Scheme & Syllabus of
Bachelor of Science in Data Analytics
B. Sc. (Data Analytics)

Batch 2021 onwards

By

Board of Study Computer Applications

Department of Academics

IKGujralPunjabTechnicalUniversity

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

Bachelors of Science in Data Analytic (B.Sc. Data Analytic):
It is a Under Graduate (UG) Programme of 3 years duration (6 semesters)

PROGRAM OUTCOMES (POs)

Program: B Sc in Data Analytics

1. **Basic knowledge:** An ability to apply knowledge of basic mathematics, science and domain knowledge to solve the computational problems.

2. **Discipline knowledge**: An ability to apply discipline–specific knowledge to solve core and/or applied computational problems.

3. **Experiments and practice:** An ability to plan and perform experiments and practices and to use the results to solve computational problems.

4. **Tools Usage**: Apply appropriate technologies and tools with an understanding of limitations.

5. **Profession and society**: Demonstrate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional practice.

6. **Environment and sustainability**: Understand the impact of the computational solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

7. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the professional practice.

8. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.

9. **Communication:** An ability to communicate effectively.

10. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological changes.

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First Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1901	Core Theory	Mathematics	3	1	0	40	60	100	4
UGCA1902	Core Theory	Fundamentals of Computer and IT	3	1	0	40	60	100	4
UGCA1903	Core Theory	Problem Solving using C	3	1	0	40	60	100	4
UGCA1904	Practical/Laboratory	Workshop on Desktop Publishing	0	0	4	60	40	100	2
UGCA1905	Core Practical/Laboratory	Problem Solving using C Laboratory	0	0	4	60	40	100	2
UGCA1906	Core Practical/Laboratory	Fundamentals of Computer and IT Laboratory	0	0	4	60	40	100	2
BTHU103/18	Ability Enhancement Compulsory Course (AECC)-I	English	1	0	0	40	60	100	1
BTHU104/18	Ability Enhancement Compulsory Course (AECC)	English Practical/Laboratory	0	0	2	30	20	50	1
HVPE101-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules	3	0	0	40	60	100	3
HVPE102-18	Ability Enhancement Compulsory Course (AECC)	Human Values, De-addiction and Traffic Rules (Lab/ Seminar)	0	0	1	25	--**	25	1
BMPD102-18		Mentoring and Professional Development	0	0	1	25	--**	25	1
	TOTAL		**13**	**3**	**16**	**460**	**440**	**900**	**25**

The Human Values, De-addiction and Traffic Rules (Lab/ Seminar) and Mentoring and Professional Development course will have internal evaluation only. **(See guidelines at the last page of this file)

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Second Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1985	Core Theory	Probability and Statistics	3	1	0	40	60	100	4
UGCA1922	Core Theory	Database Management Systems	3	1	0	40	60	100	4
UGCA1909	Core Theory	Object Oriented Programming using C++	3	1	0	40	60	100	4
UGCA1910	Core Practical/Laboratory	Object Oriented Programming using C++ Laboratory	0	0	4	60	40	100	2
UGCA1986	Core Practical/Laboratory	Probability and Statistics Laboratory	0	0	4	60	40	100	2
UGCA1925	Core Practical/ Laboratory	Database Management Systems Laboratory	0	0	4	60	40	100	2
EVS102-18	Ability Enhancement Compulsory Course (AECC) -III	Environmental Studies	2	0	0	40	60	100	2
BMPD202-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		**11**	**3**	**13**	**365**	**360**	**725**	**21**

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Third Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1923	Core Theory	Operating Systems	3	1	0	40	60	100	4
UGCA1931	Core Theory	Data Warehouse and Mining	3	1	0	40	60	100	4
UGCA1915	Core Theory	Data Structures	3	1	0	40	60	100	4
UGCA1926	Core Practical/Laboratory	Operating Systems Laboratory	0	0	4	60	40	100	2
UGCA1937	Core Practical/Laboratory	Data Warehouse and Mining Laboratory	0	0	4	60	40	100	2
UGCA1918	Core Practical/Laboratory	Data Structures Laboratory	0	0	4	60	40	100	2
UGCA1914	Skill Enhancement Course-I	Programming inPython	3	0	0	40	60	100	3
UGCA1917	Skill Enhancement Course-Laboratory	Programming in Python Laboratory	0	0	2	30	20	50	1
BMPD302-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		**12**	**3**	**15**	**395**	**380**	**775**	**23**

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Fourth Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA2004	Core Theory	Data Visualization	3	1	0	40	60	100	4
UGCA2006	Core Theory	Big data Analytics	3	1	0	40	60	100	4
UGCA 1947	Core Theory	Digital Marketing	3	1	0	40	60	100	4
UGCA 1946	Core Theory	R Programming	3	1	0	40	60	100	4
UGCA2005	Core Practical/Laboratory	Data Visualization Laboratory	0	0	4	60	40	100	2
UGCA 1953	Core Practical/Laboratory	Digital Marketing Laboratory	0	0	4	60	40	100	2
UGCA 1952	Core Practical/ Laborary	R Programming Laboratory Laboratory	0	0	4	60	40	100	2
BMPD402-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		**12**	**4**	**13**	**365**	**360**	**725**	**23**

Fifth Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA1927	Skill Enhancement Course-III	Web Designing	3	0	0	40	60	100	3
UGCA1928	Skill Enhancement Course-Laboratory	Web Designing Lab	0	0	2	30	20	50	1
	Open Elective-I		3	1	0	40	60	100	4
	Elective-I		3	1	0	40	60	100	4
	Elective-II		3	1	0	40	60	100	4
	Elective-I Laboratory		0	0	4	60	40	100	2
	Elective-II Laboratory		0	0	4	60	40	100	2
	Project	Minor Project	0	0	2	60	40	100	1
	Institutional Summer Training*		0	0	2	60	40	100	1
BMPD502-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		**12**	**03**	**15**	**455**	**420**	**875**	**23**

Elective -I	
Course Code	Course Title
UGCA2033	Business Intelligence
UGCA2031	Distributed Databases
UGCA1913	Computer Network

Elective -II	
Course Code	Course Title
UGCA2035	Web Analytics
UGCA2021	Linux Operating System
UGCA1945	Artificial Intelligence

Elective-I Laboratory	
Course Code	Course Title
UGCA2034	Business Intelligence Lab
UGCA2032	Distributed Databases Lab
UGCA1916	Computer Network Lab

Elective-II Laboratory	
Course Code	Course Title
UGCA2036	Web Analytics Lab
UGCA2024	Linux Operating System Lab
UGCA1951	Artificial Intelligence Lab

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Sixth Semester

Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
UGCA2019	Skill Enhancement Course-IV	Advanced Web Technologies	3	0	0	40	60	100	3
UGCA2020	Skill Enhancement Course-Laboratory	Advanced Web Technologies Laboratory	0	0	2	30	20	50	1
	Open Elective-II		3	1	0	40	60	100	4
	Elective-III		3	1	0	40	60	100	4
	Elective-IV		3	1	0	40	60	100	4
	Elective-III Laboratory		0	0	4	60	40	100	2
	Elective-IV Laboratory		0	0	4	60	40	100	2
	Project	Major Project	0	0	4	120	80	200	4
BMPD602-18		Mentoring and Professional Development	0	0	1	25	--	25	1
	TOTAL		**12**	**03**	**15**	**455**	**420**	**875**	**25**

Elective - III	
Course Code	Course Title
UGCA1936	Cloud Computing
UGCA1933	Internet of Things
UGCA2037	Recommender Systems

Elective - IV	
Course Code	Course Title
UGCA1950	Machine Learning
UGCA2039	Data Preparation & Analysis
UGCA2041	Blockchain Technology

Elective-III Laboratory	
Course Code	Course Title
UGCA1942	Cloud Computing Laboratory
UGCA1939	Internet of Things Laboratory
UGCA2038	Recommender Systems Laboratory

Elective-IV Laboratory	
Course Code	Course Title
UGCA1956	Machine Learning Laboratory
UGCA2040	Data Preparation & Analysis Laboratory
UGCA2042	Blockchain Technology Laboratory

**I. K. Gujral Punjab Technical University Bachelor of
Science in Data Analytic (B Sc. Data Analytics)**

Course Code: UGCA1901
Course Name: Mathematics

Program: B. Sc. Data Analytics	**L:**3 **T:**1 **P:**0
Branch: Computer Applications	**Credits:** 4
Semester: 1st	**Contact hours:** 44 hours
Internal max. marks: 40	**Theory/Practical:** Theory
External max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status: core/elective:** Core

Prerequisite: Student must have the knowledge of Basic Mathematics.
Co requisite: NA.
Additional material required in ESE: Minimum two exercises of each concept will be recorded in the file and the file will be submitted in End Semester Examinations.
Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Represent data using various mathematical notions.
CO2	Explain different terms used in basic mathematics.
CO3	Describe various operations and formulas used to solve mathematical problems.

Detailed contents	Contact hours
Unit-I Set Introduction, Objectives, Representation of Sets (Roster Method, Set BuilderMethod),TypesofSets(NullSet,SingletonSet,FiniteSet,InfiniteSet, Equal Set, Equivalent Set, Disjoint Set, Subset, Proper Subset, Power Set, Universal Set) and Operation with Sets (Union of Set, Intersection of Set, DifferenceofSet,SymmetricDifferenceofSet)UniversalSets,Complement of a Set.	12 hours
Unit-II Logic Statement, Connectives, Basic Logic Operations (Conjunction, Disjunction, Negation) Logical Equivalence/Equivalent Statements, Tautologies and Contradictions.	10 hours
Unit -III Matrices Introduction, Types of Matrix (Row Matrix, Column Matrix, Rectangular Matrix, Square Matrix, Diagonal Matrix, Scalar Matrix,Unit Matrix,NullMatrix,ComparableMatrix,EqualMatrix),ScalarMultiplication,	12 hours

Negative of Matrix, Addition of Matrix, Difference of two Matrix, Multiplication of Matrices, Transpose of a Matrix.	
Unit-IV Progressions Introduction, Arithmetic Progression, Sum of Finite number of quantitiesinA.P,ArithmeticMeans,GeometricProgression,GeometricMean.	10 hours

Text Books:

1. Discrete Mathematics and Its Applications by Kenneth H. Rosen, Mc Graw Hill, 6th Edition.
2. College Mathematics, Schaum's Series, TMH.

Reference Books:

1. Elementary Mathematics, Dr. RDSharma
2. Comprehensive Mathematics, ParmanandGupta
3. Elements of Mathematics, MLBhargava

E Books/ Online learning material

1. www.see.leeds.ac.uk/geo-maths/basic_maths.pdf
2. www.britannica.com/science/matrix-mathematics
3. www.pdfdrive.com/schaums-outline-of-discrete-mathematics-third-edition-schaums-e6841453.html

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Course Code: UGCA1902
Course Name: Fundamentals of Computer and IT

Program: B. Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0	
Branch: Computer Applications	**Credits:** 4	
Semester: 1st	**Contact hours:** 44 hours	
Internal max. marks: 40	**Theory/Practical:** Theory	
External max. marks: 60	**Duration of end semester exam (ESE):** 3hrs	
Total marks: 100	**Elective status:** Core	

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: -NA-

CourseOutcomes:

CO#	Course outcomes

CO1	Understanding the concept of input and output devices of Computers
CO2	Learn the functional units and classify types of computers, how they process information and how individual computers interact with other computing systems and devices.
CO3	Understand an operating system and its working, and solve common problems related to operating systems
CO4	Learn basic word processing, Spreadsheet and Presentation Graphics Software skills.
CO5	Study to use the Internet safely, legally, and responsibly

Detailed Contents	Contact hours
Unit-I **Human Computer Interface** Concepts of Hardware and Software; Data and Information. **Functional Units of Computer System:** CPU, registers, system bus, main memory unit, cache memory, Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors. **Devices:** Input and output devices (with connections and practical demo), keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera, monitor, printer, plotter. **Memory:** Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks. **Data Representation:** Bit, Byte, Binary, Decimal, Hexadecimal, and Octal Systems, Conversions and Binary Arithmetic (Addition/ Subtraction/ Multiplication) Applications of IT.	12
Unit-II **Concept of Computing, Types of Languages:** Machine, assembly and High level Language; Operating system as user interface, utility programs. **Word processing:** Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge, equation editors.	10
Unit-III **Spreadsheet:** Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using	10

formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs. **Presentation Graphics Software:** Templates, views, formatting slide, slides with graphs, animation, using special features, presenting slide shows.	
Unit-IV **Electronic Payment System:** Secure Electronic Transaction, Types of Payment System: Digital Cash, Electronic Cheque, Smart Card, Credit/Debit Card E-Money, Bit Coins and Crypto currency, Electronic Fund Transfer (EFT),Unified Payment Interface (UPI),Immediate Payment System(IMPS), Digital Signature and Certification Authority. Introduction to Bluetooth, Cloud Computing, Big Data, Data Mining, Mobile Computing and Embedded Systems and Internet of Things (IoT)	12

Text Books:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education
2. Computer Fundamentals, A. Goel, 2010, Pearson Education.
3. Fundamentals of Computers, P. K.Sinha & P. Sinha, 2007, BPB Publishers.
4. IT Tools, R.K. Jain, Khanna Publishing House
5. "Introduction to Information Technology", Satish Jain, Ambrish Rai & Shashi Singh, Paperback Edition, BPB Publications,2014.

Reference Books:

1. "Introduction to Computers", Peter Norton
2. Computers Today, D. H. Sanders, McGraw Hill.
3. "Computers", Larry long & Nancy long, Twelfth edition, Prentice Hall.
4. Problem Solving Cases in Microsoft Excel, Joseph Brady & Ellen FMonk, Thomson Learning

E Books/ Online learning material

1. www.sakshat.ac.in
2. https://swayam.gov.in/course/4067-computer-fundamentals

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

Course Code: UGCA1903

Course Name: Problem Solving using C

Program: B. Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits:** 4
Semester: 1st	**Contact hours:** 44 hours
Internal max. marks: 40	**Theory/Practical:** Theory
External max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-

Co requisite:-NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Student should be able to understand the logic building used in Programming.
CO2	Students should be able to write algorithms for solving various real life problems.
CO3	To convert algorithms into programs using C .

Detailed Contents	Contact hours
Unit-I **Logic Development:** Data Representation, Flowcharts, Problem Analysis, Decision Trees/Tables, Pseudo code and algorithms. Fundamentals: Character set, Identifiers and Key Words, Datatypes,Constants,Variables, Expressions, Statements, Symbolic Constants. **Operations and Expressions:** Arithmetic operators, Unary operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.	11
Unit-II **Data Input and Output:** formatted & unformatted input output. **Control Statements:** While, Do–while and For statements, Nested loops, If–else, Switch, Break – Continue statements.	10
Unit-III	11

Functions: Brief overview, defining, accessing functions, passing arguments to function, specifying argument data types, function prototypes, recursion. **Arrays**: Defining, processing arrays, passing arrays to a function, multi–dimensional arrays. **Strings**: String declaration, string functions and string manipulation Program Structure Storage Class: Automatic, external and static variables.	
Unit-IV **Structures & Unions:** Defining and processing a structure, user defined data types, structures and pointers, passing structures to functions, unions. **Pointers:** Understanding Pointers, Accessing the Address of a Variable, Declaration and Initialization of Pointer Variables, Accessing a Variable through its Pointer, Pointers and Arrays **File Handling:** File Operations, Processing a Data File	12

Text Books:

1. Programming in ANSI C, E. Balagurusami, Fourth Edition, Tata McGrawHill.
2. Programming in C, Third Edition, Stephen G Kochan,Pearson.
3. The C Programming Language, Kernighan & Richie, Second Edition, PHI Publication.

Reference Books:

1. Object Oriented Programming, Lafore R, Third Edition, Galgotia Publications
2. Let us C, Yashvant P Kanetkar, Seventh Edition, BPB Publications, New Delhi.
3. Programming in C, Byron S. Gottfried, Second Edition, McGraw Hills.
4. Problem Solving and Programming in C, R.S. Salaria, Second Edition
5. Programming in C, Atul Kahate.

**I. K. Gujral Punjab Technical University Bachelor of
Science in Data Analytic (B Sc. Data Analytics)**

Course Code: UGCA1904
Course Name: Workshop on Desktop Publishing

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 1st	**Contact hours**: 4 hours per week
Internal max. marks: 60	**Theory/Practical**: Practical
External max. marks: 40	**Duration of end semester examinations (ESE):** 3hrs
Total marks: 100	**Elective status**: Core

Prerequisite: Students must have basic understanding of designing/ Painting tools.
Co requisite: Printing & Publishing tools.
Additional material required in ESE: Softcopy & Hardcopy of the exercises are to be maintained during the practical labs and to be submitted during the End Semester Examinations.

Course Outcomes: After studying this course, students will be able to:

CO#	Course outcomes
CO1	The students will gain professional skills of *Desk Top Publishing* Tools like designing, Printing & Publishing by using various tools.
CO2	Develop skills in printing jobs through basic understanding of a variety of designing tools.
CO3	Apply these concepts and knowledge in designing field including practice from text formatting to final publishing.
CO4	Workshops are included to enhance professional skills like Brochures, Flexes, Business Cards, Certificates and News Letter layouts etc.

Instructions: Instructor can increase/decrease the experiments as per the requirement.
Assignments:

1.	Design and print a *Title Page* of a Magazine/Book.
2.	Prepare multiple designs for a *Flex* by using different Tools.
3.	Prepare NSS *Certificates* for appreciation using logos of University, College & NSS unit.
4.	Prepare 5 different Designing of *Business Cards*.
5.	Prepare *Envelops* displaying full address of the company by inserting graphical symbol/ logos of company.
6.	Design and Print *Invoices* for three companies.
7.	Prepare and print *News Letter Layouts* for any five activities of your college/ university.
8.	Prepare *Invitation Cards* for cultural meet held in your college.

