Appendix – A
Teaching & Examination Scheme
Bachelor of Science (Data Science)
Three Year (SIX SEMESTER) DEGREE COURSE

B.Sc. Data Science **Semester-I**

Course Code	Subjects Name	Teaching Scheme (Hours/week)			Credits	Examination Scheme								
						Theory					Practical			
		Th + Tu (Period)	Pr. (Periods)	Total Periods		Duration Hrs	Max Marks Theory Paper	Max Marks (IA)	Total	Min Passing Marks	Duration Hrs	Max Marks Practical Paper	Min Passing Marks	Total Marks (Th. Pr. IA)
1DST01	**Compulsory English**	4 +1	-	4+1	5	3	60	15	75	30	-	-	-	75
1DST02	**Second Language**	3	-	3	3	3	60	15	75	30	-	-	-	75
1DST03	**Linear Algebra**	4		4	4	3	80	20	100	40	-	-	-	100
1DST04	**Computer Fundamentals and Operating System**	4		4	4	3	80	20	100	40	-	-	-	100
1DST05	**Programming in C**	4		4	4	3	80	20	100	40	-	-	-	100
1DSP01	**Operating System Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
1DSP02	**Programming in C Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment; @ = Tutorials wherever applicable; * = If required, for two days.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.
- Details of Course of Languages shall be as per B.Sc. I

Grand Total of Semester I & II: 400 + 150 each semester = TOTAL – 550 Marks per semester

B.Sc. Data Science **Semester-II**

Course Code	Subjects Name	Teaching Scheme (Hours/week)			Credits	Examination Scheme								
						Theory					Practical			
		Th + Tu (Period)	Pr. (Periods)	Total Periods		Duration Hrs	Max Marks Theory Paper	Max Marks (IA)	Total	Min Passing Marks	Duration Hrs	Max Marks Practical Paper	Min Passing Marks	Total Marks (Th. Pr. IA)
2DST01	**Compulsory English**	4 +1	-	4+1	5	3	60	15	75	30	-	-	-	75
2DST02	**Second Language**	3	-	3	3	3	60	15	75	30	-	-	-	75
2DST03	**Probability and Statistics**	4		4	4	3	80	20	100	40	-	-	-	100
2DST04	**Discrete Mathematics and Graph Theory**	4		4	4	3	80	20	100	40	-	-	-	100
2DST05	**Data Structures**	4		4	4	3	80	20	100	40	-	-	-	100
2DSP01	**Statistics Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
2DSP02	**Data Structure Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50

Note:

1. Th = Theory; Pr = Practical; Tu = Tutorial; IA = Internal Assessment; @ = Tutorials wherever applicable; * = If required, for two days.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. Candidate has to pass theory papers and practical separately

- The strength of Batch of Practical and Tutorial for Under Graduates classes shall be 16 with an additional; of 10% with the permission of Hon'ble Vice-Chancellor.
- Details of Course of Languages shall be as per B.Sc. I

Grand Total of Semester I & II: 400 + 150 each semester = TOTAL – 550 Marks per semester

B.Sc. Data Science **Semester-III**

Course Code	Subjects Name	Teaching Scheme (Hours/week)			Credits	Examination Scheme								
						Theory					Practical			
		Th + Tu (Period)	Pr. (Periods)	Total Periods		Duration Hrs	Max Marks Theory Paper	Max Marks (IA)	Total	Min Passing Marks	Duration Hrs	Max Marks Practical Paper	Min Passing Marks	Total Marks (Th. Pr. IA)
3DST01	**Programming in Java**	4		4	4	3	80	20	100	40	-	-	-	100
3DST02	**Database Management System**	4		4	4	3	80	20	100	40	-	-	-	100

