – Results.	10

References	**Text Books:** **1.** Roger D. Peng, "Exploratory Data Analysis with R" , Lean Publishing , 2015. **Reference Books:** 1. John Maindonald and W. John Braun, "Analysis and Graphics Using R – an Example Based Approach", Cambridge University Press, Third Edition, 2010. 2. Maria L. Rizzo, Statistical Computing with R, Second Edition, 2019.
Course Outcomes	**On completion of the course, students will be able to** **CO1:** Understand dpylr package. **CO2:** Understand analytic graphics and exploratory graphs. **CO3:** Apply plotting system. **CO4:** Recognize plotting and colors **CO5:** Learn how to use, customize plotting system.

Course Code & Title	Discipline Specific Elective Course – II 19DAU40A Parallel and Distributed Computing		
Class	III-BSc Computer Science with Data Analytics	Semester: VI	Total Hrs : 48
Course Objectives	The Course aims • To understand scope of Parallel Computing and Distributed Systems. • To Analyze the Parallel Programming Platforms. • To Know the Principles of system models and networks.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Introduction to Parallel Computing:** Motivating Parallelism-Scope of Parallel Computing. **Parallel Programming Platforms** :-Implicit Parallelism: Trends in Micro processor Architecture-Limitation of Memory System Performance-Dichotomy of Parallel Computing Platforms-Physical organization of Parallel Platforms-Communication cost in Parallel Machines-Routing Mechanism for interconnection networks	9
II	**Principles of Parallel Algorithm Design:**-Decomposition Tasks , and Dependency Graphics-Granularity Concurrency and Task interaction-Processes and Mapping-Processes vs. Processors- Decomposition Techniques-Recursive Decomposition – Data Decomposition-Exploratory Decomposition-Speculative Decomposition-Hybrid Decomposition-Characteristics of Task and Interaction- Mapping Techniques for Load balancing-Methods for Containing Interaction Overheads-Parallel Algorithm Models	9
III	**Characterization of Distributed Systems:**-Introduction-Examples of Distributed systems-Trends in Distributed systems-Focus on resource sharing-Challenges. **System Models:** Introduction-Physical Models-Architectural Models- Fundamental Models. **Networking and Internetworking**:- Types of Network- Network principles-Internet Protocols.	10
IV	**Inter Process Communication**-Introduction-The API for the Internet Protocols-External data Representation-Multicast Communication **Remote Invocation:**-Introduction-Request-reply protocols-Remote Procedure call-Remote Method Invocation-**Distributed Objects and Components**:-Introduction-Distributed Objects-**Web Services**: Introduction-Web Services-Service-Services descriptions and IDL for web service-A directory- Service for use with web services.	10
V	**Name Services:** Name services and the Domain name system-Directory services- Case Study: The Global Name Service- The X.500 Directory Services. **Distributed Transaction**: Flat and nested Transaction-Atomic Commit	10

	protocols-Concurrency control in distributed transactions-Distributed Deadlocks-Transaction recovery.	
References	**Text Books:** 1. Ananth Grama, Anushal Gupta, George Karypis , Vipin Kumar "Introduction to Parallel Computing", Pearson Education(India) Pvt Ltd , Second Edition, Reprint 2019.(Unit I-II) 2. George Coulouris, Jean Dollimore,Tim Kindberg,Gordon Blair , " Distributed Systems – Concepts and Design", Pearson Education(India) Pvt Ltd., Fifth Edition 2017.(Unit III - V) **Reference Books:** 1. M.L.Liu, " Distributed Computing –Principles and Applications " Pearson Education, Fourteenth Impression, 2013.	
Course Outcomes	**On Completion of the Course the Students should be able to** **CO1:** Understand the parallel programming platform. **CO2:** analyze the design of parallel algorithm. **CO3:** Able to Understand System Models and Network Basics **CO4:** Able to understand Distributed Objects and web services **CO5:** Be Familiar with Name Services and Distributed Transaction	

Course Code & Title	Discipline Specific Elective Course – II 19DAU40B Internet of Things		
Class	**III - BSc Computer Science with Data Analytics**	**Semester: VI**	**Total Hrs:48**
Course Objectives	**The Course aims** • To understand Smart Objects and IoT Architectures. • To learn about various IOT-related protocols. • To build simple IoT Systems using Arduino and Raspberry Pi. • To understand data analytics and cloud in the context of IoT. • To develop IoT infrastructure for popular applications.		