9.	Design and print *Brochures* to advertise a "Blood Donation Camp" in your college.
10.	Design *Logos* of your college, University & Govt.ofPunjabalsodisplaytheselogos on black background as water mark.
11.	Design, Print and Publish 5 motivations Playcards.
12.	Design & Print assignment book of minimum 20 Pages an any Topic.
13.	Design & Print any five most important activities of your college in a collage.
14.	Design & Print Question Paper of any Subject.
15.	Assemble all the latest news cutting of your activities on a 10 X 8 size flex.

Reference Books:

1. DTP Course, by Shirish Chavan published byRapidex.
2. DTP Course Kit by Vikas Gupta published byComdex.
3. CorelDraw 9 by David Karlins published by Techmedia.
4. Adobe Illustrator CC by Brian Wood published by AdobePress.
5. Page Maker in Easy Steps - ScottBasham.

Software Tools:

1. Adobe Illustrator 14.
2. CorelDraw Graphics Suit.
3. GNU image manipulationprogram.
4. InkScape.
5. PhotoScapeSetup.
6.PM701.

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

Course Code: UGCA1905
Course Name: Problem Solving using C Laboratory

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 1st	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical:** Practical
External max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
Total marks:100	**Elective status:** Core

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course Outcomes
CO1	Students should be able understand the logic building used in programming
CO2	Students should be able to write algorithms for solving various real-life problems
CO3	Students should be able to convert the algorithms into computer programs using C language.

Instructions: Develop all programs in C programming language.

Assignments:

1.	WRITEAPROGRAMtodisplayyourname.Writeanotherprogramtoprintmessage with inputted name.
2.	WRITE A PROGRAM to add two numbers.
3.	WRITE A PROGRAM to find the square of a given number.
4.	WRITE A PROGRAM to calculate the average of three real numbers.
5.	Write a program to Find ASCII Value of a Character
6.	WRITE A PROGRAM to Find the Size of int, float, double and char
7.	WRITE A PROGRAM to Compute Quotient and Remainder
8.	WRITE A PROGRAM to accept the values of two variables.
9.	WRITE A PROGRAM to find the simple interest, inputs are amount, period in years and rate of interest.
10.	Basic salary of an employee is input through the keyboard. The DA is 25% of the basic salary while the HRA is 15% of the basic salary. Provident Fund is deducted at the rate of 10% of the gross salary(BS+DA+HRA). WRITE A PROGRAM to calculate the net salary
11.	WRITE A PROGRAM to find area of a circle using PI as constant
12.	WRITE A PROGRAM to find volume of a cube using side as input from user
13.	WRITE A PROGRAM using various unformatted Input Functions

14.	WRITEAPROGRAMtofindareaofrectangleandprinttheresultusingunformatted output Functions
15.	WRITE A PROGRAM to find the larger of two numbers.
16.	WRITE A PROGRAM to find greater of three numbers using Nested If.
17.	WRITE A PROGRAM to find whether the given number is even or odd.
18.	WRITE A PROGRAM to Generate Multiplication Table Using for loop
19.	WRITE A PROGRAM to Generate Multiplication Table Using while loop
20.	WRITE A PROGRAM to Make a Simple Calculator Using switch...case
21.	WRITE A PROGRAM to find whether the given number is a prime number.
22.	WRITE A PROGRAM using function to find the largest of three numbers
23.	WRITE A PROGRAM using function to print first 20 numbers and its squares.
24.	WRITE A PROGRAM to find the factorial of a given number.
25.	WRITE A PROGRAM to print the sum of two matrices
26.	WRITE A PROGRAM to Find the Length of a String
27.	WRITE A PROGRAM to Copy String using strcpy()
28.	WRITE A PROGRAM to compare a string
29.	WRITE A PROGRAM to reverse a string
30.	WRITE A PROGRAM to reverse a string
31.	WRITE A PROGRAM to multiply two numbers using pointers.
32.	WRITE A PROGRAM to display address of variable using pointers
33.	WRITE A PROGRAM to show the memory occupied by Structure and Union
34.	WRITE A PROGRAM to create Student I-Card using a Structure
35.	WRITE A PROGRAM to read data from a file from a file
36.	WRITE A PROGRAM to save Employee details in a file using File Handling

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**I. K. Gujral Punjab Technical University Bachelor of
Science in Data Analytic (B Sc. Data Analytics)**

Course Code: UGCA1906
Course Name: Fundamentals of Computer and IT Laboratory

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits:** 2
Semester: 1st	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical:** Practical
External max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: - NA-

Course Outcomes:

CO#	Course outcomes
CO1	FamiliarizingwithOpenOffice(Wordprocessing,SpreadsheetsandPresentation).
CO2	To acquire knowledge on editor, spread sheet and presentation software.
CO3	The students will be able to perform documentation and accounting operations.
CO4	Students can learn how to perform presentation skills.

Instructions:

Word Orientation: The instructor needs to give an overview of word processor. Details of the four tasks and features that would be covered Using word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter.	
1.	Using word to create Resume Featurestobecovered:-FormattingFontsinword,DropCapinword,Applying Texteffects,UsingCharacterSpacing,BordersandColors,InsertingHeaderand Footer, Using Date and Time option inWord.
2.	Creating an Assignment Features to be covered: - Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.
3.	Creating a Newsletter Features to be covered :- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs
4.	Creating a Feedback form Features to be covered :- Forms, Text Fields, Inserting objects, Mail Merge in Word.
Excel Orientation:	

The instructor needs to tell the importance of Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered Excel – Accessing, overview of toolbars, saving excel files,

1.	Creating a Scheduler Features to be covered :- Gridlines, Format Cells, Summation, auto fill, Formatting Text
2.	Calculations Features to be covered :- Cell Referencing, Formulae in excel – average, std.deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP
3.	Performance Analysis Features to be covered :- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting
4.	Game (like Cricket, badminton) Score Card Features to be covered :- Pivot Tables, Interactive Buttons, Importing Data, Data Protection, Data Validation

Presentation Orientation:

1.	Studentswillbeworkingonbasicpowerpointutilitiesandtoolswhichhelpthem create basic power point presentation. Topic covered includes :- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows
2.	This session helps students in making their presentations interactive. Topicscoveredincludes:Hyperlinks,Inserting–Images,ClipArt,Audio,Video, Objects, Tables andCharts
3.	Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background, textures,DesignTemplates,Hiddenslides.Autocontentwizard,SlideTransition, Custom Animation, Auto Rehearsing
4.	Power point test would be conducted. Students will be given model power point presentation which needs to be replicated

Internet and its Applications

The instructor needs to tell the how to configure Web Browser and to use search engines by defining search criteria using Search Engines

1.	To learn to setup an e-mail account and send and receive e-mails
2.	Tolearntosubscribe/postonablogandtousetorrentsforaccelerateddownloads
3.	Hands on experience in online banking and Making an online payment for any domestic bill

Reference Books:

1. IT Tools, R.K. Jain, Khanna PublishingHouse.

2. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
3. Introduction to information technology, Turban, Rainer and Potter, John Wiley and Sons.
4. Problem Solving Cases in Microsoft Excel, Joseph Brady & Ellen F Monk, Thomson Learning.

AECC (For UGC courses)
BTHU103-18 English:

Course Outcomes:

- The objective of this course is to introduce students to the theory, fundamentals and tools of communication.
- To help the students become the independent users of English language.
- To develop in them vital communication skills which are integral to their personal, social and professional interactions.
- The syllabus shall address the issues relating to the Language of communication.
- Students will become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills such as report writing, note taking etc.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below.

Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

Detailed Contents:

Unit1- 1 (Introduction)

- Theory of Communication
- Types and modes of Communication

Unit- 2 (Language of Communication)

- Verbal and Non-verbal
- (Spoken and Written)
- Personal, Social and Business
- Barriers and Strategies
- Intra-personal, Inter-personal and Group communication

Unit-3 (Reading and Understanding)

- Close Reading
- Comprehension

- Summary Paraphrasing

- Analysis and Interpretation
- Translation (from Hindi/Punjabi to English and vice-versa)
  OR
  <mark>**Precis writing /Paraphrasing (for International Students)**</mark>
- Literary/Knowledge Texts

Unit-4 (Writing Skills)

- Documenting
- Report Writing
- Making notes
- Letter writing

Recommended Readings:

1. *Fluency in English* - Part II, Oxford University Press,2006.
2. *Business English*, Pearson,2008.
3. *Language, Literature and Creativity*, Orient Blackswan,2013.
4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr RanjanaKaul, Dr Brati Biswas
5. *On Writing Well*. William Zinsser. Harper Resource Book.2001
6. *Study Writing*. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006.

AECC
BTHU104/18 English Practical/Laboratory
: 0L 0T 2P 1 Credit

Course Outcomes:

- The objective of this course is to introduce students to the theory, fundamentals and tools of communication.
- To help the students become the independent users of English language.
- To develop in them vital communication skills which are integral to personal, social and professional interactions.
- ThesyllabusshalladdresstheissuesrelatingtotheLanguageofcommunication.
- Students will become proficient in professional communication such as interviews, group discussions and business office environments, important reading skills as well as writing skills such as report writing, note takingetc.

The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below.

Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books.

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension

- Self Introduction, Group Discussion and Role Play

- Common Everyday Situations: Conversations and Dialogues

- Communication at Workplace

- Interviews

- Formal Presentations

- Monologue

- Effective Communication/ Mis-Communication

- Public Speaking

Recommended Readings:

1. *Fluency in English* - Part II, Oxford University Press,2006.
2. *Business English*, Pearson,2008.
3. Practical English Usage. Michael Swan. OUP.1995.
4. *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press.2011.
5. *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

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Course Code: HVPE101-18
Course Name: Human Values, De-addiction and Traffic Rules

Program: B. Sc. Data Analytics	**L**: 3 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits:** 3
Semester: 1st	**Contact hours:** 33 hours
Internal max. marks: 40	**Theory/Practical:** Theory
External max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Ability Enhancement

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the coreaspirations of all human beings.

CO2	To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way.
CO3	To highlight plausible implications of such a Holistic understanding in terms of ethicalhuman conduct, trustful and mutually satisfying human behavior and mutually enriching interaction with Nature.

Note: This course is intended to provide a much needed orientational input in Value Education to the young enquiring minds.

Detailed Contents	Contact hours
Unit-I **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** 1. Understanding the need, basic guidelines, content and process for Value Education 2. Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly-A critical appraisal ofthe current scenario 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels	8
Unit-II **Understanding Harmony in the Human Being - Harmony in Myself!** 1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body' 2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha* 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) 4. Understanding the characteristics and activities of 'I' and harmonyin 'I'	8

5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail 6. Programs to ensure *Sanyam* and *Swasthya* - Practice Exercises and Case Studies will be taken up in Practice Sessions.	

Unit-III
 	
Understanding Harmony in the Family and Society-Harmony in Human-Human Relationship
  1. Understanding harmony in the Family- the basic unit of human interaction
  2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship
  3. Understanding the meaning of *Vishwas*; Difference between intention and competence
  4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
  5. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals
  6. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha)*- from family to world family!
     - Practice Exercises and Case Studies will be taken up in Practice Sessions.
	6

Unit-IV
 	
Understanding Harmony in the Nature and Existence - Whole existence as Co-existence
  1. Understanding the harmony in the Nature
  2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
  3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
  4. Holistic perception of harmony at all levels of existence
     - Practice Exercises and Case Studies will be taken up in Practice Sessions.
	5

Unit-V	6

Implications of the above Holistic Understanding of Harmony on Professional Ethics 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics:
    a) Ability to utilize the professional competence for augmenting universal human order,
    b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
    c) Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order:
    a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b) At the level of society: as mutually enriching institutions and organizations.	

Text Book

1. R R Gaur, R Sangal, G P Bagaria, 2009, *A Foundation Course in Value Education*.

Reference Books

1. Ivan Illich, 1974, *Energy & Equity,* The Trinity Press, Worcester, and Harper Collins, USA.
2. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs,Britain.
3. A Nagraj, 1998, *Jeevan Vidya ek Parichay,* Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How *the Other Half Dies,* Penguin Press. Reprinted 1986, 1991.
5. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Common wealthPublishers.
6. A.N. Tripathy, 2003, *Human Values*, New Age InternationalPublishers.
7. Subhas Palekar, 2000, *How to practice Natural Farming,* Pracheen (Vaidik) Krishi Tantra Shodh,Amravati.
8. DonellaH.Meadows,DennisL.Meadows,JorgenRanders,WilliamW.Behrens III, 1972, *Limits to Growth – Club of Rome's report*, UniverseBooks.
9. E G Seebauer & Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers,* Oxford UniversityPress

10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, *Engineering Ethics (includingHumanValues)*,EasternEconomyEdition,PrenticeHallofIndiaLtd.
11. B P Banerjee, 2005, *Foundations of Ethics and Management,* Excel Books.
12. BLBajpai,2004,*IndianEthosandModernManagement*,NewRoyalBookCo., Lucknow. Reprinted2008.

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website,http://uhv.ac.in
2. Story of Stuff,http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics,USA
4. Charlie Chaplin, Modern Times, United Artists,USA
5. IIT Delhi, Modern Technology – the Untold Story

Course Code: HVPE102-18
Course Name: Human Values, De-addiction and Traffic Rules (Lab/ Seminar)

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**:1
Branch: Computer Applications	**Credits:** 1
Semester: 1st	**Contact hours:** 1 hour per week
Internal max. marks: 25	**Theory/Practical:** Practical
External max. marks: 0	**Duration of end semester exam (ESE):** 3hrs
Total marks: 25	**Elective status:** Ability Enhancement

One each seminar will be organized on Drug De-addiction and Traffic Rules. Eminent scholar and experts of the subject will be called for the Seminar at least once during the semester. It will be binding for all the students to attend the seminar.

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

Course Code: UGCA1985
Course Name: Probability and Statistics

Program: B. Sc. Data Analytics	**L: 3 T: 1 P:0**
Branch: Computer Applications	**Credits:** 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 40	**Theory/Practical:** Theory
External max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: Students must have the basic knowledge of mathematic terms.
Co requisite: NA
Additional material required in ESE: Minimum two exercises of each concept will be recorded in the file and the file will be submitted in End Semester Examinations.
Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Understand the science of studying & analyzing numbers.
CO2	Define probability.
CO3	Describe various statistical formulas.
CO4	Compute various statistical measures.

Detailed Contents	Contact hours
Unit I Define probability, Random experiment, outcome, trial and event, Exhaustive events, favourable events, Independentevents, sample space, definition of probability, addition theorem of probability, conditional probability, independent events, Mutually and pair wise independent events, multiplication theorem of probability for independent events, Baye'stheorem.	11 hours
Unit II Random Variable (Univariate): Random Variable, Distribution function, discrete random variable, Probability mass function, Distribution function of discrete random variable, Continuous random variable, Probability density function. Distribution function of continuous random variable. Two dimensional probability mass function, Marginal probability function, conditional probability function, Two dimensional distribution function, marginal distribution function, Joint density function, marginal density function.	11 hours

Unit III Define statistics, Measures of Central tendency: Introduction to Central Tendency, Purpose and Functions of Average, Characteristics of a Good Average, Types of Averages, Meaning of Arithmetic Mean, Calculation of Arithmetic Mean, Merit and Demerits of Arithmetic Mean, Meaning of Median, Calculation of Median, Merit and Demerits of Median, Meaning of Mode, Calculation of Mode, Merit and Demerits of Mode, Harmonic Mean- Properties- Merit and Demerits.	11 hours
Unit IV Measures of Dispersion: Meaning of Dispersion, Objectives of Dispersion, Properties of a good Measure of Dispersion, Methods of Measuring Dispersion, Range Introduction, Calculation of Range , Merit and Demerits of Range, Mean Deviation, Calculation of Mean Deviation , Merit and Demerits of Mean Deviation, Standard Deviation Meaning, Calculation of Standard Deviation , Merit and Demerits of Standard Deviation, Coefficient of Variation, Calculation of Coefficient Variance, Merit and Demerits of Coefficient of Variation.	11 hours

Text Books:
1. Statistics and Data Analysis, A.Abebe, J. Daniels, J.W.Mckean, December2000.
2. Statistics, Tmt. S. EzhilarasiThiru, 2005, Government ofTamilnadu.
3. Introduction to Statistics, David M.Lane.
4. Weiss, N.A., Introductory Statistics. Addison Wesley,1999.
5. Clarke, G.M. & Cooke, D., A Basic course in Statistics. Arnold,1998.

Reference Books:
1. Banfield J.(1999), Rweb: Web-based Statistical Analysis, Journal of Statistical Software.
2. Bhattacharya, G.K. and Johnson, R.A.(19977), Statistical Concepts and Methods,New York, John Wiley &Sons.

E-Books/ Online learning material
1. http://onlinestatbook.com/Online_Statistics_Education.pdf
2. https://textbookcorp.tn.gov.in/Books/12/Std12-Stat-EM.pdf

3. https://3lihandam69.files.wordpress.com/2015/10/introductorystatistics.pdf

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Course Code: UGCA1922
Course Name: Database Management Systems

Program: B. Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits:** 4
Semester: 4th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** --
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Core
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes: Students will be able to

CO#	Course outcomes
CO1	Understand the basic concepts of DBMS.
CO2	Formulate, using SQL, solutions to a broad range of query and data update problems.
CO3	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
CO4	Understand the concept of Transaction and Query processing in DBMS.

Detailed contents	Contact hours
Unit-I Introduction of DBMS, Data Modeling for a Database, Three level Architecture of DBMS, Components of a DBMS. Introduction to Data Models, Hierarchical, Network and Relational Model, Comparison of Network, Hierarchical and Relational Model, Entity Relationship Model.	10
Unit-II Relational Database, Relational Algebra and Calculus, SQL Fundamentals, DDL, DML, DCL, PL/SQL Concepts, Cursors, Stored Procedures, Stored Functions, Database Triggers.	12
Unit-III Introduction to Normalization, First, Second, Third Normal Forms, Dependency Preservation, Boyce-Codd Normal Form, Multi-valued	12

Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Domain-key normal form (DKNF).	
Unit-IV Database Recovery, Concurrency Management, Database Security, Integrity and Control. Structure of a Distributed Database, Design of Distributed Databases.	10

Text Books:

1. "An Introduction to Database System", Bipin C. Desai, Galgotia Publications Pvt Ltd-New Delhi, Revised Edition,(2012).
2. "Database System Concepts",Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Tata McGraw Hill, 6th Edition,(2013).