3DST03	**Statistical Inference**	4		4	4	3	80	20	100	40	-	-	-	100
3DST04	**Data communication and Network**	4		4	4	3	80	20	100	40	-	-	-	100
3DST05	**Design and Analysis of Algorithms**	4		4	4	3	80	20	100	40	-	-	-	100
3DSP01	**Programming in Java Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
3DSP02	**Database Management System Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
Note: 1. Th = Theory; Pr = Practical; IA = Internal Assessment; * = If required, for two days. 2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical. 3. Candidate has to pass theory papers and practical separately														
Grand Total of Semester III & IV: 600 each semester = TOTAL – 600 Marks per semester														

B.Sc. Data Science **Semester-IV**

Course Code	Subjects Name	Teaching Scheme (Hours/week)			Credits	Examination Scheme								
						Theory					Practical			Total Marks (Th. Pr. IA)
		Th + Tu (Period)	Pr. (Periods)	Total Periods		Duration Hrs	Max Marks Theory Paper	Max Marks (IA)	Total	Min Passing Marks	Duration Hrs	Max Marks Practical Paper	Min Passing Marks	
4DST01	**Python Programming**	4		4	4	3	80	20	100	40	-	-	-	100
4DST02	**Cloud Computing**	4		4	4	3	80	20	100	40	-	-	-	100
4DST03	**Data Warehousing & Mining**	4		4	4	3	80	20	100	40	-	-	-	100
4DST04	**Business Research Methods**	4		4	4	3	80	20	100	40	-	-	-	100
4DST05	**Time Series Analysis**	4		4	4	3	80	20	100	40	-	-	-	100
4DSP01	**Python Programming Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
4DSP02	**Data Mining Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
Note: 1. Th = Theory; Pr = Practical; IA = Internal Assessment; * = If required, for two days. 2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical. 3. Candidate has to pass theory papers and practical separately														
Grand Total of Semester III & IV: 600 each semester = TOTAL – 600 Marks per semester														

B.Sc. Data Science **Semester-V**

Course Code	Subjects Name	Teaching Scheme (Hours/week)			Credits	Examination Scheme								
						Theory					Practical			Total Marks (Th. Pr. IA)
		Th + Tu (Period)	Pr. (Periods)	Total Periods		Duration Hrs	Max Marks Theory Paper	Max Marks (IA)	Total	Min Passing Marks	Duration Hrs	Max Marks Practical Paper	Min Passing Marks	
5DST01	**Machine Learning**	4		4	4	3	80	20	100	40	-	-	-	100
5DST02	**Introduction to Artificial Intelligence**	4		4	4	3	80	20	100	40	-	-	-	100
5DST03	**R-Programming**	4		4	4	3	80	20	100	40	-	-	-	100
5DST04	**Big Data Analytics**	4		4	4	3	80	20	100	40	-	-	-	100
5DSP01	**Big Data Analytics-Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
5DSP02	**AdvancedR-Programming Lab**	-	2*1=2	2	2	-	-	-	-	-	6-8*	50	20	50
5DSPR01	**Minor project**	-	2*1=2	2	2	-	-			-	6-8*	100 **	40	100

Note:
1. Th = Theory; Pr = Practical; IA = Internal Assessment; * = If required, for two days.** = The Practical and Project shall be evaluated by both External and Internal Examiner in the respective Department / Center / Affiliated College as per guidelines appended with this direction.
2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical.
3. For Minor project evaluation 50 marks will be (internal Assessment) and 50 Marks will be (External Assessement)
3. Candidate has to pass theory papers and practical separately

Grand Total of Semester V: 600 Marks

B.Sc. Data Science **Semester-VI**

Course Code	Subjects Name	Teaching Scheme (Hours/week)			Credits	Examination Scheme								
						Theory					Practical			Total Marks (Th. Pr. IA)
		Th + Tu (Period)	Pr. (Periods)	Total Periods		Duration Hrs	Max Marks Theory Paper	Max Marks (IA)	Total	Min Passing Marks	Duration Hrs	Max Marks Practical Paper	Min Passing Marks	
6DST01	**Internet of Things**	4		4	4	3	80	20	100	40	-	-	-	100
6DST02	**Optimization Technique**	4		4	4	3	80	20	100	40	-	-	-	100
6DST03	**Elective I (any one out of four)**	4		4	4	3	80	20	100	40	-	-	-	100