SYLLABUS

UNIT	Content	No. of Hours
I	**Fundamentals of IOT**: Genesis of IOT – IOT and Digitization – IOT Impact. **Comparing IOT Architectures:** The oneM2M IoT Standardized Architecture – The IoT World Forum (IoTWF) Standardized Architecture - A Simplified IoT Architecture - The Core IoT Functional Stack - IoT Data Management and Compute Stack - Sensors, Actuators, and Smart Objects.	**9**
II	**IoT Access Technologies:** Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e and LORA WAN. **IP as the IoT Network Layer**: The Need for Optimization - Optimizing IP for IoT. **Application Protocols for IoT:** The Transport Layer - IoT Application Transport Methods and Protocols.	**9**
III	**Data and Analytics for IOT:** An Introduction to Data Analytics for IoT - Machine Learning - Big Data Analytics Tools and Technology - Edge Streaming Analytics - Network Analytics.	**10**
IV	**Securing IoT:** A Brief History of IoT Security - Common Challenges in IoT Security - IoT Security Practices and Systems - Formal Risk Analysis Structures: OCTAVE and FAIR.	**10**
V	**Case Studies/ Industrial Applications:** **Manufacturing:** An Introduction to Connected Manufacturing - Architecture for the Connected Factory. **Utilities:** An Introduction to the Power Utility Industry - The GridBlocks Reference Model. **Smart and Connected Cities:** Smart City Use-Case Examples: Street Lighting Architecture - Smart Parking - Smart Parking Architecture - Smart Traffic Control Architecture.	**10**

References	**Text Book:** 1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017. **Reference Books:** 1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015. 2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley Publications, 2012.
Course Outcomes	**On completion of the course, student should be able to :** **CO1:** Explain the concept of IoT. **CO2:** Analyze various protocols for IoT. **CO3:** Design a PoC of an IoT system using Raspberry Pi/Arduino. **CO4:** Apply data analytics and use cloud offerings related to IoT. **CO5:** Analyze applications of IoT in real time scenario.

Course Code & Title	19DAU41 - LAB XIV(Artificial Intelligence Lab)	
Class	III - BSc Computer Science and Data Analytics	Semester : VI
Course Objectives	**The Course aims** • To introduce PROLOG programming language and to solve AI problems. • To use Prolog for problem solving and algorithm design. • To use python to solve artificial intelligence problems.	

List of Practical	
1. Define the relation: last (Item, List), so that item is the last element of a List. Implement: (a) using the conc relation (b) without conc.	
2. Write predicates, one converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing.	
3. Check the eligibility of a person for voting.	
4. Demonstrate Family Relationship.	
5. Solve the Monkey Banana problem.	
6. Demonstrate 4-Queen problem.	
7. Solve traveling salesman problem.	
8. Illustrate different Set Operations.	
9. Create food ordering system by defining the following classes: Clients, Workers and Food items.	
10. (a) Write a python program to remove punctuations from the given string? (b) Write a python program to sort the sentence in alphabetical order	
11. Write and execute Stack operations.	
12. Implement Breadth First Search Traversal.	
13. Implement stemming for a given sentence.	
14. Solve Water Jug Problem.	
15. Demonstrate Tic-Tac-Toe game.	
Course Outcomes	**On completion of the course, students should be able to** **CO1:** Solve problems using AI Concepts. **CO2:** Demonstrate the real world problems. **CO3:** Apply various data structure algorithms to solve problems.

Course Code & Title	19DAU42 Lab-XV (Mining of Massive Data Lab)		
Class	III-BSc Computer Science with Data Analytics	Semester	VI
Course Objectives	**The Course aims** • To explore big data analytics. • To understand and work on massive data sets. • To get knowledge on page rank in massive dataset.		

SYLLABUS

List of Practical
2. (i)Perform setting up and Installing Hadoop in its two operating modes: Pseudo distributed, Fully distributed. (ii) Use web based tools to monitor your Hadoop setup.
3. (i) Implement the following file management tasks in Hadoop: adding files and directories, Retrieving files, Deleting files. (ii) Benchmark and stress test an Apache Hadoop cluster.
3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm. i)Find the number of occurrence of each word appearing in the input file ii)Perform a MapReduce Job for word search count (look for specific keywords in a file)
4. Demonstrate stop word elimination problem:
5. Run sensitive page rank program to understand ranking task in Hadoop.
6. Demonstrate data mining-based approach for ontology matching problem to match ontology instances.
7. Advertise and market your product on the web using data mining techniques.
8. Apply the following data mining techniques in your dataset for Dimensionality Reduction. i) Missing Values Ratio ii) Low Variance Filter iii) High Correlation Filter
9. Implement the idea of principal component analysis (PCA) to reduce the dimensionality of a data set consisting of many variables correlated with each other, either heavily or lightly, while retaining the variation present in the dataset, up to the maximum extent.
10. Cut a graph into several disjoint sub-graphs with the aim of minimizing the edges between these sub-graphs while retaining almost the same number of vertices in every partition.

Course Outcomes	**On completion of the course, students should be able to** **CO1:** apply data mining and map reducing techniques for massive data. **CO2:** handle larger file management in Hadoop. **CO3**: mine social graphs in massive dataset.