Reference Books:

1. "SQL, PL/SQL The Programming Language of Oracle", Ivan Bayross, BPB Publications, 4th Revised Edition (2009)
2. "AnIntroductiontoDatabaseSystems",C.J.Date,A.Kannan,S.Swamynathan,8th Edition, Pearson Education,(2006).
3. Database Management Systems, Raghu Rama krishnan, McGraw-Hill, Third Edition,2014.

Course Code: UGCA1909
Course Name: Object Oriented Programming using C++

Program: B. Sc. Data Analytics	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 2nd	**Contact hours:** 44 hours
Internal max. marks: 40	**Theory/Practical:** Theory
External max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	To learn programming from real world examples.

CO2	To understand Object oriented approach for finding Solutions to various problems with the help of C++ language.
CO3	To create computer based solutions to various real-world problems using C++
CO4	To learn various concepts of object oriented approach towards problem solving

Detailed Contents	Contact hours
Unit-I **Principles of object oriented programming** Introduction to OOP and its basic features, Basic components of a C++, Program and program structure, Compiling and Executing C++ Program. Difference between Procedure Oriented Language(C) and Object Oriented Language	12
Unit-II **Classes & Objects and Concept of Constructors** Defining classes, Defining member functions, Declaration of objects to class, Access to member variables from objects, Different forms of member functions, Access specifiers (Private, public, protected), Array of objects. Introduction to constructors, Parameterized constructors, Copy Constructor, Multiple constructors in class, Dynamic initialization of objects, Destructors.	10
Unit-III **Inheritance and Operator overloading** IntroductiontoInheritance,Typesofinheritance:-Singleinheritance,Multiple inheritance, Multilevel inheritance, Hierarchical inheritance, Hybrid inheritance, Defining operator overloading, Overloading of Unary and Binary operators, Rules for overloading operators	12
Unit-IV **Polymorphism and File Handling** Early Binding, Late Binding, Virtual Functions, pure virtual functions, Abstract Classes. Opening and Closing File, Reading and Writing a file.	10

Text Books:

1. Object Oriented Programming with C++, E. Balagurusami, Fourth Edition, Tata Mc-GrawHill.
2. Object Oriented Programming in Turbo C++, Robert Lafore, Fourth Edition GalgotiaPublications.
3. The C++ Programming Language, Bjarna Stroustrup, Third Edition, Addison-Wesley PublishingCompany.
4. ObjectOrientedProgrammingUsingC++,Salaria,R.S,FourthEdition,Khanna Book Publishing.

Course Code: UGCA1910
Course Name: Object Oriented Programming using C++ Laboratory

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 2nd	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical:** Practical
External max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	To learn programming from real world examples.
CO2	To understand Object oriented approach for finding Solutions to various problems with the help of C++ language.
CO3	To create computer based solutions to various real-world problems using C++
CO4	To learn various concepts of object oriented approach towards problem solving

**I. K. Gujral Punjab Technical University Bachelor of
Science in Data Analytic (B Sc. Data Analytics)**

Instructions: Develop all program in C++

Assignments:

1.	Write a program to enter mark of 6 different subjects and find out the total mark (Using cin and cout statement)
2.	Write a function using reference variables as arguments to swap the values of pair of integers.
3.	Write a function to find largest of three numbers.
4.	Write a program to find the factorial of a number.
5.	Define a class to represent a bank account which includes the following members as Data members: a) Name of the depositor b) Account Number c) Withdrawal amount d) Balance amount in the account Member Functions: a) To assign initial values b)To deposit an amount c) To withdraw an amount after checking the balance d) To display name and balance.
6.	Write the above program for handling n number of account holders using array of objects.
7.	Write a C++ program to compute area of right angle triangle, equilateral triangle, isosceles triangle using function overloading concept.
8.	Consider a publishing company that markets both book and audio cassette version to its works. Create a class Publication that stores the title (as tring) and price (typefloat) of a publication. Derive the following two classes from the above Publication class: Bookwhich adds a page count (int) and Tape which adds a playing time inminutes (float). Each class should have get_data() function to get its data from the user at the keyboard. Write the main() function to test the Book and Tape classes by creating instances of the masking the user to fill in data with get_data() and then displaying it using put_data().
9.	Consideranexampleofdeclaringtheexaminationresult.Designthreeclassesstudent, exam and result. The student has data members such as rollno, name. Create the lass exam by inheriting the student class. The exam class adds data members representing the marks scored in 5 subjects. Derive the result from exam-class and it has owndata members like total, avg.
10.	Write a program for overloading of Unary ++ operator.
11.	Write a program for overloading of Binary + operator.
12.	Write a program of Virtual Functions.
13.	Write a program of Abstract Classes.
14.	Write a program to read and write from file.

Reference Books:

1. Object Oriented Programming with C++, E. Balagurusami, Fourth Edition, Tata Mc-GrawHill.
2. Object Oriented Programming in Turbo C++, Robert Lafore, Fourth Edition GalgotiaPublications.
3. The C++ Programming Language, Bjarna Stroustrup, Third Edition, Addison-Wesley PublishingCompany.
4. ObjectOrientedProgrammingUsingC++,Salaria,R.S,FourthEdition,Khanna Book Publishing.

Course Code: UGCA1986
Course Name: Probability and Statistics Laboratory

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**: 2
Semester: 2nd	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical:** Practical
External max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Core

Prerequisite:NA.
Co requisite: NA.
Additional material required in ESE:.

Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Installation and use of open source statistical tool.
CO2	Apply various operations/ formulas using open source statistical tool.

Instructions:
1. Installation of any open source statistical tool.
2. Implementation of various measures of central tendency.
3. Implementation of various measures of dispersion.
4. Implementation of probability functions.

Reference Books:
1. Statistics for Economics, TR Jain, VKOhri.
2. Statistics and Data Analysis, A.Abebe, J. Daniels, J.W.Mckean, December 2000.

E-Books/ Online learning material
1. https://www.meritnation.com/cbse-class-11-commerce/economics/class_13_tr_jain.

2. http://college.cengage.com/mathematics/brase/understandable_statistics/9780618949922_ch03.pdf
3. http://www.rockcreekschools.org/pages/uploaded_files/Excel%201%20Lab%20Exercises.pdf

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Course Code: UGCA1925
Course Name: Database Management Systems Laboratory

Program: B. Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits:** 2
Semester: 2nd	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** 100%
Internal max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 40	**Elective status:** Core
Total marks: 100	

Prerequisite: -NA-
Co requisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Able to understand various queries and their execution
CO2	Populate and query a database using SQL DML/DDL commands.
CO3	Declare and enforce integrity constraints on a database
CO4	Programming PL/SQL including stored procedures, stored functions, cursors, packages
CO5	Able to design new database and modify existing ones for new applications and reason about the efficiency of the result

Instructions:

1.	Used of CREATE, ALTER, RENAME and DROP statement in the database tables (relations)
2.	Used of INSERT INTO, DELETE and UPDATE statement in the database tables (relations)
3.	Use of simple select statement.
4.	Use of select query on two relations
5.	Use of nesting of queries.
6.	Use of aggregate functions.
7.	Use of substring comparison.
8.	Use of order by statement.
9.	Consider the following schema for a Library Database:

	BOOK (*Book_id, Title, Publisher_Name, Pub_Year*) BOOK_AUTHORS (Book_id, Author_*Name*) PUBLISHER (*Name, Address, Phone*) BOOK_COPIES (*Book_id, Branch_id, No-of_Copies*) BOOK_LENDING (*Book_id, Branch_id, Card_No, Date_Out, Due_Date*) LIBRARY_BRANCH (*Branch_id, Branch_Name, Address*) Write SQL queries to 1. Retrieve details of all books in the library_id, title, name of publisher,authors, number of copies in each branch, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books between Jan 2018 to Jun 2018 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working witha simple query. 5. Create a view of all books and its number of copies that are currently available in the Library.
10.	Consider the following schema for Order Database: SALESMAN (*Salesman_id, Name, City, Commission*) CUSTOMER (*Customer_id, Cust_Name, City, Grade,Salesman_id*) ORDERS (*Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id*) Write SQL queries to 1. Count the customers with grades above Amritsar's average. 2. Find the name and numbers of all salesmen who had more than one customer. 3. List all salesmen and indicate those who have and don't have customers in theircities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order of a day. 5. DemonstratetheDELETEoperationbyremovingsalesmanwithid1000.Allhis orders must also be deleted.
11.	WriteaPL/SQLcodetoaddtwonumbersanddisplaytheresult.Readthenumbersduring run time.
12.	Write a PL/SQL code to find sum of first 10 natural numbers using while and for loop.
13.	Writeaprogramtocreateatriggerwhichwillconvertthenameofastudenttouppercase before inserting or updating the name column of student table.
14.	WriteaPL/SQLblocktocountthenumberofrowsaffectedbyanupdatestatementusing SQL%ROWCOUNT
15.	Write a PL/SQL block to increase the salary of all doctors by 1000.

Reference Books:

1. "SQL, PL/SQL The Programming Language of Oracle", 4th Revised Edition, Ivan Bayross(2009).

2. "Oracle PL/SQL Programming", 5th Edition, Steven Feuerstein and Bill Pribyl (2009).

**Ability Enhancement Compulsory Course
EVS102-18 Environmental Studies**

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.

2. The students will gain practical knowledge by visiting wildlife areas, environmentalinstitutesandvariouspersonalitieswhohavedonepracticalworkon various environmental Issues.

3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.

4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

UNIT-1: Introduction to Environmental Studies
Multidisciplinary nature of Environmental Studies: Scope & Importance
Need for Public Awareness

UNIT-2: Ecosystems Concep to fan Ecosystem: Structure & functions of an ecosystem (Producers, Consumers & Decomposers)
Energy Flow in an ecosystem: Food Chain, Food web and Ecological Pyramids
Characteristic features, structure & functions of following Ecosystems:
- Forest Ecosystem
- Aquatic Ecosystem (Ponds, Lakes, River &Ocean)

UNIT-3: Natural Resources
Renewable & Non-renewable resources
Forest Resources: Their uses, functions & values (Biodiversity conservation, role in climate change, medicines) & threats (Overexploitation, Deforestation, Timber extraction, Agriculture Pressure), Forest Conservation Act
Water Resources: Their uses (Agriculture, Domestic & Industrial), functions & values, Overexploitation and Pollution of Ground & Surface water resources (Case study of Punjab), Water Conservation, Rainwater Harvesting,

Land Resources: Land as a resource; Land degradation, soil erosion and desertification

Energy Resources: Renewable & non-renewable energy resources, use of alternate energy resources (Solar, Wind, Biomass, Thermal), Urban problems related to Energy

UNIT-4: Biodiversity & its conservation
Types of Biodiversity: Species, Genetic & Ecosystem
India as a mega biodiversity nation, Biodiversity hot spots and biogeographic regions of India
Examples of Endangered & Endemic species of India, Red data book

UNIT-5: Environmental Pollution & Social Issues
Types, Causes, Effects & Control of Air, Water, Soil & Noise Pollution
Nuclear hazards and accidents & Health risks
Global Climate Change: Global warming, Ozone depletion, Acid rain, Melting of Glaciers & Ice caps, Rising sea levels
Environmental disasters: Earthquakes, Floods, Cyclones, Landslides

UNIT-6: Field Work
Visit to a National Park, Biosphere Reserve, Wildlife Sanctuary
Documentation & preparation of a Biodiversity (flora & fauna) register of campus/river/forest
Visit to a local polluted site: Urban/Rural/Industrial/Agricultural
Identification & Photography of resident or migratory birds, insects (butterflies)
Public hearing on environmental issues in a village

Suggested Books:

1. Bharucha, E. Text Book for Environmental Studies. University Grants Commission, NewDelhi.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd.Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford(TB)
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai,1196p
7. De A.K., Environmental Chemistry, Wiley EasternLtd.
8. Down to Earth, Centre for Science and Environment(R)
9. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
10. Hawkins R.E., Encyclopedia of Indian Natural History, BombayNatural History Society, Bombay(R)
11. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press1140p.
12. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.

13. Mckinney, M.L. & School, R.M. 1996. Environmental
    Science systems &Solutions, Web enhanced edition.639p.

14. Mhaskar A.K., Matter Hazardous, Techno-Science Publication(TB)

15. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co.(TB)

16. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA,574p

17. Rao M N. & Datta, A.K. 1987. Waste Water treatment.
    Oxford & IBH Publ. Co. Pvt. Ltd. 345p.

18. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House,Meerut

19. Survey of the Environment, The Hindu(M)

20. Townsend C., Harper J, and Michael Begon,
    Essentials of Ecology, Blackwell Science (TB)

21. Trivedi R. K. and P.K. Goel, Introduction to air pollution,
    Techno-Science Publication(TB)

22. Wanger K.D., 1998 Environmental Management.
    W.B. Saunders Co. Philadelphia, USA499p

Course Code: UGCA 1923

Course Name: Operating Systems

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits**:4
Semester:3rd	**Contact hours:**44hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 15%
Internal max. marks: 40	**Duration of end semester exam(ESE):** 3hrs
External max. marks:60	**Elective status:** Core
Total marks:100	

Prerequisite: Basic understanding of computer system.
Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Discuss the evaluation of operating systems.
CO2	Explain different resource managements performed by operating system.
CO3	Describe the architecture in terms of functions performed by different types of Operating systems.
CO4	Analyze the performance of different algorithms used in design of operating system components.
CO5	Compare the key properties of different types of Operating Sytems.

Detailed contents	Contact hours

Unit-I **Fundamentals of Operating system**: Introduction to Operating system, Functions of an operating system. Operating system as a resource manager. Structure of operating system (Role of kernel and Shell).Views of operating system. Evolution and types of operating systems.[CO1] **Process & Thread Management**: Program vs. Process; PCB, State transition diagram, Scheduling Queues, Types of schedulers, Conceptof Thread, Benefits, Types of threads, Process synchronization.[CO2] **CPU Scheduling**: Need of CPU scheduling, CPU I/O Burst Cycle, Pre-emptive vs. Non-pre-emptive scheduling, Different scheduling criteria's, scheduling algorithms (FCSC, SJF, Round- Robin, Multilevel Queue).[CO2]	12
Unit-II **Memory Management**: Introduction, address binding, relocation, loading, linking, memory sharing and protection; Paging and segmentation; Virtual memory: basic concepts of demand paging, page replacement algorithms.[CO2]	12
Unit-III **I/O Device Management**: I/O devices and controllers, device drivers; disk storage. **File Management**: Basic concepts, file operations, access methods, directory structuresand management, remote file systems; file protection.[CO3]	08
Unit-IV **Advanced Operating systems:** Introduction to Distributed Operating system, Characteristics, architecture, Issues, Communication &Synchronization; Introduction Multiprocessor Operating system, Architecture,Structure,Synchronization&Scheduling;Introductionto Real- Time Operating System, Characteristics, Structure & Scheduling. Case study of Linux operating system[CO4][CO5]	12

TextBooks:

1. Operating System Principles by Abraham Silberschatz and
   Peter Baer Galvin, Seventh Edition, Published by Wiley-India.
2. Principals of Operating System by Naresh Chauhan, Published by
   OXFORD University Press, India.

ReferenceBooks:
1. Operating Systems by Sibsankar Haldar and Alex A. Aravind, Published
   byPearsonEducation.
2. OperatingsystembyStalling,W., SixthEdition,PublishedbyPrenticeHall(India)

Course Code: UGCA1931
Course Name: Data Warehouse and Mining

Program: B.Sc. Data Analytics	L: 3 T: 0 P:0
Branch: Computer Applications	Credits:3
Semester:3rd	Contact hours:44hours
Theory/Practical: Theory	Percentage of numerical/design problems:20%
Internal max.marks:40	Duration of end semester exam (ESE): 3hrs
External max.marks:60	Elective status: Elective
Total marks: 100	

Prerequisite:-NA-Corequisite:-NA-
Additional material required in ESE: -NA-
**Course Outcomes:** After completing this course, students will be able to:

CO#	Course outcomes
CO1	Explain the need of Data Warehousing & Mining
CO2	Evaluate the Transactional and Analytical data models.
CO3	Analyze the real-life applications where data mining can be applied.
CO4	Apply different datamining algorithms on wide range of data sets.