6DST04	**Elective II (any one out of four)**	4		4	4	3	80	20	100	40	-	-	-	100
6DSTPR 01	**Major Project**	4		4	4	3		100	100	40	-	100 **	40	200
Note: 1. Th = Theory; Pr = Practical; IA = Internal Assessment; * = If required, for two days. ** = The Project shall be evaluated by both External and Internal Examiner in the respective Department / Center / Affiliated College as per guidelines appended with this direction. 2. Minimum marks for passing will be 40% of the total marks allotted to that paper / practical. 3. Candidate has to pass theory papers and practical separately														
Grand Total of Semester VI: 600 Marks														

Electives for Semester VI			
Sr. No.	Electives-1	Sr. No.	Electives-2
1	Reinforcement Learning	1	Social Media Analytics
2	Supply Chain and Logistics Analytics	2	Natural Language Processing
3	Marketing and Retail Analytics	3	Financial Analysis
4	Digital Image Processing	4	Digital Signal Processing

Appendix - B:

Internal Assessment:

Guidelines for Internal Assessment are appended herewith.

a) The internal assessment marks assigned to each theory paper as mentioned in Appendix - A shall be awarded on the basis of assignments like class test, attendance, project assignments, seminar, study tour, industrial visits, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice / activity.

b) There shall be two assignments (as described above) per Theory paper.

c) At the beginning of each semester, every teacher shall inform his / her students unambiguously the method he / she proposes to adopt and the scheme of marking for internal assessment.

d) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD / principal.

e) Final submission of internal marks to the University shall be before the commencement of the University Theory examinations.

2Assignments – 6+6 = 12
Marks Performance & Conduct – 4
Marks Attendance - 4 Marks
TOTAL – 20 MARKS

Theory Papers:

1) All Theory papers shall be divided into four units.

2) Each theory paper will be of 80 marks (60 marks for Languages) each.

3) The theory question papers shall be of 3 hours duration and comprise of 5 questions with equal weightage to all units.

4) The pattern of question papers is appended herewith.

Theory paper will be of 80 marks each. All questions are compulsory and will carry equal marks. Question paper for any theory paper will comprise of five questions of 16 marks each. Question No. 1 to 4 will be from four units each with an internal choice. The questions can be asked in the form of long answer type for 16 marks or two questions of 8marks each. Question No. 5 shall be compulsory with four questions / notes of very short answer type from each of the four units having 4 mark each.

Practical Papers:

Practicals will be based on the relevant semester subjects

Valuation Pattern for practical examination:-

The valuation scheme of practical examination will be as under.

1. Record - 10
2. Viva - 10
3. Writing - 15
4. Execution - 15

TOTAL – 50

Valuation Pattern for Major and Minor project Evaluation:-

Minor Project		
	Internal Evaluation	**External Evaluation**
Two Seminar	20	-
Project Report	30	30
Viva	-	20
Total	50	50

Major Project		
	Internal Evaluation	**External Evaluation**
Two Seminar	40	-
Project Report	60	60
Viva	-	40
Total	100	100

Syllabus
for the Program of
B.Sc. in Data Science

B.Sc. (Data Science)
Semester – 1
Paper – I
Compulsory English (1DST01)

As per defined by RTMNU syllabus for B.Sc – I (Semester – I)

B.Sc. (Data Science)
Semester – 1
Paper – II
Second Language (1DST02)

As per defined by RTMNU syllabus for B.Sc – I (Semester – I)

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THREE YEAR BACHELOR OF SCIENCE (B. Sc.) DATA SCIENCE DEGREE COURSE
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B. Sc. (Data Science)		**Semester - I**	
Course Name : Linear Algebra (Paper – III)		Course Code: (1DST03)	
Periods per week (1 Period is 60 minutes)		4	
Credits		4	
		Hours	Marks
Evaluation Scheme	Theory Examination	3	80
	Internal Assessment	--	20
		Total Marks	100

Learning Objectives:
This course aims to provide an in-depth understanding of Linear Algebra which is foundation of many Machine Learning algorithms. It covers basic linear algebra tools such as matrices, matrix operations and properties and determinants, vector spaces, linear transformations, eigenvalues and eigenvectors, and diagonalization, In this course students will be able to learn topic like matrixes and vector which will serve as foundation of learning many data sciences related techniques.