Detailed Contents	Contact hours

Unit-I Need for strategic information, difference between operational and Informational data stores Datawarehouse definition, characteristics, Data warehouserole and structure ,OLAP Operations, Data mart, Different between data mart and data warehouse, Approaches to build a data warehouse, Building a datawarehouse, Metadata & its types.	11
Unit-II Data Pre- processing: Need, Data Summarization, Methods. Denormalization, Multidimensional data model, Schem as for multi-dimensional data (Star schema,Snowflake Schema, Fact Constellation Schema, Difference between different schemas. Data warehouse architecture, OLAP servers, Indexing OLAP Data,OLA P query processing, Data cube computation	11
Unit-III Data Mining: Definition, Data Mining process, Data mining methodology, Data mining tasks, Mining various Datatypes & issues.	12
Attribute- Oriented Induction, Association rule mining, Frequent item set mining, The A priori Algorithm, Mining multilevel association rules.	
Unit-IV Overview of classification, Classification process, Decision tree, Decision Tree Induction, Attribute Selection Measures. Overview of classifier'saccuracy, Evaluating classifier's accuracy, Techniquesfor accuracy estimation, Increasing the accuracy of classifier. Introduction to Clustering, Types of clusters, Clustering methods,Data visualization& various data visualization tools	10

TextBooks:

1. Berson, Data Warehousing, Data Mining & OLAP,TataMcGraw-Hill.
2. Han J., Kamber M. and Pei J., Data mining concepts and techniques, Morgan Kaufmann Publishers (2011) 3rd ed.
3. PudiV.,KrishanaP.R.,Data Mining,OxfordUniversitypress,(2009)1sted.
4. AdriaansP.,ZantingeD.,Data mining,Pearson educationpress(1996),1sted.
5. Pooniah P., Data Warehousing Fundamentals, Willey interscience Publication,(2001),1st ed.
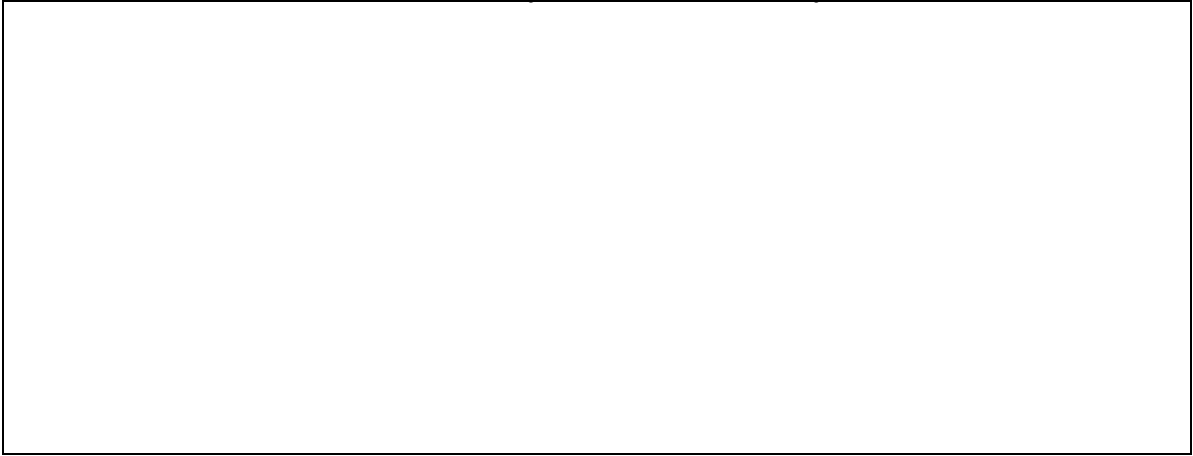
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Course Code: UGCA1915

Course Name: Data Structures

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits**:4
Semester:3rd	**Contact hours:**44hours
Theory/Practical: Theory	**Percentage of numerical/design problems:**--
Internal max. marks: 40	**Duration of end semester exam(ESE):** 3hrs
External max. marks:60	**Elective status:** Core
Total marks:100	

Prerequisite:-NA-

Corequisite:-NA- Additional material

required in ESE: -NA-

Course Outcomes: Students will be able to

CO#	Course outcomes
CO1	Apply appropriate constructs of Programming language, coding standards for application development
CO2	Select appropriate data structures for problem solving and programming
CO3	Illustrate the outcome of various operations on data structures.
CO4	Identify appropriate searching and/or sorting techniques for wide range of problems and datatypes.
CO5	Differentiate between various types of data structures

Detailed Contents	Contact hours
Unit-I **Introduction to Data Structures:** Algorithms and Flowcharts, Basics Analysis on Algorithm, Complexity of Algorithm, Introduction and Definition of Data Structure, Classification of Data, Arrays, Various types of Data Structure, Static and Dynamic Memory Allocation, Function, Recursion.[CO5] **Arrays, Pointers and Strings:** Introduction to Arrays, Definition, One Dimensional Array and Multi-DimensionalArrays, Pointer, Pointer to Structure, various Programs for Array and Pointer.Strings. Introduction to Strings, Definition, Library Functions of Strings.[CO1]	10

Unit-II **Stacks and Queue** Introduction to Stack, Definition, Stack Implementation, Operations of Stack, Applications of Stack and Multiple Stacks. Implementation of Multiple Stack Queues, Introduction to Queue, Definition, Queue Implementation, Operations of Queue, Circular Queue, De-queue and Priority Queue.[CO2]	8
Unit-III **Linked Lists and Trees** Introduction, Representation and Operations of Linked Lists, Singly Linked List, Doubly Linked List, Circular Linked List, And Circular Doubly Linked List.[CO3] **Trees** Introduction to Tree, Tree Terminology Binary Tree, Binary Search Tree,Strictly Binary Tree, Complete Binary Tree, Tree Traversal, Threaded BinaryTree,AVLTreeBTree,B+Tree.[CO3]	14
Unit-IV **Graphs, Searching, Sorting and Hashing Graphs:** Introduction, Representation to Graphs, Graph Traversals Shortest Path Algorithms.[CO3] **Searching and Sorting:** Searching, Types of Searching, Sorting, Types of sorting like quick sort, bubble sort, merge sort, selection sort.[CO4] **Hashing:** Hash Function, Types of Hash Functions, Collision, Collision Resolution Technique(CRT),Perfect Hashing[CO4]	12

TextBooks

1. Brijesh Bakariya. Data Structures and Algorithms Implementation through C,BPB Publications.
2. KruseR.L. Data Structures and Program Designin C;PHI
3. AhoAlfredV.,Hopperoft JohnE.,UIlmanJeffreyD.,"Data Structures and Algorithms", Addison Wesley

Referencebooks

1. Horowitz & Sawhaney: Fundamentals of Data Structures, Galgotia Publishers.
2. Yashwant Kanetkar, Understanding Pointers in C, BPB Publications.
3. Horowitz, S.Sahni, and S.Rajasekaran, Computer Algorithms, Galgotia Pub. Pvt. Ltd.,1998.

Course Code: UGCA1914
Course Name: Programming in Python

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits**:4
Semester:3rd	**Contact hours:**44hours
Theory/Practical: Theory	**Percentage of numerical/design problems**:40%
Internal max. marks:40	**Duration of end semester exam(ESE):** 3hrs
External max. marks:60	**Elective status:** Core
Total marks:100	

Prerequisite:-NA-
Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Explain environment, datatypes ,operators used in Python.
CO2	Compare Python with other programming languages.
CO3	Outline the use of control structures and numerous native data types with their methods.
CO4	Design user defined functions, modules, files, and packages and exception handling methods.
CO5	Write solutions for Object Oriented Programming Concepts.

Detailed Contents	Contact hours

Unit-I **Introduction to Python Programming Language:** Programming Language, History and Origin of Python Language, Features of Python, Limitations, Major Applications of Python, Getting, Installing Python, Setting up Path and Environment Variables, Running Python, First Python Program, Python Interactive Help Feature, Python differences from other languages. [CO1][CO2] **Python DataTypes & Input/Output:** Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Importcommand.[CO1] **Operators and Expressions:** Operators in Python, Expressions, Precedence, Associativity of Operators, Non Associative Operators.[CO1]	12
Unit-II **Control Structures:** Decision making statements ,Python loops, Python control statements. **Python Native Data Types:** Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary, Strings(in detail with their methods and operations).[CO3]	10
Unit-III **Python Functions:** Functions, Advantages of Functions, Built-inFunctions, User defined functions, Anonymous functions, Pass by value Vs. Pass by Reference, Recursion, Scope and Lifetime of Variables.[CO3] **Python Modules:** Module definition, Need of modules, Creating amodule, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages.[CO3]	12
Unit-IV **Exception Handling:** Exceptions, Built- in exceptions, Exception handling, User defined exceptions in Python.	10

File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python.[CO4] **Classes and Objects:** The concept of OOPS in Python, Designing classes, Creating objects, Accessing attributes, Editing class attributes, Built- in class attributes, Garbage collection, Destroying objects.[CO5]	

TextBooks:

1. Programming in Python, Pooja Sharma, BPB Publications,2017.
2. Core Python Programming, R. Nageswara Rao, 2nd Edition, Dreamtech.

Reference Books:

1. Python, The complete Reference, Martin C. Brown, McGraw Hill Education.
2. Pythonina Nutshell,A. Martelli,A.Ravenscroft, S.Holden, OREILLY.

Course Code: UGCA1926
Course Name: Operating Systems Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**:2
Semester:3rd	**Contacthours**:4hoursperweek
Theory/Practical: Practical	**Percentage of numerical/design problems:** 100
Internal max. marks: 60	**Duration of end semester exam(ESE):** 3hrs
External max. marks:40	**Elective status:** Core
Totalmarks:100	

Prerequisite:-NA-
Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: After going through the practical, student will be able to:

CO#	Course outcomes
CO1	Implement the installation and configuration of different operating systems.
CO2	Write programs for different scheduling algorithms.
CO3	Execute various commands in Vi editor
CO4	Implement the dual boot installation
CO5	Execute commands in shell programming

Instructions:

1	Installation of windows OS.
2	Installation of Linux OS.
3	Dual boot installation of Operating systems.
4	Implementation of FCFS Scheduling algorithm
5	Implementation of SJF Scheduling algorithm
6	Implementation of Round-Robin Scheduling algorithm
7	Vi Editor &its commands
8	Shell Commands
9	Shell Scripting-Using variables
10	Shell Scripting- Input & Output
11	Shell Scripting-Datatypes
12	Shell Scripting-Use of arithmetic operators
13	Shell Scripting-if control statement programs
14	Shell Scripting- while control statement
15	Shell Scripting- for control statement

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Reference Books:

1. Linux: The complete reference by Richard Petersen, Published by Tata McGraw-Hill Publication.
2. Operating System Principles by Abraham Silberschatz and Peter Baer Galvin, Seventh Edition, Published by Wiley-India.

Course Code: UGCA1917
Course Name: Programming in Python Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**:2
Semester:3rd	**Contacthours**:4hoursperweek
Theory/Practical: Practical	**Percentage of numerical/design problems**:90%
Internal max. marks:60	**Duration of end semester exam(ESE)**:3hrs
External max. marks:40	**Elective Status :**Core
Totalmarks:100	

Prerequisite:-NA-Corequisite:-NA-

Additional material required in ESE:-Maintain practical notebook as per the instructions given by the instructor.

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Outline various programming constructs like data types and control structures of Python.
CO2	Implement different data structures.
CO3	Implement modules and functions.
CO4	Illustrate concept of object oriented programming.
CO5	Implement file handling.

List of assignments:

1.	Compute sum,subtraction,multiplication,division and exponent of given variables input by the user.
2.	Compute area of following shapes: circle,rectangle,triangle,square,trapezoid and parallelogram.
3.	Compute volume of following 3 D shapes: cube, cylinder, cone and sphere.
4.	Compute and print roots of quadratice quationax^2+bx+c=0, where the values of a, b, and c are input by the user.
5.	Print numbers up to N which are not divisible by3, 6, 9,, e.g., 1, 2, 4, 5, 7,….
6.	Write a program to determine whether a triangle is isosceles or not?
7.	Print multiplication table of a number input by the user.

8.	Compute sum of natural numbers from one to n number.
9.	Print Fibonacci series upton numbers e.g. 0 11235813…..n
10.	Compute factorial of a given number.
11.	Count occurrence of a digit 5in a given integer number input by the user.
12.	Print Geometric and Harmonic means of a series input by the user.
13.	Evaluate the following expressions: a. $x-x^2/2!+x^3/3!-x^4/4!+…x^n/n!$ b. $x-x^3/3!+x^5/5!-x^7/7!+… x^n/n!$
14.	Print all possible combinations of 4 ,5, and 6.
15.	Determine prime numbers within a specific range.
16.	Count number of persons of age above 60 and below 90.
17.	Compute transpose of a matrix.
18.	Perform following operations on two matrices. 1)Addition2)Subtraction 3)Multiplication
19.	Count occurrence of vowels.
20.	Count total number of vowels in a word.
21.	Determine whether a string is palindrome or not.
22.	Perform following operations on a list of numbers: 1)Insert an element2)delete an element3)sortthelist4)delete entire list
23.	Display word after Sorting in alphabetical order.
24.	Perform sequential search on a list of given numbers.
25.	Perform sequential search on ordered list of given numbers.
26.	MaintainpracticalnotebookaspertheirserialnumbersinlibraryusingPython dictionary.
27.	Perform following operations on dictionary 1)Insert2)delete3)change
28.	Check whether a number is in a given range using functions.
29.	Write a Python function that accepts a string and calculates number of uppercase Letters and lower case letters available in that string.
30.	To find the Max of three numbers using functions.
31.	Multiply all the numbers in a list using functions.
32.	Solve the Fibonacci sequence using recursion.
33.	Get the factorial of anon-negative integer using recursion.
34.	Write a program to create a module of factorial in Python.
35.	Design a Python class named *Rectangle,* constructed by a length & width, also design A method which will compute the area of a rectangle.
36.	DesignaPythonclassnamed*Circle*constructedbyaradiusandtwomethodswhich Will compute the area and the perimeter of a circle.
37.	Design a Python class to reverse a string 'word by word'.
38.	Write a Python program to read an entire *textfile*.
39.	Design a Python program to read first n lines of a *text file*.
40.	Construct a Python program to write and append text to a file and display the text.

Text Books:

1. Programming in Python, Pooja Sharma, BPB Publications,2017.
2. Core Python Programming, R. Nageswara Rao, 2nd Edition, Dreamtech.

Reference Books:
1. Python, The complete Reference, Martin C. Brown, McGraw Hill Education.
2. Python in a Nutshell, A. Martelli, A. Ravenscroft, S. Holden, OREILLY.

Course Code: UGCA1918
Course Name: Data Structures Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits**:2
Semester:3rd	**Contacthours:**4hoursperweek
Theory/Practical: Practical	**Percentage of numerical/design problems:**--
Internal max. marks: 60	**Duration of end semester exam(ESE):** 3hrs
External max. marks:40	**Elective status:** Core
Total marks:100	

Prerequisite:-NA-Corequisite:-NA-
Additional material required in ESE: - NA-

Course Outcomes: Student will be able to

CO#	Course outcomes
CO1	Implement Dynamic memory allocation.
CO2	Create different data structures in C/C++
CO3	Implement various operations of all data structures
CO4	Illustrate the outcome of various operations with the help of examples.
CO5	Write programs to implement various types of searching and sorting algorithms

Instructions: Programs may be developed in C/C++/Python/Java language.
List of assignments:

1	Program for using Dynamic Functions (malloc(), calloc(), realloc()andfree())functions.
2	Program to insert, delete and traverse an element from an array
3	Program to merge one dimensional arrays
4	Program for addition and subtraction of two matrices.
5	Program for implementing multiplication of two matrices
6	Implement linear search using one and two dimensional array.
7	Program for implementing selection sort.

8	Program for implementing insertion sort.
9	Program for implementing quick sort.
10	Program for implementing merge sort.
11	Program to calculate length of the string using user defined function.
12	Program to concatenate and compare two strings using user defined function.
13	Program for using the concept of pointer to string.
14	Program to reverse a sentence by recursion.
15	Program to delete all repeated words in string.
16	Program to find the number of vowels, consonants, digits and whitespace in a string.
17	Program to find the length of the longest repeating sequence in a string.
18	Program to find highest and lowest frequency character in a string.
19	Program for implementing Stack using array.
20	Program for implementing Stack using pointer.
21	Program for implementing multiple stack.
22	Program for converting infix to postfix form.
23	Program for implementing Queue using array.
24	Program for dynamic implementation of queue.
25	Program for implementing circular queue.
26	Program for implementing dequeue.
27	Program for implementing priority queue.
28	Program for implementing Singly Linked list.
29	Program for implementing Doubly Linked list.
30	Program for implementing Binary Search Tree.
31	Program for Breadth First Search(BFS) for graph traversal.
32	Program for Depth First Search(DFS) for graph traversal.

Reference Books:

1. Brijesh Bakariya. Data Structures and Algorithms Implementation through C, BPB Publications.

2. Aho Alfred V., Hopperoft John E.,UIlman Jeffrey D.,"Data Structures and Algorithms",
Addison Wesley

3. Horowitz & Sawhaney: Fundamentals of Data Structures, Galgotia Publishers.

Course Code: UGCA1937

Course Name: Data Warehouse and Mining Laboratory

Program: B.Sc. Data Analytics	**L:** 0 **T**: 0 **P**:2
Branch: Computer Applications	**Credits:**1
Semester:3rd	**Contact hours:**4 hours per week

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Theory/Practical: Practical	**Percentage of numerical/design problems:**90
Internal max. marks:60	**Duration of end semester exam (ESE):** 3hrs
External max. marks:40	**Elective status:** Elective
Total marks: 100	

Prerequisite: Basic understanding of database concepts.

Corequisite:-NA-

Additional material required in ESE: -

NA-

Course Outcomes: After going through this laboratory, student will be able to:

CO#	Course outcomes
CO1	Apply different data mining tools used to analyze data.
CO2	Apply and Evaluate different data mining algorithms to analyze data.
CO3	Understand effective visualization for representing data.

Instructions:

1	Introduction to WEK/ R tool.
2	Installation of Weka/R Tool.
3	Introduction to various components of WEKA/R tool.
4	Fundamental programming using WEKA/R tool.
5	Implementing data preprocessing.
6	Implementing a priori algorithm.
7	Implementing classification using decision tree.
8	Implementing classification using decision tree induction.
9	Implementation k-mean clustering
10	Implementing different Data visualization tools.

- Number of practical's can be more than 10 by implementing these algorithmson different data sets. Also, visualization tools can be used simultaneously to represent the outcomes in a better way

Reference Books:

1. Data Mining: Practical Machine Learning Tools and Techniques, 3rd edition by Ian H. Witten, Eibe Frank, Mark A. Hall Published by Morgan Kaufmann.
2. Data analytics using R, 1st edition by Seema Acharya Published by Tata Mcgraw Hill.

EBooks/Online learning material

Students can refer to youtube channel: Data Mining with Weka (WekaMOOC) byUniversity of WAIKATO for reference using the following link:https://www.youtube.com/user/WekaMOOC

Fourth Semester

Course Code: UGCA1947
Course Name: Digital Marketing

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits**:4
Semester:4th	**Contacthours:**44hours
Theory/Practical: Theory	**Percentage of numerical/design problems**:--
Internal max. marks:40	**Duration of end semester exam(ESE):** 3hrs
External max. marks:60	**Elective status:** Core
Totalmarks:100	

Prerequisite:-NA-Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Learn how to use new media such as mobile, search and social networking.
CO2	Understand how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy.
CO3	Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media.
CO4	Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan

Detailed Contents	Contact hours

Unit-I **Introduction to Digital Marketing** Difference between Traditional Marketing and Digital Marketing, Benefits of using Digital Media, Inbound and Outbound Marketing, Online marketing POEM: (Paid, Owned, and Earned Media), Components of Online Marketing (Email, Forum, Social network, Banner, Blog), Impact of Online Marketing, Basics of Affiliate Marketing, Viral Marketing, Influencer Marketing, Referral Marketing. [co1] **Email Marketing:** Email newsletters, Digests, Dedicated Emails, Lead Nurturing, Sponsorship Emails and Transactional Emails, Drawbacks of Email Marketing [co1] **Social Media Marketing (SMM):** Different types of Social Media Marketing like Facebook, LinkedIn, Twitter, Video, Instagram etc. [co1]	11
Unit –II **Search Engine Optimisation (SEO)** About SEO, Need of an SEO friendly website, Importance of Internet and Search Engines; Role of Keywords in SEO. [co2] **On-Page Optimization (Onsite):** Basics of Website Designing / Development; HTML Basics for SEO; Onsite Optimization Basics; Website Structure and Navigation Menu Optimization; SEO Content Writing. Keywords Research and Analysis (eg. SWOT analysis of website, finding appropriate keywords). [co2] **Off Page Optimization:** Introduction; Local marketing of websites depending on locations; Promoting Subsequent pages of the website. Introduction to organic SEO vs non-organic SEO; Social Media Optimization Techniques and Page Rank Technology. [co2]	11

Unit-III **Website Planning & Creation** **Content Marketing Strategy**: Goals and concepts, Strategic building blocks, Content creation & channel distribution, Tools of the trade, Advantages and challenges. **Keywords Research and Analysis:** Introduction to Keyword Research; Business Analysis; Types of Keywords; Keywords Analysis Tools. **Web Presence:** How to increase online presence and drive more traffic for a website, Search result visibility in search engines for chosen keyword and phrases, Using e-mail marketing to drive traffic for a website, Posting social media content for lead generation, Tools to create and manage content, Use of Blogging as content strategy. **Creating content:** Writing and posting content on the web and in social networks, blog and video; Create, manage and implement a content marketing strategy; Monitoring and recording results to improve content marketing campaigns; Successful content marketing strategies and case studies. [co3]	12
Unit-IV **Online Advertising, Mobile Marketing and Web analytics** Introduction to Online Advertising and its advantages, Paid versus Organic, Pay Per Click (PPC) Model. Basic concepts Cost per Click (CPC), CPM, CTR, CR etc. About Mobile Marketing, Objectives of Mobile Advertising, Creating a Mobile Marketing Strategy, Introduction to SMS Marketing. About Web Analytics, Types of Web Analytics (On-site, Off-site), Importance of Web Analytics. [co3, co4]	10

Text Books:
1. Puneet Singh Bhatia, Fundamentals of Digital Marketing First Edition, Publication Pearson.
2. Vandana Ahuja, Digital Marketing 1st Edition, Publication Oxford
3. Shivani Karwal, "Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing", CreateSpace Independent Publishing Platform, 1st edition.

Reference Books:
1. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.
2. Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, Publication Wiley India Pvt Ltd.
3. Venakataramana Rolla, "Digital Marketing Practice guide for SMB: SEO, SEM and SMM", CreateSpace Independent Publishing Platform, First edition.
4. Enge, E., Spencer, S., Stricchiola, J., & Fishkin, R. (2012). The art of SEO. " O'Reilly Media, Inc.".

E Books/ Online learning material:

1. www.sakshat.ac.in
2. https://swayam.gov.in
3. https://www.edx.org/course/online-marketing-strategies-curtinx- mkt5x
4. https://www.emarketinginstitute. org/free-courses/ eMarketing Institute

Course Code: UGCA1953

Course Name: Digital Marketing Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits:**1
Semester:4th	**Contacthours:**4hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:**--
Internalmax.marks:60	**Duration of end semester exam (ESE):** 3hrs
Externalmax.marks:40	**Elective status:** core
Total marks: 100	

Prerequisite:-NA-Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Familiarizing with the key elements of a digital marketing strategy.
CO2	The students will be able to perform practical skills in common digital marketing tools such as SEO, Social media and Blogs.
CO3	Learn to manage the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media
CO4	Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan

Instructions:

The instructor needs to give an overview of digital marketing with case studies	
1.	Explore Facebook, LinkedIn, Twitter, Video, Instagram, blog etc
2.	Explore Online Display Advertising, Ecommerce Marketing, Mobile Web and Content marketing.
3.	Explore Email Marketing; Google AdWords and Google Analytics
The instructor needs to discuss a case study using Search Engine Optimisation (SEO). Case Study – I : Student will plan and create a webpage will display Web presence	
4.	How to increase online presence and drive more traffic for a website.
5.	Search result visibility in Google for chosen keyword and phrases.
6.	Using e-mail marketing to drive traffic for a website.
7.	Posting social media content for lead generation.
8.	Tools to create and manage content.

9.	Use of Blogging as content strategy
Case Study – II : Student will plan and create a commercial website	
10.	Show results for Search Engine Algorithms & Page Rank Technology
11.	How to promote home page, SWOT Analysis of Website & finding right appropriate keywords.
12.	Monitoring and recording results to improve content marketing campaigns
13.	Writing and posting content on the web and in social networks.

Text Books:

1. Puneet Singh Bhatia, Fundamentals of Digital Marketing First Edition, Publication Pearson.
2. Vandana Ahuja, Digital Marketing 1st Edition, Publication Oxford
3. Shivani Karwal, "Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing", CreateSpace Independent Publishing Platform, 1st edition.

Reference Books:

1. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.
2. Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, Publication Wiley India Pvt Ltd.
3. Venakataramana Rolla, "Digital Marketing Practice guide for SMB: SEO, SEM and SMM", CreateSpace Independent Publishing Platform, First edition.
4. Enge, E., Spencer, S., Stricchiola, J., & Fishkin, R. (2012). The art of SEO. " O'Reilly Media, Inc.".

Course Code: UGCA1946
Course Name: R Programming

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:0
Branch: Computer Applications	**Credits**:4
Semester:4th	**Contacthours:**44hours
Theory/Practical: Theory	**Percentage of numerical/design problems**:--
Internal max. marks:40	**Duration of end semester exam(ESE):** 3hrs
External max. marks:60	**Elective status:** Core
Totalmarks:100	

Prerequisite:- Logics of basic programming terminologies.
Additional material required in ESE: -NA-

Course Outcomes: Simulation study

CO#	Course Outcomes
CO1	Identify the key components of R programming Language.
CO2	Define the concept of data Science.
CO3	Differentiate between vectors and arrays.
CO4	Outline the usage of data frames, lists, factors, tables and R structures.

CO5	Explain the need and utilization of various visualization tools.

Detailed Contents	Contact hours
Unit-I R Programming Fundamentals: Introduction to R, Installing R, Windows/Linux/Mac Installation, Setting up Path, Using Packages, and Running R: Interactive Mode, Batch Mode, Getting Help, Startup and Shut Down.[CO1] **Vectors:** Scalars, Vectors, Arrays and Matrices, Declarations, Recycling, Common Vector Operations, Using all() and any(), Na and Null Values, Filtering, ifelse() Function.[CO3] **Matrices and Arrays:** Creating Matrices, General Matrix Operations, Applying Functions to Matrix Rows and Columns, Adding & Deleting Matrix Rows and Columns, Difference Between Matrix and Vector.[CO3]	11
Unit-II Lists: Creating Lists, General List Operations, Accessing List Components and Values, Applying Functions to Lists, Recursive Lists. Data Frames: Creating Data Frames, Merging Data Frames, Applying Functions to Data Frames. [CO4] **Factors and Tables:** Introduction, Common Functions use with Factors, Working with Tables.[CO4] **R Programming Structures:** Control Statements, Arithmetic and Boolean Operators, Default Values for Arguments, Return Values, Recursion.[CO4]	11
Unit-III **Object Oriented Programming:** Concept of Classes, S3 Classes, S4 Classes, S3 Versus S4 Classes, Managing Objects.[CO1] **Input/Output:** Accessing Keyboard and Monitor, Reading and Writing Files, Accessing the Internet. **String Manipulation**: Overview of String Manipulation Functions grep(), nchar(), paste(), sprintf(), substr(), strsplit(), regexpr(), gregexpr(), Regular expression].[CO5]	12
Unit-IV **Graphics:** Creating Graphs, Customizing Graphs, Saving Graphs to Files, Creating 3D Plots. **Debugging:** Principles of Debugging, Use of Debugging Tool, Using R Programming Debugging Facilities. [CO3] **Simulation:** Generating Random Numbers, Setting the Random Number Seed, Simulating a Linear Model, Random Sampling.[CO5]	10

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

Text Books: 1. The ART of R Programming, Norman Matloff, No Starch Press.
2. R Programming for Data Science, Roger D. Peng, Lean Publishing.
3. R Programming for Beginners, S. Rakshit, TMH.

Reference Books:
1. Data Analytics using R, Seema Acharya, TMH.

Course Code: UGCA1952

Course Name: R Programming Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits:**2
Semester:4th	**Contacthours:**4hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:**--
Internalmax.marks:60	**Duration of end semester exam (ESE):** 3hrs
Externalmax.marks:40	**Elective status:** core
Total marks: 100	

Prerequisite:- Logics of basic programming terminologies.
Co requisite :- Simulation Study.
Additional material required in ESE: -Record the Simulation Results on Practical File.

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Write programs for arrays and matrices.
CO2	Execute data frames and lists.
CO3	Differentiate between arrays from vectors.
CO4	Implement factors in R
CO5	Execute minor projects using R.

Instructions: All programs are to be developed in R Programming Language.

1.	Design a program to take input from the user (name and age) and display the values through R Programming.
2.	Write a program to get the details of the objects in memory using R Programming.
3.	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 using R Programming.
4.	Create a vector which contains 10 random integer values between -50 and +50 using R Programming.
5.	Write a R program to get the first 10 Fibonacci numbers.
6.	Show all prime numbers up to a given number using R programming.
7.	Design a R program to find the factors of a given number

8.	Write a R program to find the maximum and the minimum value of a given vector
9.	Write a R program to create a data frame from four given vectors.
10.	Write a program to get the structure of a given data frame.
11.	Write a R program to extract specific column from a data frame using column name.
12.	Write a R program to create a matrix taking a given vector of numbers as input. Display the matrix.

Text Books:

1. The ART of R Programming, Norman Matloff, No Starch Press.
2. R Programming for Data Science, Roger D. Peng, Lean Publishing.
3. R Programming for Beginners, S. Rakshit, TMH.

Reference Books:

1. Data Analytics using R, Seema Acharya, TMH

Course Code: UGCA2004
Course Name: Data Visualization

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:
Branch: Computer Applications	**Credits:**4
Semester:4th	**Contacthours:**4hours per week
Theory/Practical: Theory	**Percentage of numerical/design problems:**--
Internalmax.marks:40	**Duration of end semester exam (ESE):** 3hrs
Externalmax.marks:60	**Elective status:** core
Total marks: 100	

Prerequisite:-NA-Corequisite:-NA-
Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Familiarize students with the basic and advanced techniques of information visualization and scientific visualization
CO2	To learn key techniques of the visualization process
CO3	A detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques

Unit 1 Introduction of visual perception, visual representation of data, Gestalt principles, information overloads. Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications. **[co1]**	

Unit 2 Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents. **[co2]**	
Unit 3 Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations. **[co2]**	
Unit 4 Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization. **TOOLS: Programming Statistical Data Visualization, Google Map API, Google Chart, Tableau - Heat Map Generation [co3]**	

Suggested Books.

1. Jon Raasch, Graham Murray, Vadim Ogievetsky, Joseph Lowery, "JavaScript and jQuery for Data Analysis and Visualization", WROX
2. Ritchie S. King, Visual story telling with D3" Pearson
3. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
4. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Relly
5. Andy Kirk, Data Visualization: A Successful Design Process, PAKT
6. Scott Murray, Interactive Data Visualization for Web, O'Relly
7. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

Course Code: UGCA2005

Course Name: Data Visualization Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**:4
Branch: Computer Applications	**Credits:**2
Semester:4th	**Contacthours:**4hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:**--
Internalmax.marks:60	**Duration of end semester exam (ESE):** 3hrs
Externalmax.marks:40	**Elective status:** core
Total marks: 100	

Prerequisite:- Logics of basic programming terminologies.
Co requisite :- Simulation Study.
Additional material required in ESE: -Record the Simulation Results on Practical File.

Course Outcomes: Students will be able to:

CO#	Course Outcomes

CO1	Design effective data visualizations to communicate information to the viewer.
CO2	Identify appropriate data that can be used in order to create a visualization.
CO3	Organize data and visualizations in order to prepare them for reuse.

Instructions: All programs are to be developed in R Programming Language.

1. Loading and Distinguishing Dependent and Independent parameters

2. Exploring Data Visualization tools

3. Drawing Charts

4. Drawing Graphs

5. Data mapping

6. Creating Scatter Plot maps

7. Using BNF Notations

8. Working with REGEX

9. Visualize Network Data

10. Understanding Data Visualization frameworks

11. Design applications to implement **Google Map API, Google Chart, Tableau - Heat Map Generation**

Reference Book:
1. E. Tufte, The Visual Display of Quantitative Information, Graphics Press. 2nd Edition, 2001
2. Alexandru C Telea, Data Visualization: Principles And Practice, 2nd Edition, 2014
3. Wang Kaining, Infographic & Data Visualizations, sew Edition. 2013
4. Andy Krik, Data Visualisation : A Handbook for Data Driven Design, 1st Edition, 2016

Course Code: UGCA2006
Course Name: Big Data Analytics

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**:
Branch: Computer Applications	**Credits:**4
Semester:4th	**Contacthours:**4hours per week
Theory/Practical: Theory	**Percentage of numerical/design problems:**--
Internalmax.marks:40	**Duration of end semester exam (ESE):** 3hrs
Externalmax.marks:60	**Elective status:** core
Total marks: 100	

Prerequisite:-NA-Corequisite:-NA-

Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course Outcomes
CO1	Explain the need of Big Data.
CO2	Discuss the architecture of Big Data
CO3	Setup environment for creating Big Data Applications
CO4	Implement basic applications of Big Data.

Unit 1 An Overview of Big Data and Big Data Analytics, Big Data sources, Application areas of Big Data. Understanding Hadoop and its Ecosystem. Brief intro to Hadoop Ecosystem components: Hadoop Distributed File System, MapReduce, YARN, HBase, Hive, Pig, Sqoop, ZooKeeper, Flume, Oozie, Ambari. Understanding a Hadoop cluster. [co1]	11
Unit 2 Overview of HDFS. Architecture of HDFS, Advantages and disadvantages of HDFS, HDFS Daemons, HDFS Blocks, HDFS file write and read, NameNode as SPOF, Hadoop HA, heartbeats, block reports and rereplication, Safemode of Namenode, Hadoop fs commands: cat, ls, put, get, rm, df, count, fsck, balancer, mkdir, du, copyfromlocal, copytolocal. [co2]	11
Unit 3 Hadoop fs commands: expunge, chmod, chown, chgrp, setrep, stat. Hadoop dfsadmin commands. Introduction to Apache Pig, Need of Pig, Installation of Pig, Execution modes of Pig, Pig – Architecture, Grunt shell and basic utility commands, Data types and Operators in Pig, Analysing data stored in HDFS using Pig, Pig operators for Data analysis: Dump, Describe, Explanation, Illustration, Store. [co2, co3]	10
Unit 4 Group, cogroup, join, split, filter, distinct, foreach, order by, limit operators. Functions in Pig: Eval functions, Load and store functions, Bag and tuple functions, String functions, Date time functions, Math functions, Case Studies: Analyzing various datasets with Pig. [co3, co4]	10

Suggested Books.

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

1. Big Data, Black Book by DT Editorial Services, Dreamtech Press.
2. Hadoop – The Definitive Guide 3rd Edition, Tom White/ OReilly-Yahoo press
3. Hadoop in Action, Chuck Lam/Manning
4. Hadoop – Beginner's Guide, Garry Turkington/Packt Publishing

Fifth Semester

I. K. Gujral Punjab Technical University Bachelor of Science in Data Analytic (B Sc. Data Analytics)

Course Code: UGCA1927
Course Name: Web Designing

Program: B.Sc. Data Analytics	**L**: 3 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 3
Semester: 5th	**Contact hours:** 33 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 80%
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Skill Enhancement
Total marks: 100	

Prerequisite: Student must have the basic knowledge of any text editor like notepad, notepad++ and Edit plus etc.
Co requisite: Student must know the background of Markup Language.
Additional material required in ESE:
➢ Demonstration of the website of college/ specific department/specific cells etc. will be presented by the students during the final practical.
➢ Developed Website/s must be made online by the student/s.
➢ Printouts of the Main Page of the website must be arranged on Practical file during daily lab work and must be submitted in the final examinations.