Learning Outcomes:
After completion of this course successfully the students will be able to:

1. Perform various operation on matrix
2. Understand the core concepts related to normal and special matrix
3. Understand the fundamental concepts of Eigenvalues and Eigenvectors
4. Implement Singular Value Decomposition

B.Sc. (Data Science)
Semester – 1
Paper – III
Linear Algebra (1DST03)

Unit - I
Matrix and Basic properties of matrix & vectors:
Matrix, scalar multiplication, linear transformation, transpose, conjugate, rank, determinant, Inner and outer products, matrix multiplication rule and various algorithms, matrix inverse, square matrix, identity matrix, triangular matrix, idea about sparse and dense matrix, unit vectors, symmetric matrix, Hermitian, skew-Hermitian and unitary matrices.

Unit – II
Special matrices and Vector Space:
Matrix factorization concept/LU decomposition, Gaussian/Gauss-Jordan elimination, solving Ax=b linear system of equation, vector space, subspaces, basis, span, dimension of subspace, orthogonality, orthonormality, linear least square, Eigenvalues, eigenvectors, and diagonalization

Unit - III
Linear Transformations:
Definition and example of linear transformation, Null space, range, rank and nullity of linear transformation, matrix representation of a linear transformation, dual space, dual basis, double dual, composition of linear transformation and matrix multiplication.

Unit – IV
Numerical Techniques
Diagonalizability, matrix Limits and Introduction to Markov Chains and the Caley- Hamilton Theorem, Numerical Linear Algebra: Regularization, Introduction to Principal Component Analysis, Singular-Value Decomposition, Latent Semantic Analysis, Case Studies: Recommender Systems, Page Ranking.

Reference Books:
1. Linear Algebra, Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
2. Linear Algebra and its Applications, David C. Lay, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. Introduction to Linear Algebra, S. Lang, 2nd Ed., Springer, 2005.

4. Linear Algebra and its Applications, Gilbert Strang, Thomson, 2007.
5. Introduction to Algebra, A.I. Kostrikin, Springer Verlag, 1984.
6. Theory and Problems of Matrix Operations, Richard Bronson, Tata McGraw Hill, 1989.

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B. Sc. (Data Science)		**Semester - I**	
Course Name : Computer Fundamentals & Operating Systems (Paper – IV)		Course Code: (1DST04)	
Periods per week (1 Period is 60 minutes)		4	
Credits		4	
		Hours	Marks
Evaluation Scheme	Theory Examination	3	80
	Internal Assessment	--	20
		Total Marks	100

Learning Objectives:
To introduce various aspects of computer to students with the basic understanding of fundamental theory of computer such as number systems, binary arithmetic etc. and basic understanding of various components of a computer system such as memory, I/O devices etc. along with the fundamental concepts and techniques of Operating Systems; such as the concepts in process management and concurrency control mechanisms, memory managements and deadlocks solutions.

Learning Outcomes:
After successful completion of this course, the students are able to:
1. Identify various components of a computer system,
2. Learn the different terminologies of logic gates and Boolean algebra.
3. Understand the working principle of different I/O and Memory devices.
4. To describe process management, scheduling and concurrency control mechanisms.
5. To analyze memory management and deadlocks.

B.Sc. (Data Science)
Semester – 1
Paper – IV
Computer Fundamentals & Operating Systems (1DST04)

UNIT –I

Introduction:

Number Systems: Binary, Octal Decimal Hexadecimal and Their interconversion, Logic Gates and Boolean algebra. Computer Arithmetic. Primary Memory Devices: RAM, ROM, PROM, EPROM, CACHE Memory, Registers. Block Diagram of Computer System, Computer Generations. Computer Software: System and Application Software.