Course Outcomes: The students will be able to:

CO#	Course Outcomes
CO1	Create pages with simple tags in HTML
CO2	Design webpages with multiple sections or frames
CO3	Explain how to link webpages through hypertext or images a links
CO4	Outline the key web designing concepts using java script
CO5	Design forms with special controls using HTML

Detailed Contents	Contact hours
Unit-I **Internet Basics** Basic concepts, communicating on the internet, internet domains, internet server identities, establishing connectivity on the internet client IP address. **Introduction To HTML** Information Files Creation, Web Server, Web Client/Browser, Hyper Text Markup Language (HTML Tags, Paired Tags, Singular Tags), Commonly Used Html Commands (Document Head, Document Body), Title and Footer, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page (Heading Styles, Drawing Lines). Basic Formatting Tags HTML Basic Tags, Text Formatting (Paragraph Breaks, Line Breaks), Emphasizing Material in a Web Page (Heading Styles, Drawing Lines), Text Styles (Bold, Italics, Underline), Other Text Effects (Centering (Text, Images etc.), Spacing (Indenting Text), HTML Color Coding. [CO1]	8

Unit-II **Lists** Type of Lists (Unordered List (Bullets), Ordered Lists (Numbering), Definition Lists. **Adding Graphics To Html Documents** Using The Border Attribute, Using The Width And Height Attribute, Using The Align Attribute, Using The Alt Attribute. [CO2] **Tables** Introduction (Header, Data rows, The Caption Tag), Using the Width and Border Attribute, Using the Cell padding Attribute, Using the Cell spacing Attribute, Using the BGCOLOR Attribute, Using the COLSPAN and ROWSPAN Attributes [CO2] **Linking Documents** Links (External Document References, Internal Document References), Image As Hyperlinks. [CO3] **Frames** Introduction to Frames: The<FRAMESET> tag, The <FRAME> tag, Targeting Named Frames. DHTML: Cascading Style Sheets, Style Tag. [CO2]	9
Unit-III **Forms Used by a Web Site** The Form Object, The Form Object's Methods (The Text Element, The Password Element, The Button Element, The Submit (Button) Element, The Reset (Button) Element, The Checkbox Element, The Radio Element, The Text Area Element, The Select and Option Element, The Multi Choice Select Lists Element). [CO4]	8
Unit 4 **Introduction to JavaScript** JS Introduction, Where To, Output, Statements, Syntax, Comments, Variables, Operators, Arithmetic, Assignment, Data Types, Functions, Objects, Events, Strings, String Methods, Numbers, Number Methods, Arrays, Array Methods, Array Sort, Array Iteration, Dates, Date Formats, Date Get Methods, Date Set Methods, Math, Random, Booleans, Comparisons, Conditions, Switch, Loop For, Loop While, Break, Type Conversion, Bitwise, RegExp, Errors, Scope, Hoisting, Strict Mode, JSON, Forms, Forms API [CO5] JS Functions, Function Definitions, Function Parameters, Function Invocation, Function Call, Function Apply, Function Closures [CO5]	8

Text Books/Reference Books:
1. Internet for EveryOne: Alexis Leon, 1st Edition, Leon Techworld, Publication, 2009.
2. Greenlaw R; Heppe, "Fundamentals of Internet and WWW", 2nd Edition, Tata McGraw-Hill, 2007.
3. Raj Kamal, "Internet& Web Technologies", edition Tata McGraw-Hill Education.2009.

E-Books/ Online learning material:

1. BayrossIvan, "HTML, DHTML, JavaScript, PERL, CGI", 3rd Edition, BPB Publication,2009.
2. Chris Payne, "Asp in 21 Days", 2nd Edition, Sams Publishing, 2003 PDCA.
3. A Beginner's Guide To Html Http://www.Ncsa.Nine.Edit/General/Internet/w ww/Html.Prmter
4. https://www.tutorialspoint.com/html/html_tutorial.pdf
5. https://www.w3schools.com/js/
6. https://www.w3schools.com/html/
7. https://www.cs.uct.ac.za/mit_notes/web_programming.html
8. http://www.pagetutor.com/table_tutor/index.html

Course Code: UGCA1928
Course Name: Web Designing Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 2
Branch: Computer Applications	**Credits**: 1
Semester: 5th	**Contact hours:** 2 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** 80%
Internal max. marks: 30	**Duration of End Semester Exam (ESE):** 3hrs
External max. marks: 20	**Elective status:** Skill Enhancement
Total marks: 50	

Prerequisite: Students must have the knowledge of editors like Notepad etc.
Co requisite: Knowledge of Networking, Internet, Client Server concepts, Static & Dynamic environment of the websites etc.
Additional material required in ESE:
 ➤ Demonstration of the website of college/ specific department/specific cells etc. will be presented by the students during the final practical.
 ➤ Developed Website/s must be made online by the student/s.
 ➤ Printouts of the Main Page of the website must be arranged on Practical file during daily lab work and must be submitted in the final examinations.

Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Design pages with simple tags in HTML
CO2	Create web pages with Auido and Video content in it.
CO3	Illustrate the movement from one web page to another
CO4	Implement advanced web designing concepts using java script
CO5	Execute a small web pased project for the benefit of scoiety

Instructions: Instructor can increase/decrease the experiments as per the requirement.

1.	Create a simple HTML page to demonstrate the use of different tags.
2.	Design index page of a book on web designing.
3.	Display Letter Head of your college on a web page.
4.	Create a Hyperlink to move around within a single page rather than to load

	another page.
5.	Display letter using different Text formatting Tags.
6.	Design Time Table of your department and highlights of most important periods.
7.	Use Tables to provide layout to your web page.
8.	Embed Audio and Video into your web page.
9.	Divide a web page vertically and horizontally and display logo of your college in left pane and logo of university in right pane.
10.	Create a student Bio- Data.
11.	Design front page of hospital with different style sheets.
12.	Design a web page and display two different pages at a time.
13.	Write a program to create a login form. On submitting the form, the user should get navigated to a profile page using JavaScript.
14.	Write a code to create a Registration Form. On submitting the form, the user should be asked to login with the new credentials using JavaScript.
15.	Write an HTML code to create your Institute website/Department website/ Tutorial website for specific subject. Also use Java Script for validation.

Reference Books:
1. Greenlaw R; Hepp E, "Fundamentals of Internet and www", 2nd Edition, Tata. McGraw-Hill, 2007.
2. A Beginner's Guide to HTML
        http://www.Ncsa.Nine.Edit/General/Internet/www/
    a. html.prmter.

Online Experiment material:
1. https://www.w3schools.com/html/html_examples.asp
2. https://www.cs.uct.ac.za/mit_notes/web_programming.html

Elective –I

Course Code: UGCA2033
Course Name: Business Intelligence

Program: B. Sc Data Analytics	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 5th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 20%
Internal max. marks: 40	**Duration of end semester exam (ESE**): 3hrs
External max. marks: 60	**Elective status:** Elective
Total marks: 100	

Prerequisite:
Co requisite: -NA-

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Additional material required in ESE: -NA-

Course Outcomes: After completing this course, students will be able to:

CO#	Course outcomes
CO1	Understand the fundamentals of business intelligence and link data mining with business intelligence
CO2	Apply various modeling techniques and business intelligence methods to various situations using data mining principles and techniques
CO3	Implement data analysis techniques to make better business decisions and demonstrate the impact of business reporting, information visualization, and dashboards

Detailed contents	Contact hours
Unit-I **DECISION SUPPORT SYSTEMS AND BUSINESS INTELLIGENCE** The Concept of Decision Support Systems – A Framework for Business Intelligence - Effective and timely decisions – A Work System View of Decision Support – The Major Tools and Techniques of Managerial Decision Support - Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system	10
Unit-II **BASICS OF DATA INTEGRATION ETL** Concepts of data integration - need and advantages of using data integration - introduction to common data integration approaches - introduction to ETL - introduction to data quality, data profiling concepts and applications. Introduction to data and dimension modeling - multidimensional data model - ER Modeling vs. multi-dimensional modeling - concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema.	10
Unit-III **Business intelligence applications & Classification:** Marketing models: Relational marketing, Sales force management, Logistic and production models: Supply chain optimization, Optimization models for logistics planning, Revenue management systems. Data envelopment analysis: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices. Classification: Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression, Neural networks, Support vector machines.	12
Unit-IV **KNOWLEDGE MANAGEMENT AND KNOWLEDGE DELIVERY**	12

| Introduction to Knowledge Management – Knowledge Management Activities – Approaches to Knowledge Management - Information Technology(IT) in Knowledge Management - The business intelligence user types - Standard reports - Interactive Analysis and Ad Hoc Querying - Parameterized Reports and Self-Service Reporting - Dimensional analysis - Alerts/Notifications - Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards - Geographic Visualization - Integrated Analytics - Considerations: Optimizing the Presentation for the Right Message | |

Text Books:

[1] Efraim Turban, Ramesh Sharda, Dursun Delen, Decision Support and Business Intelligence Systems, 9th Edition, Pearson 2013.
[2] Cindi Howson, Successful Business Intelligence, Unlock the Value of BI & Big Data Hardcover –Second Edition: Import, Nov 2013.
[3] Gert H.N. Laursen, JesperThorlund, Business Analytics for Managers: Taking Business Intelligence beyond Reporting Paperback, Sep 2013

Course Code: UGCA2034
Course Name: Business Intelligence Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 5th	**Contact hours:** 2 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** 100
Internal max. marks: 30	**Duration of End Semester Exam (ESE):** 3hrs
External max. marks: 20	**Elective status:** Elective
Total marks: 50	

Detailed list of Tasks:

1. To apply all types of data preprocessing.
2. To implement different forms of ETL activities.
3. To implement various types of classifiers.
4. To use any open-source tool to create a small project.

Course Code: UGCA2031
Course Name: Distributed Databases

Program: B.Sc. Data Analytics	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 5th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 20%

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Internal max. marks: 40	Duration of end semester exam (ESE): 3hrs
External max. marks: 60	Elective status: Elective
Total marks: 100	

Prerequisite: Database Management System
Co requisite:
Additional material required in ESE:

Course Outcomes: The students will be able to:

CO#	Course Outcomes
CO1	Design trends in distributed systems.
CO2	Apply network virtualization in distributed environment.
CO3	Apply remote method invocation and objects.

Detailed Contents	Contact hours
Unit-I **INTRODUCTION**: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts **DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE**: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues. [CO1]	10
Unit-II **DISTRIBUTED DATABASE DESIGN**: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation. **SEMANTICS DATA CONTROL**: View management; Data security; Semantic Integrity Control. **QUERY PROCESSING ISSUES**: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data.[CO1]	12
Unit-III **DISTRIBUTED QUERY OPTIMIZATION**: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms. **TRANSACTION MANAGEMENT**: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models. **CONCURRENCY CONTROL**: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management.[CO2]	12
Unit 4 **RELIABILITY**: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols. **PARALLEL DATABASE SYSTEMS**: Parallel architectures; parallel query processing and optimization; load balancing.	10

References/ Books:
1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Course Code: UGCA2032
Course Name: Distributed Databases Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 5th	**Contact hours:** 2 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** 80%
Internal max. marks: 30	**Duration of End Semester Exam (ESE):** 3hrs
External max. marks: 20	**Elective status:** Elective
Total marks: 50	

Detailed list of Tasks:

Programs may be implemented using any open source tool

Expt. 1: Installation and configuration of database packages.
Expt. 2: Creating and managing database objects (Tables, views, indexes etc.)
Expt. 3: Creating and managing database security through user management.
Expt. 4: Creating and maintaining database links.
Expt. 5: Implement Partitioning on the database tables.
Expt. 6: Implement various Transaction concurrency control methods [i.e. lock's] by executing multiple update and queries.
Expt. 7: Performance tuning of SQL queries.
Mini Project: Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Course Code: UGCA1913
Course Name: Computer Networks

Program: B.Sc Data Analytics	**L**: 3 **T**: 1 **P:** 0
Branch: Computer Applications	**Credits:** 4
Semester: 5th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** --
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks:60	**Elective status:** Elective
Total marks:100	

Prerequisite: Information Technology

Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes:

CO#	Course outcomes
CO1	Highlight the characteristics of various protocols.
CO2	Define different network technologies and their application.
CO3	Identify Hardware and software components for designing network.
CO4	Compare the performance of different network media
CO5	Implement various configuration settings

Detailed Contents	Contact hours
Unit-I **Data communications concepts:** Digital and analog transmissions-Modem, parallel and serial transmission, synchronous and asynchronous communication. Modes of communication: Simplex, half duplex, full duplex.[CO1] **Types of Networks:** LAN, MAN, WAN [CO1] **Network Topologies:** Bus, Star, Ring, Mesh, Tree, Hybrid[CO2] **Communication Channels: Wired transmissions:** Telephone lines, leased lines, switch line, coaxial cables-base band, broadband, optical fiber transmission. **[CO2]** **Communication Switching Techniques**: Circuit Switching, Message Switching, Packet Switching.	12
Unit-II **Network Reference Models**: OSI Reference Model, TCP/IP Reference Model, Comparison of OSI and TCP/IP Reference Models. Transmission impairments − Attenuation, Distortion, Noise. Multiplexing − Frequency division, Time division, Wavelength division. **[CO1]** **Data Link Layer Design Issues**: Services provided to the Network Layer, Framing, Error Control (error detection and correction code), Flow Control, Data Link Layer in the Internet (SLIP, PPP)[CO1]	10
Unit-III **MAC sub layer:** CSMA/CD/CA, IEEE standards (IEEE802.3 Ethernet, Gigabit Ethernet, IEEE 802.4 Token Bus, IEEE 802.5 Token Ring) **Network Layer:** Design Issues, Routing Algorithms: Optimality Principle, Shortest Path Routing, Congestion Control Policies, Leaky bucket and token bucket algorithm, Concept of Internetworking. [CO4]	12
Unit-IV	10

Transport Layer: Design issues, Elements of transport protocols – Addressing, Connection establishment and release, Flow control and buffering, Introduction to TCP/UDP protocols. [CO5]

Session, Presentation and Application Layers: Session Layer – Design issues, remote procedure call. Presentation Layer – Design issues, Data compression techniques, Cryptography. Application Layer – Distributed application (client/server, peer to peer, cloud etc.), World Wide Web (WWW), Domain Name System (DNS), E-mail, File Transfer Protocol (FTP), HTTP as an application layer protocol.[CO5]

Text Books:
1. Computer Networks, Tanenbaum, Andrew, Fifth Edition, PHI.
2. Data Communication and Networking, Behrouz A. Forouzan, Fourth Edition.
3. Computer Today, S.K. Basandra, First Edition, Galgotia.

Reference Books:
1. Data Communication System, Black, Ulysse, Third Edition, PHI.
2. Data and Computer Communications, Stalling, Ninth Edition, PHI.
3. James F. Kurose and Keith W. Ross, "Computer Networking", Pearson Education.
4. Douglas E. Comer, "Internetworking with TCP/IP", Volume-I, Prentice Hall, India.

Course Code: UGCA1916
Course Name: Computer Networks Laboratory

Program: B.Sc Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 5th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 40	**Elective status:** Elective
Total marks: 100	

Prerequisite: -NA-
Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes:

CO#	Course outcomes
CO1	Outline the key features of various protocols
CO2	Implement network configuration settings for an operating system
CO3	Prepare different types of cables for networking.
CO4	Design network model using network simulation tool
CO5	Implement various setting on FTP, Proxy and other servers.

List of assignments:

1.	Familiarization with networking components and devices: LAN Adapters, Hubs, Switches, Routers etc
2.	Familiarization with transmission media and tools: Coaxial cable, UTP cable, Crimping tool, Connectors etc
3.	Preparing straight and cross cables
4.	Study of various LAN topologies and their creation using network devices, cables and computers
5.	Configuration of TCP/IP Protocols in Windows and Linux
6.	Implementation of resource sharing (file, printer etc.)
7.	Designing and implementing class A, B and C networks
8.	Subnet planning and its implementation
9.	To configure dynamic IP address for a computer connected to a LAN
10.	Use of commands like ping, ipconfig for trouble shooting network related problems
11.	Develop a program to compute the Hamming Distance between any two code words
12.	Installation of FTP server and client
13.	To configure proxy server
14.	Familiarization with network simulation tools.

Reference Books:
1. Data Communication and Networking, Behrouz A. Forouzan, Fourth Edition.
2. Douglas E. Comer, "Internetworking with TCP/IP", Volume-I, Prentice Hall, India.

Elective-II

Course Code: UGCA2035
Course Name: Web Analytics

Program: B.Sc Data Analytics	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 5th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 60%
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Elective
Total marks: 100	

Prerequisite:
Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes: After completing this course, students will be able to:

CO#	Course outcomes

CO1	Understand the concept and importance of Web analytics in an organization and the role of Web analytic in collecting, analyzing and reporting website traffic.
CO2	Identify key tools and diagnostics associated with Web analytics
CO3	Explore effective Web analytics strategies and implementation and Understand the importance of web analytic.

Detailed contents	Contact hours
Unit-I **INTRODUCTION TO WEB ANALYTICS:** Introduction to Web Analytics: Web Analytics Approach – A Model of Analysis – Context matters – Data Contradiction – Working of Web Analytics: Log file analysis – Page tagging – Metrics and Dimensions – Interacting with data in Google Analytics.	10
Unit-II **LEARNING ABOUT USERS THROUGH WEB ANALYTICS:** Goals: Introduction – Goals and Conversions – Conversion Rate – Goal reports in Google Analytics – Performance Indicators – Analyzing Web Users: Learning about users – Traffic Analysis – Analyzing user content – Click-Path analysis – Segmentation	10
Unit-III **GOOGLE ANALYTICS:** Different analytical tools - Key features and capabilities of Google analytics- How Google analytics works - Implementing Google analytics - Getting up and running with Google analytics -Navigating Google analytics – Using Google analytics reports - Google metrics - Using visitor data to drive website improvement- Focusing on key performance indicators Integrating Google analytics with third-Party applications	12
Unit-IV **OVERVIEW OF QUALITATIVE ANALYSIS:** Lab Usability Testing-Heuristic Evaluations- Site Visits- Surveys (Questionnaires) - Testing and Experimentation: A/B Testing and Multivariate Testing-Competitive Intelligence - Analysis Search Analytics: Performing Internal Site Search Analytics, Search Engine Optimization (SEO) and Pay per Click (PPC)-Website Optimization against KPIs- Content optimization- Funnel/Goal optimization - Text Analytics: Natural Language Processing (NLP)-Supervised Machine Learning (ML) Algorithms-API and Web data scarping using R and Python	12

Text Books:

[1] Beasley M, (2013), Practical web analytics for user experience: How analytics can help you understand your users. Newnes, 1st edition, Morgan Kaufmann.
[2] Sponder M, (2013), Social media analytics: Effective tools for building, interpreting, and using metrics, 1st edition, McGraw Hill Professional.

[3] Clifton B, (2012), Advanced Web Metrics with Google Analytics, 3rd edition, John Wiley & Sons.

Web resources:
[1] https://analytics.google.com/analytics/web/
[2] https://www.optimizely.com/optimization-glossary/web-analytics/
[3] https://www.tutorialspoint.com/web_analytics/web_analytics_introduction.htm

Course Code: UGCA2036
Course Name: Web Analytics Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 5th	**Contact hours:** 2 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** 80%
Internal max. marks: 30	**Duration of End Semester Exam (ESE):** 3hrs
External max. marks: 20	**Elective status:** Elective
Total marks: 50	

Detailed list of Tasks:

1. Working concept of web analytics.
2. Evaluation with Intermediate metrics, custom metrics, calculated metrics.
3. Collection of web data and other internet data with the help of web analytics.
4. Delivering reports based on collected data.
5. Implement the concept of web analytics ecosystem.
6. Creation of segmentation in web analytics.
7. Visualization, acquisition and conversions of web analytics data.
8. Performing site search analytics.
9. Analyze the web analytic reports and visualizations.
10. Performing visual web analytics.

Course Code: UGCA2021
Course Name: Linux Operating System

Program: B.Sc Data Analytics	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 5th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 60%
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Elective
Total marks: 100	

Prerequisite: Operating System
Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes: After completing this course, students will be able to:

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CO#	Course outcomes
CO1	Discuss the evolution of Open Source operating systems.
CO2	Prepare environment for working on open source operating system like Linux.
CO3	Perform resource management in Linux
CO4	Write scripts in Linux.
CO5	Execute user level privileges

Detailed contents	Contact hours
Unit-I **Introduction to Linux** History of Linux & Unix, Overview of Linux Operating System, structure of Linux Operating system, Installation. [CO1] Desktops (The X window System, GNOME, KDE), desktop operations. Different types of editors, vi editor and its command.	12
Unit-II **Shells and Utilities** Role of shells in the Linux environment, Different types of shells in Linux Operating system, Shell configuration: Shell initialization & configuration directories & file, Aliases, Filename expansion, Standard Input/ Output & Redirection, Pipes, Managing Jobs.[CO3] **Shell Scripting:** Different types of statements in shell script, variables in shell, assign values to shell variables, Default shell variables value, Rules for Naming variables, Display the value of shell variables Getting User writing simple shell scripts to accept input from the user and display a message on screen, Shell scripts to implement various control statements. [CO4]	12
Unit-III **Files Systems & Linux Software** Linux Files, File structure, commands for managing files & directories with other commonly used commands, Software Management, Office and Database Applications, Graphics Tools and Multimedia, Internet & Network services, Web, FTP & java Clients. [CO3]	10
Unit-IV **Linux Administration** Managing users, Superuser Control, System Run levels, Managing File Systems, [CO3]	10

Kernel Administration: Linux kernel sources, rebuilding kernel, installing kernel, Virtualization, backup management. [CO5]	

Text Books:
1. Linux: The complete reference by Richard Petersen, Published by Tata McGraw- Hill Publication.
2. Linux in a Nutshell: A Desktop Quick Reference, 6th Edition by Stephen Figgins, Arnold Robbins, Ellen Siever & Robert Love Published by O'Reilly Media.
3. Linux Administration: A Beginner's Guide by Steve Shah & Wale Soyinka, Published by McGraw-Hill Education.
4. Unix Shell Programming by Yashavant P. Kanetkar, Published by BPB Publishers.

Course Code: UGCA2024
Course Name: Linux Operating System Laboratory

Program: B.Sc Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 5th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:** 100
Internal max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 40	**Elective status:** Core
Total marks: 100	

Prerequisite: Operating system
Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes:

CO#	Course outcomes
CO1	Prepare the environment for installation and use of Linux operating system
CO2	Write Shell Scripts
CO3	Implement C programs using gcc compiler
CO4	Implement virtualization
CO5	Execute commands related to grantinf and revoking user priviledges.

Instructions:

1	Installation of Linux OS.
2	Writing advanced shell programs
3	Installation and management of printers
4	Using gcc compiler to write c programs
5	Configuring mail server
6	Configuring FTP server
7	Connecting to internet
8	Implementing different commands to manage file system
9	Implementation of virtualization
10	Becoming super user and implementing configuration commands
11	Implementing commands to manage users

- Instructor can select the commands, utilities and services to be managed on their own.

Reference Books:
1. Linux: The complete reference by Richard Petersen, Published by Tata McGraw- Hill Publication.
2. Linux in a Nutshell: A Desktop Quick Reference, 6th Edition by Stephen Figgins, Arnold Robbins, Ellen Siever & Robert Love Published by O'Reilly Media.
3. Unix Shell Programming by Yashavant P. Kanetkar, Published by BPB Publishers.

Course Code: UGCA1945
Course Name: Artificial Intelligence

Program: B.Sc Data Analytics	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 5th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems: --**
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Elective
Total marks:100	

Prerequisite: NA--
Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes:

CO#	Course outcomes
CO1	Highlight the significance and domains of Artificial Intelligence and knowledge representation.
CO2	Outline the advantages and disadvantages of various search techniques.
CO3	Identify various Expert Systems and AI applications.
CO4	Define the role of AI in different areas like NLP, Pattern Recognition etc.
CO5	Select the right AI tool for different AI based applications.

Detailed Contents	Contact hours
Unit-I **Introduction-**What is intelligence? Foundations of artificial intelligence (AI). History of AI. AI problems: Toy Problems, Real World problems- Tic-Tac-Toe, Water Jug, Question-Answering, 8-puzzle, 8-Queens problem. Formulating problems, Searching for Solutions.[CO1] **Knowledge Representation:** Propositional Logic, Propositional Theorem Proving-Inference and Proofs, Proof by Resolution, Horn Clauses and definite Clauses, Forward and Backward chaining; First order Logic, Inference in First Order Logic. [CO1]	10
Unit-II	**10**

Uncertain Knowledge and Reasoning: Basic probability, Bayes rule, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic. **Structured Knowledge:** Associative Networks, Frame Structures, Conceptual Dependencies and Scripts.	
Unit-III **Uninformed Search strategies-** Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Comparing uninformed search strategies.[CO2] **Informed (Heuristic) Search Strategies-** Hill Climbing, Simulated Annealing, Genetic Algorithm, Greedy best-first search, A* and optimal search, Memory-bounded heuristic search.[CO2]	**12**
Unit-IV **Natural language processing:** Grammars, Parsing.[CO4] **Pattern Recognition:** Recognition and Classification Process-Decision Theoretic Classification, Syntactic Classification; Learning Classification Patterns, Recognizing and Understanding Speech. [CO5] **Expert System Architectures:** Characteristics, Rule-Based System Architectures, Nonproduction System Architectures, Knowledge Acquisition and Validation.[CO3]	12

Text Books:
1. Artificial Intelligence-A Modern Approach, Russel and Norvig, Prentice Hall.
2. Artificial Intelligence, Elaine Rich, Kevin Knight and SB Nair, 3 Ed.,Tata McGraw-Hill.
3. Artificial Intelligence And Expert Systems, D.W.Patterson, Prentice Hall.
4. Artificial Inteligence Structures and Strategies for complex Problem Solving, George F. Luger, Pearson Addison Wesley.

Reference Books:
1. Artificial Intelligence-A New Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishers.

Course Code: UGCA1951
Course Name: Artificial Intelligence Laboratory

Program: B.Sc Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 5th	**Contact hours:** 4 weeks per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 40	**Elective status:** Elective
Total marks: 100	

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Prerequisite: Working Knowledge of Python Programming
Language**Co requisite:** Installing Python, Installing packages,
Loading data **Additional material required in ESE: -NA-**

Course Outcomes:

CO#	Course outcomes
CO1	Identify right tool for different AI based problems.
CO2	Develop basic applications using AI tools.
CO3	Represent various real life problem domains using logic based techniques and use this to perform inference or planning.
CO4	Outline the use of Bayesian approach to solve uncertain problems.
CO5	Implement basic Natural Language processing programs.

Instructions:

1.	Learn the building blocks of Logic Programming in Python.
2.	Python script for comparing mathematical expressions and finding out unknown values.
3.	Use logic programming in Python to check for prime numbers.
4.	Use logic programming in Python parse a family tree and infer the relationships between the family members.
5.	Python script for building a puzzle solver.
6.	Implementation of Naïve Bayes classifier, computing its accuracy and visualizing its performance.
7.	Creation of a fuzzy control system which models how you might choose to tip at a restaurant.
8.	Implementation of uninformed search techniques in Python.
9.	Implementation of heuristic search techniques in Python.
10.	Python script for tokenizing text data.
11.	Extracting the frequency of terms using a Bag of Words model.
12.	Predict the category to which a given piece of text belongs.
13.	Python code for visualizing audio speech signal
14.	Python code for Generating audio signals
15.	Python code for Synthesizing tones to generate music

Reference Books:
1. Artificial Intelligence with Python, Prateek Joshi, Packt Publishing.

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Course Code: UGCA2019
Course Name: Advance Web Technologies

Program: B. Sc Data Analytics	**L**: 3 **T**: 0 **P**: 0
Branch: Computer Applications	**Credits**: 3
Semester: 6th	**Contact hours:** 33 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 80%
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Skill Enhancement
Total marks: 100	

Prerequisite: -Basic Web Programming

Co requisite: -NA-

Additional material required in ESE: -NA-
Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Learn to represent web data and XML document handling.
CO2	Understand AJAX and relevance.
CO3	Able to learn how to perform basic CRUD database operations in a Dynamic Website.
CO4	Learn about web services and their development.

Detailed contents	Contact hours
Unit-I **PHP**: Server-side web scripting, Installing PHP, Adding PHP to HTML, Syntax and Variables, Passing information between pages, Strings, Arrays and Array Functions, Numbers, Basic PHP errors/ problems.[CO1]	8
Unit-II **Advanced PHP and MySQL**: PHP/MySQL Functions, Displaying queries in tables, Introduction to PHP OOPs concepts, Building Forms from queries, String and Regular Expressions, Sessions, Cookies and HTTP, Type and Type Conversions, E-Mail.[CO1][CO2] **Introduction to Web Services:** Use of Web Services, Types of Web Services, Introduction to Content Management System CMS (Types, Usages, Benefits).[CO4]	8

Unit-III **XML**: Introduction to XML, XML Basics, XML Syntax and Editors, documents, Elements, Attributes. Creating XML documents.[CO2] **Ajax** : Introduction and Use of Ajax in Website.[CO2] **jQuery** : Introduction, jQuery UI: Date picker, auto complete, tooltip, accordion, retrieving page content, manipulating page content, working with events.[CO4]	9
Unit-IV **Introduction to Bootstrap :** Components of Bootstrap[CO3] **Introduction to Node.js**: Node Package Manager (NPM), Node.js Webserver – Server and Clients.[CO4] **React**: Introduction to ReactJS, Environment Setup, JSX, Components, State, Props, Validating Props, Component API, Component Life Cycle,Forms, Events.[CO4]	8

Text Books:
1. Steven Holzner, "PHP: The Complete Reference", TATA McGraw Hill, 2015.
2. Roger S Pressman, David Lowe, "Web Engineering: A Practitioner's Approach", TMH.
3. W. Jason Gilmore,"Beginning PHP and MySQL: From Novice to Professional", Apress.
4. "Learning PHP, MySQL, JavaScript, CSS and HTML 5", Robin Nixon, O'Reilly publication
5. Web Technologies, Black Book, dreamtech Press
6. Alex Young, "Node.js in Action", 2ed, Bradley Meck

Reference Books:
1. Jesus Caspagnetto, "Professional PHP Programming", Wrox Publication.
2. P.J. Deitel & H.M. Deitel, "Internet and World Wide Web How to program", Pearson
3. Harwani, "Developing Web Applications in PHP and AJAX", McGrawHill
4. Ralph Moseley and M. T. Savaliya, "Developing Web Applications", Wiley-India
5. HTML 5, Black Book, Dreamtech Press

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Course Code: UGCA2020
Course Name: Advanced Web Technologies Laboratory

Program: B.Sc Data Analytics	**L**: 0 **T**: 0 **P**: 2
Branch: Computer Applications	**Credits**: 1
Semester: 6th	**Contact hours:** 2 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems:**100%
Internal max. marks: 30	**Duration of End Semester Exam (ESE):**
External max. marks: 20	**Elective status:** Skill Enhancement
Total marks: 50	

Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Understand the advance concepts of website development.
CO2	Provide skills to design and develop dynamic web sites.
CO3	Work independently for database programming for web applications
CO4	Understand concepts of jQuery methods, AJAX, Bootstrap and REACT
CO5	Connect Website with an Database Server and perform basic CRUD operations.
CO6	Develop market ready website, to be used by clients.

Instructions: Instructor can increase/decrease the experiments as per the requirement.
 Assignments: All the Practical Assignments need to be carried on specific applications.
 (Example: InventoryManagement System, Bus/Airline/Railway Reservation System, Student Management System etc.)

	Practice Programs with PHP
1.	PHP Code to display today's date in dd-mm-yyyy format.
2.	PHP Code to check if number is prime or not.
3.	PHP Code to print first 10 Fibonacci Numbers.
4.	PHP Code to read data from txt file and display it in html table (the file contains info in format Name: Password: Email)
5.	PHP Script for login authentication. Design an HTML form which takes username and password from user and validate against stored username and password in file.
6.	PHP Script for storing and retrieving user information from MySql table. • Design A HTML page which takes Name, Address, Email and Mobile No. Fromuser (register.php) • Store this data in MySql database / text file. • Next page display all user in html table using PHP (display.php)
7.	PHP Script for user authentication using PHP-MYSQL. Use session for storing username. Implement the following with specific web applications
8.	Create HTML page for chosen application that contain textbox, submit / reset button. Write php program to display this information and also store into text file.
9.	Create XML documents for chosen application and validate using DTD and schema.Also render the content of XML document using XSL. Scenarios include • XML document must have attributes and elements so that they can be validated against DTD/Schema. • Check the data types of variables declared in XML document using Schema. • Display the details of data contained in XML document in a table usingXSL.

10.	Embed the JQuery features for the application chosen. Perform the Scenarios using JQUERY ready function • In login form, define username and password constraints and ensure that the credentials follow them. • In registration form, username must be of atleast 6 characters. Password must be of atleast 8 characters and follow password constraints. Password and confirm password fields must match with each other. E-mail id must be of the form "yourname@domain.com". Mobile number must be of 10 digits only and startingdigit must be any number from 6-9 etc… • Use the get and post methods for server side communication.
11.	Modify the specific web applications to use AJAX to show the result on the same page.
12.	Enhance functionality of the specific web applications using BOOTSTRAP
13.	Create a responsive Photo Gallery in BOOTSTRAP
14.	Suppose you have a list of Students having Student's Name, Roll Number, Marks infive subjects, Show this list in a responsive table in BOOTSTRAP
15.	Modify your answer for above question with PHP and MYSQL database and PerformCRUD operations with AJAX
16.	Build a Password Strength Check App with JQuery. You can use AJAX for form validation and add an alert when the user enters a weak password.
17.	Build a Registration Form and Validate it with JQuery. Registration Form must have at least 10 elements.
18.	Design a Sign In, Sign Up and Forgot Password Page with BOOTSTRAP. Use PHP and MYSQL to store Sign Up data in Database.
19.	Create a Star Rating System in JQuery.
20.	Create a simple To-do list Application with REACT
21.	Create a Calculator with REACT
22.	Create a Photo Gallery with REACT. Also implement search operation
23.	How can you create a Portfolio App with Node.js?
24.	Create a simple Shopping Cart with REACT and Node.js
25.	Modify your Shipping Cart with JQuery, JSON and AJAX functionality.

Reference Books:
1. Roger S Pressman, David Lowe, "Web Engineering: A Practitioner's Approach", TMH.
2. Steven Holzner, "PHP: The Complete Reference", TATA McGraw Hill, 2015.
3. W. Jason Gilmore,"Beginning PHP and MySQL: From Novice to Professional", Apress.
4. Learning PHP, MySQL, JavaScript, CSS and HTML 5, Robin Nixon, O'Reilly publication

I. K. Gujral Punjab Technical University
Bachelor ofScience in Data Analytic (B Sc. Data Analytic)

Elective –III

Course Code: UGCA1936
Course Name: Cloud Computing

Program: : B.Sc. Data Analytic	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits:** 4
Semester: 6th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** --
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Elective
Total marks: 100	

Prerequisite: -NA-
Co requisite: -NA-
  Additional material required in ESE: -NA-

  Course Outcomes:

CO#	Course outcomes
CO1	Define the concept of cloud computing.
CO2	Outline the benefits if migrating to a cloud solution for different applications.
CO3	Compare different virtualization technologies.
CO4	Identify various resources needed to build cloud.
CO5	Explain various security threats to cloud.

Detailed contents	Contact hours
Unit-I **Overview of Computing Paradigm:** Recent trends in Computing -Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. [CO1] **Introduction to Cloud Computing:** Vision of Cloud Computing, Defining aCloud, Cloud delivery Model, Deployment Model, Characteristics, Benefits ofCloud Computing, Challenges ahead. Cloud computing vs. Cluster computing vs. Grid computing. [CO1] **Migrating into a Cloud:** Introduction, Broad approaches to Migrating into the Cloud, The Seven-Step Model of Migration Into a Cloud. [CO2]	12
Unit-II **Virtualization:** Introduction, Characteristics of Virtualized environment,Taxonomy of Virtualization techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Hypervisor Technology Examples- Xen, VMware, Microsoft Hyper-V. [CO3] **Capacity Planning:** Elasticity vs Scalability, Introduction, Defining Baseline and Metrics-Baseline Measurements, System Metrics, Load Testing, Resource Ceilings, Server and Instance types; Network Capacity, Scaling. [C04]	10

Unit-III **SLA Management in Cloud Computing:** Inspiration, Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLAmanagement in Cloud. Automated Policy-based management. [CO4] **Securing Cloud services:** Cloud Security, Securing Data- Brokered CloudStorage Access, Storage location and tenancy, Encryption, Auditing and compliance. Steps to ensure security over cloud.[CO5]	12
Unit-IV **Cloud Platforms in Industry:** Amazon Web Services-Compute Services,Storage Services, Communication Services, Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life Cycle. Cost Model.Microsoft Azure-Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. [CO4]	10

Text Books:

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0, New Delhi, India, Feb 2013.

2. Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, ISBN-13: 978- 81- 265-2980-3, New Delhi, India, 2011.

3. Cloud Computing: Principles and paradigms, RajKumar Buyya, James Broberg,Andrezei M. Goscinski, Wiley India Pvt. Ltd, ISBN- 13: 978-81-265-4125-6, New Delhi, India, 2011

Reference Books:

1. 1.Cloud Computing for Dummies, Fern Halper, Hurwitz, Robin Bloor, Marcia Kaufman, Wiley India Pvt. Ltd, ISBN-13: 978-0-47-0597422, New Delhi, India,2011.
2. Dr. Saurabh Kumar, Cloud Computing: Insights into New-Era Infrastructure, Wiley India Pvt. Ltd, ISBN-13: 978-8-12-6528837, New Delhi, India, 2011.

E Books/ Online learning material

1. P.D. Kaur, I. Chana, Unfolding the distributed computing paradigm, in: Proceedings of the IEEE International Conference on Advances in Computer Engineering, ACE, Bangalore, Karnataka, India, 2010, pp. 339–342.
2. P. Mell and T. Grance, "The NIST definition of cloud computing (draft), NIST Spec.Publ. 800 (2011) 7.

Course Code: UGCA1942
Course Name: Cloud Computing Laboratory

Program: B.Sc. Data Analytic	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 6th	**Contact hours:** 4 hours per week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 40	**Elective status:** Elective
Total marks: 100	

Prerequisite: Working Knowledge of Linux Operating system
Co requisite: -NA-
Additional material required in ESE: -NA-
Course Outcomes:

CO#	Course outcomes
CO1	Identify major commercial projects in the field of cloud computing
CO2	Design basic cloud applications
CO3	Execute basic functionalities of open source tools like Open Stack.
CO4	Implement virtualization
CO5	Define major services provided by cloud service provider.

Assignments:

1.	Enlist various companies in cloud business and the corresponding services provided by them and tag them under SaaS , PaaS & IaaS.
2.	Create a warehouse application using tools supplied by any SaaS provider.
3.	Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle'sVirtual Box and Guest O.S. Learn creation, migration, cloning and managing of virtual machines.
4.	Using public cloud service providers tools for exploring the usage of IaaS, PaaS and SaaS cloud services.
5.	Setting up a private cloud using open source tools (Eucalyptus/Open Stack etc.).

Course Code: UGCA1933

Course Name: Internet of Things

Program: B.Sc Data Analytic	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**Contact hours:** 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** --
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status:** Elective
Total marks: 100	

Prerequisite: -

NA-Co requisite:

-NA-

Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Define the concept of IoT
CO2	Outline various domains of IOT
CO3	Explain M2M (machine to machine) applications with necessary protocols
CO4	Express the need of IOT system management.
CO5	Implement the basic Raspberry PI platform for creating IOT applications.

Detailed Contents	Contact hours
Unit-I Definition and Need of IoT, Characteristics of IoT, Physical Design of IoT – IoT Protocols, Logical Design of IoT, IoT Enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels and Templates.[CO1]	11
Unit-II Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.M2M Applications, Software Defined Networks, Network Function Virtualization. [CO2]	11
Unit-III Need for IoT System Management, Simple Network Management Protocol, Network Operator Requirements, NETCONF, YANG, IoT System Management with NETCOZF-YANG, IoT Design Methodology. [CO3]	11

Unit-IV	
Introduction to Raspberry PI-Interfaces (serial, SPI, I2C), Introduction to Cloud Storage Models and Communication APIs Webserver – Web Server for IoT, Cloud for IoT, Security Management in an IoT System. [CO4] [CO5]	11

Text Books:

1. Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, FirstEdition, 2015, University Press.

Reference Books:

1. The Internet of Things-Enabling Technologies, Platforms, and Use Cases, Pethuru Raj & Anupama C. Raman, CRC Press, 2017.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly(SPD), 2014
3. The Definitive Guide to the Internet of Things for Business, Syed Zaeem Hosain, Aeris Communications, 2016, 2nd edition.
4. Internet of Things: Architecture and Design Principals, Raj Kamal, McGraw-Hill, 2017.

Course Code: UGCA1939
Course Name: Internet of Things Laboratory

Program: B.Sc Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits:** 2
Semester: 6th	**Contact hours:** 4 hours a week
Theory/Practical: Practical	**Percentage of numerical/design problems: --**
Internal max. marks: 60	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 40	**Elective status:** Elective
Total marks: 100	

Prerequisite: -NA-
Co requisite: -NA-
   Additional material required in ESE: -NA-

Course Outcomes:

CO#	Course outcomes
CO1	Identify different types of IOT devices and sensors.
CO2	Analyze sensor generated data
CO3	Outline the use of Bluetooth for connectivity of mobile application with IOT device
CO4	Designing small IoT applications
CO5	Building interface of application with various devices

Assignments:

1	Interfacing Light Emitting Diode (LED) for Blinking LED
2	Interfacing Button and LED for LED blinking when button is pressed
3	Interfacing Light Dependent Resistor (LDR) and LED for displaying automaticnight lamp
4	Interfacing Temperature Sensor (LM35) and/or humidity sensor (e.g. DHT11)
5	Interfacing Liquid Crystal Display (LCD) to display data generated by sensor on LCD
6	Interfacing Air Quality Sensor-pollution (e.g. MQ135) to display data on LCD , switch on LED when data sensed is higher than specified value.
7	Interfacing Bluetooth module (e.g. HC05) for receiving data from mobile phone on Arduino and display on LCD
8	Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).

Reference Books:

1. Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, First Edition, 2015, Universities Press.
2. Arduino Projects for Engineers, Neerparaj Rai, First Edition, 2016, BPBPublications.
3. 21 Internet of Things (IOT) Experiments, Yashavant Kanetkar, Shrirang Korde,First Edition, 2015, BPB Publications.

List of components:
1. One kit for 3-4 students: Arduino Uno, sensors (Bluetooth module (HC05),MQ135, DHT11, breadboard, LCD, 2-relay module etc.)
2. Consumables: LED, button, connecting wires, LDR, LM35, battery, etc

Course Code: UGCA2037

Course Name Recommender Systems

Program: B.Sc. Data Analytic	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**Contact hours**: 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:**
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status**: Elective
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

CO#	Course outcomes
CO1	To understand basic techniques and problems in the field of recommender systems
CO2	Evaluate Types of recommender systems: non-personalized, content based, collaborative filtering
CO3	Apply algorithms and techniques to develop Recommender Systems that are widely used in the Internet industry
CO4	To develop state-of-the-art recommender systems

Detailed Contents	Contact hours
Unit-I **Introduction:** Recommender system functions, Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with **recommender system. [CO1]**	8
Unit-II **Collaborative Filtering:** User-based nearest neighbour recommendation, Item-based nearest neighbour recommendation, Model based and pre-processing based approaches, Attacks on collaborative recommender systems. **Content-based recommendation:** High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, Obtaining item features from tags, Representing item profiles, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.[CO1][CO2]	12

Unit-III **Knowledge based recommendation:** Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders. **Hybrid approaches:** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.[CO1][CO3]	12
Unit-IV **Evaluating Recommender System:** Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centred metrics.[CO1][CO4]	12

Text Books:
1. C.C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1st Edition, 2016.
2. Jannach D., Zanker M. and FelFering A., "Recommender Systems: An Introduction", Cambridge University Press, 1st Edition, 2011.
3. Kim Falk, "Practical Recommender Systems", Manning, 1st Edition, 2019
4. Rounak Banik, "Hands-On Recommendation Systems with Python: Start building powerful and personalized, recommendation engines with Python", 2018.

Reference Books:
1. M.D. Ekstrand, J.T. Riedl, J.A. Konstan, "Collaborative filtering recommender systems", Now publishers, 1st Edition, 2011.
2. J. Leskovec, A. Rajaraman and J. Ullman, "Mining of massive datasets", Cambridge, 2nd Edition, 2012.
3. P. Pavan Kumar, S. Vairachilai, Sirisha Potluri, "Recommender Systems: Algorithms and Applications", CRC Press, 1st Edition, 2021.

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Course Code: UGCA2038

Course Name Recommender Systems Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical**: Practical
External max. marks: 40	**Duration of End Semester Exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Elective

Prerequisite: NA Co requisite: NA
Additional material required in ESE:

Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Design a recommender system for various problems.
CO2	Build different types of recommendation engines.
CO3	Build Recommenders using various algorithms.
CO4	Compare the performance of different recommender systems

Experiments:

1	Build a Recommendation Engine with Item-Based Collaborative Filtering.
2	Build Content-based recommendation engine on different datasets.
3	Build Recommender System using association rule mining
4	Implement Recommendation System using K-Nearest Neighbors
5	Build Context-Aware Recommender Systems.
6	Build Constraint-based Recommenders.
7	Implement knowledge-based recommender system.
8	Evaluate the recommendation system with evaluation matrix
9	Compare the performance of different recommender systems

Reference Books:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press(2011), 1st ed.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.
3. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed

Elective –IV

Course Code: UGCA1950

Course Name: MachineLearning

Program: B.Sc. Data Analytics	**L**: 3　　**T**: 1　　**P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**Contact hours**: 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:** 40%
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status**: Elective
Total marks: 100	

Prerequisite: -NA-

Co requisite: -NA-

Additional material required inESE: -NA-

CO#	Course Outcomes
CO1	Define the concept of machine learning
CO2	Outline the key characteristics of machine learning algorithms
CO3	Compare the performance of different machine learning algorithms
CO4	Design solution for basic problems using machine learning algorithms
CO5	Explain the concept of reinforcement learning

Detailed Contents	Contact hours
Unit-I **Introduction** What is Machine Learning, Unsupervised Learning, Reinforcement Learning Machine Learning Use-Cases, Machine Learning Process Flow, Machine Learning Categories, Linear regression and Gradient descent.[CO1]	8
Unit-II **Supervised Learning** Classification and its use cases, Decision Tree, Algorithm for Decision Tree Induction Creating a Perfect Decision Tree, Confusion Matrix, Random Forest. What is Naïve Bayes, How Naïve Bayes works, Implementing Naïve Bayes Classifier, Support Vector Machine, Illustration how Support Vector Machine works, Hyper parameter Optimization, Grid Search Vs Random Search, Implementation of Support Vector Machine for Classification.[CO4]	12
Unit-III **Clustering** What is Clustering & its Use Cases, K-means Clustering, How does K- means algorithm work, C-means Clustering, Hierarchical Clustering, How Hierarchical Clustering works.[CO3]	12

Unit-IV Why Reinforcement Learning, Elements of Reinforcement Learning, Exploration vs Exploitation dilemma, Epsilon Greedy Algorithm, Markov Decision Process (MDP) Q values and V values, Q – Learning, α values.[CO5]	12

Text Books:

1. Pattern Reorganization and Machine learning by Christopher M. Bishop.
2. The elements of Statistical learning by Jeromeh. Friedman, Robert Tivshirani and Trevorhaspie.
3. Introduction to Machine Learning by Ethem Alpaydin. PHI Publisher.
4. Machine Learning, A practical approach on the statistical learinging theory by Rodrigo fernandes de Mello and Moacir Antonelli Ponti.
5. Machine Learning A probabilistic prospective by Kevin P. Murphy

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Course Code: UGCA1956
Course Name: Machine Learning Laboratory

Program: B.Sc. Data Analytic	**L**: 0　　**T**: 0　　**P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical**: Practical
External max. marks: 40	**Duration of End Semester Exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Elective

Prerequisite: Students must have the knowledge of editors like Notepadetc. and basic understanding of Scripting Language/s.
Co requisite: Knowledge of Networking, Internet, Client Serverconcepts, Static &Dynamic environment of the websites etc.
Additional material required in ESE:
Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Differentiate between various data types.
CO2	Implement programs for various Learning algorithms.
CO3	Compare different machine learning algorithms.
CO4	Choose the right algorithm for different problems.
CO5	Apply Machine Learning algorithms to solve real world problems.

Instructions: Instructor can increase/decrease the experiments as per the requirement.
Assignments:

1.	Read the numeric data from .CSV file and use some basic operation on it.
2.	Write a program to demonstrate the working of the decision tree algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3.	Write a program to demonstrate the working of the Random Forest algorithm.

4.	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 testdata sets.
5.	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 writethe program. Calculate the accuracy, precision, and recall for your data set.
6.	Write a program to construct a Bayesian network considering medical data. Use thismodel to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
7.	Write a program to implement k-Nearest Neighbour algorithm to classify the iris dataset. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
8.	Write a program to demonstrate the working of the K-means clustering algorithm.
9.	Write a program to demonstrate the working of the Support Vector Machine for Classification Algorithm.
10.	Write a program to demonstrate the working of the Hierarchical Clustering

Reference Books:

1. Rodrigo fernandes de Mello and Moacir Antonelli Ponti., MachineLearning, Apractical approach on
   the statistical learning

2. Christopher Bishop, "Pattern Recognition and Machine Learning"Springer,2007.

3. Stephen Marsland, "Machine Learning – An Algorithmic
   Perspective", Chapmanand Hall, CRC Press, Second Edition, 2014.

4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective",MIT Press,2012.

5. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press,Third Edition,2014

6. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.

I. K. Gujral Punjab Technical University
Bachelor ofScience in Data Analytic (B Sc. Data Analytic)

Course Code: UGCA2039

Course Name: Data Preparation & Analysis

Program: B.Sc. Data Analytic	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**Contact hours**: 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:**
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status**: Elective
Total marks: 100	

COURSE OUTCOMES
After completion of course, students would be able to extract the data for performing the Analysis.

Detailed Contents	Contact hours
Unit I: **Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues.	9
Unit II: **Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.	11
Unit III: **Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis generation.	11
Unit IV: Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections,Hierarchies and networks, interactivity.	13

References:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn

J. Myatt

I. K. Gujral Punjab Technical University
Bachelor ofScience in Data Analytic (B Sc. Data Analytic)

Course Code: UGCA2040
Course Name: Data Preparation & Analysis Laboratory

Program: B.Sc. Data Analytics	**L**: 0 **T**: 0 **P**: 4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical**: Practical
External max. marks: 40	**Duration of End Semester Exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Elective

Prerequisite: NA Co
requisite: NA
Additional material required in ESE:
Course Outcomes: After studying this course, students will be able to extract the data for performing theAnalysis.

Assignments:

Programs to be implemented using WEKA.

1	Using weka tool to explore the data.
2	Using weka tool to do Parametric–Means
3	Using weka tool to do Parametric -T-Test.
4	Using weka tool to do Correlation analysis
5	Pre process the given data using weka tool.
6	Apply different classification techniques to classify the given data set.
7	Apply various clustering techniques to cluster the data.
8	Apply various association rule mining algorithms
9	Implement classification using Decision tree
10	Apply Visualization methods using weka tool.

I. K. Gujral Punjab Technical University
Bachelor ofScience in Data Analytic (B Sc. Data Analytic)

Course Code: UGCA2041
Course Name: Blockchain Technology

Program: B.Sc. Data Analytic	**L**: 3 **T**: 1 **P**: 0
Branch: Computer Applications	**Credits**: 4
Semester: 6th	**Contact hours**: 44 hours
Theory/Practical: Theory	**Percentage of numerical/design problems:**
Internal max. marks: 40	**Duration of end semester exam (ESE):** 3hrs
External max. marks: 60	**Elective status**: Elective
Total marks: 100	

Prerequisite: -NA-Co

requisite: -NA-

Additional material required in ESE: -NA-

Course Outcomes: Students will be able to:

CO#	Course outcomes
CO1	Understand block chain technology.
CO2	Gain Knowledge about the working of bit coin crypto currency
CO3	Able to do payment model using block chain applications.
CO4	Integrate ideas from various domains and implement them using block chain technology in different perspectives.
CO5	Build and deploy block chain application for on premise and cloud based architecture.

Detailed Contents	Contact hours
Unit-I Concept of Blockchain: Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs Private Blockchain, Understanding Crypto currencyto Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain.[CO1]	8
Unit-II Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, Private Key Cryptography, A basic crypto currency.[CO2]	12

Unit-III	
Bitcoin and Blockchain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.[CO2][CO3]	12

Unit-IV	
Enterprise Application of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade — Trade Finance Network, Supply Chain Financing, Identity on Blockchain [CO4][CO5]	12

Text Books:

1. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies",O'Reilly, 2014.
3. Bashir, Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition, 2nd Revised edition edition. Birmingham: Packt Publishing, 2018.

Reference Books:

1. Iran Bashir "Mastering Blockchain", Second Edition Paperback, 2018.
2. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
3. A. M. Antonopoulos, Mastering bitcoin, First edition. Sebastopol CA: O'Reilly,2015.
4. Z. Zheng, S. Xie, H. Dai, X. Chen, andH. Wang, —An Overview of Blockchain Technology.

Course Code: UGCA2042
Course Name: Blockchain Technology Laboratory

Program: B.Sc. Data Analytics	L: 0 T: 0 P: 4
Branch: Computer Applications	**Credits**: 2
Semester: 6th	**Contact hours:** 4 hours per week
Internal max. marks: 60	**Theory/Practical**: Practical
External max. marks: 40	**Duration of End Semester Exam (ESE):** 3hrs
Total marks: 100	**Elective status:** Elective

Prerequisite: NA Co
requisite: NA
Additional material required in ESE:

Course Outcomes: After studying this course, students will be able to:

CO#	Course Outcomes
CO1	Knowledge of Blockchain Concepts and creating basic blocks.
CO2	Proficiency in Blockchain Development.
CO3	Ability to Design and Implement Blockchain Applications.
CO4	Evaluation and Analysis of Blockchain Systems.
CO5	Knowledge of crypto currency and creating a basic form of it.

Assignments:

	1.	Creating Merkle tree
	2.	Creation of Block
	3.	Block chain Implementation Programming code
	4.	Creating ERC20 token
	5.	Java code to implement blockchain in Merkle Trees
	6.	Java Code to implement Mining using block chain
	7.	Java Code to implement peer-to-peer using block chain
	8.	Creating a Crypto-currency Wallet

e-Resources:
1. GitHub repository.
2. NPTEL & MOOC courses titled blockchain technology
3. blockgeeks.comguide/what-is-¬block-chain-technology
4. https://nptel.ac.in/courses/106105184/

Guidelines regarding Mentoring and ProfessionalDevelopment

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.For achieving the above, suggestive list of activities tobe conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE,CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the depart