UNIT – II

Peripheral Devices:

Type of Computers : Digital, Analog, Hybrid Computers, General purpose Computers, Micro Computers, Mini Computers, Mainframes, Super Computers, Secondary Storage Devices: Sequential and Direct Access Devices, Magnetic and Optical Storage, Flash Drive/USB Pendrive Printers: Impact and Non-Impact Printers. Computer Languages: Machine, Assembly, High Level

UNIT – III

Operating System:

Purpose of Operating Systems, OS Structure, Services of Operating System. Types of Operating System (Explain concepts): Single processor systems, Multiprogrammed, Batch, Time sharing-Interactive, Multitasking, Multiprocessor systems, Parallel systems, Distributed systems, Special purpose systems, Real Time systems, Multimedia systems Handheld Systems

UNIT –IV

Interprocess Communication:

CPU Scheduling: Concept, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF, RR, Priority). Memory Management: Concept, Swapping, Contiguous Memory Allocation, Paging, Segmentation. Deadlock: Concept, System Model, Characterization, Handling Deadlock, Detection, Prevention, Avoidance. Processes: Concept, process states, Scheduling, Operations on Processes, Cooperating Process, Process Synchronization. Threads: Concept, Multithreading models, threading issues

Reference Books

1. Computer Fundamentals, P. K. Sinha &Priti Sinha, BPB Publications, Sixth Edition
2. Operating System Principles, Silberschatz, Galvin, Gagne John Wiley & Sons, 7th Edition
3. Information Technology Concept, Dr. Madhulika Jain, BPB Publication 2nd Edition.
4. Modern Operating Systems, Andrew Tanenbaum, Prentice Hall. 4th Edition.
5. Operating Systems, William Stallings, Prentice Hall. 5th Edition.
6. An introduction to operating systems. Harvey M. Deitel, Addison-Wesley. 3rd Edition
7. Operating Systems: Design and Implementation. Andrew Tanenbaum & Albert Woodhull, Prentice-Hall 3rd Edition

8. Operating System Design - The XINU Approach, Douglas Comer, Prentice –Hall, 2nd Edition

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B. Sc. (Data Science)		**Semester - I**	
Course Name : Programming in C (Paper – V)		Course Code: (1DST05)	
Periods per week (1 Period is 60 minutes)		4	
Credits		4	
		Hours	Marks
Evaluation Scheme	Theory Examination	3	80
	Internal Assessment	--	20
		Total Marks	100

Learning Objectives:

The course is designed to provide broad knowledge of C language. Students will be able to develop logics which will help them to create applications in C. To develop programming skills of students with the help of C programming language and also by learning the basic programming skills through which they can easily switch over to any other language in future. Also, Students will be able to learn the basic concepts of data structure and use C to implement them.

Learning Outcomes:

After completion of this course successfully the students will be able to:

1. Understand functional hierarchical code organization.
2. Define and manage data structures based on problem subject domain.
3. To work with textual information, characters and strings.
4. To work with arrays of complex objects.
5. To handle possible errors during course execution.
7. To understand how a computer courses works and use various data structures.

B.Sc. (Data Science)
Semester – 1
Paper – V
Programming in C (1DST05)

Unit – I

Introduction to C:

History of C, Overview of Procedural Programming, Using main() function, Compiling and Executing Simple Courses in C.

Data Types, Variables, Constants, Operators and Basic I/O:

Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in courses, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(),), Using Basic Header Files (stdio.h, conio.hetc).

Expressions, Conditional Statements and Iterative Statements: Simple Expressions in C (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

Unit- II

Functions and Arrays :Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments.

Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

Unit – III

Derived Data Types (Structures and Unions) : Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members

Pointers in C :Understanding a Pointer Variable, Simple use of Pointers (Declaring and Dereferencing Pointers to simple variables), Pointers to Pointers, Pointers to structures, Problems with Pointers, Passing pointers as function arguments, Returning a pointer from a function, using arrays as pointers, Passing arrays to functions. Pointers

Unit – IV

Memory Allocation in C :Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation.

File I/O, Preprocessor Directives: Opening and closing a file, Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros.

Reference Books:

1. Let us C, YashwantKanetker, BPB Publications. 17th Edition
2. Programming in ANSI C, E. Balaguruswamy, Tata Mc-Graw Hill. 6th edition
3. Programming with C, Gottfried, Tata McGraw Hill 3rd edition
4. Dennis M. Ritchie, The C Programming Language, Brian W. Kernighan, 2nd Ed., PHI.

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B. Sc. (Data Science)		**Semester - I**	
Course Name : Operating System Lab		Course Code: (1DSP01)	
Periods per week (1 Period is 60 minutes)		4	
Credits		2	
		Hours	Marks
Evaluation Scheme	Practical Examination	6-8*	50
		Total Marks	50

Practicals based on DOS and Windows

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B. Sc. (Data Science)		**Semester - I**	
Course Name : Programming in C lab		Course Code: (1DSP02)	
Periods per week (1 Period is 60 minutes)		4	
Credits		2	
		Hours	Marks
Evaluation Scheme	Practical Examination	6-8*	50
		Total Marks	50

Practical's based on C programming

B.Sc. (Data Science)
Semester – 2
Paper – I
Compulsory English (2DST01)

As per defined by RTMNU syllabus for B.Sc – I (Semester – II)

B.Sc. (Data Science)
Semester – 2
Paper – II
Second Language (2DST02)

As per defined by RTMNU syllabus for B.Sc – I (Semester – II)

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B. Sc. (Data Science)		**Semester - II**	
Course Name : Probability and Statistics (Paper – III)		Course Code: (2DST03)	
Periods per week (1 Period is 60 minutes)		4	
Credits		4	
		Hours	Marks
Evaluation Scheme	Theory Examination	3	80
	Internal Assessment	--	20
		Total Marks	100

Learning Objectives: To make students able to

1. To compute various measures of central tendency.
2. To compute various measures of dispersion, skewness and kurtosis and to calculate range of variables and the deviation of specific data point.

3. To compute the correlation coefficient for bivariate data and calculate the simple linear regression equation for a set of data.
4. Learn the basic and advance concepts of Probability theory
5. Find and understand the applications of Probabilities in data science

Learning Outcomes:
After completion of this course successfully the students will be able to:
1. To understand measures of central tendency and measures of dispersion
2. To understand the concept of correlation and regression as well as able to apply various techniques for the modelling.
3.Solve problem related to probability
4. Understand and use Probability theory to solve real problem of data science
5. Understand and use various Probability distributions for different machine learning related task

B.Sc. (Data Science)
Semester – 2
Paper – III
Probability and Statistics (2DST03)

Unit – I Descriptive Statistics
Statistics and Measures of Central Tendency:
Mean, Median, Mode, Weighted mean, Geometric Mean and Harmonic Mean Measures of Dispersion:
Range, Mean Deviation, Standard Deviation, Quartile Deviation, Co-efficient of variation
Skewness and Kurtosis :
Absolute Measures of skewness, relative measures of skewness, Karl Pearson's co-efficient of skewness, Bowley's Co-efficient of skewness and Kurtosis

Unit – II Correlation and Regression
Concept of correlation, Types of correlation, Karl Pearson's co-efficient of correlation, Probable error, Interpretation of "r", Rank correlation method. Concept of regression, Lines of Regression, Co-efficient of Regression

Unit III Probability
Definition of Probability—Classical and relative frequency approach to Probability. Richard Von Mises, Cramer and Kolmogorov's approaches to Probability.
Random Experiment, sample space, an event, mutually exclusive and exhaustive events. Axiomatic definition of probability.
Conditional Probability, independence of events,

UNIT IV: Random Variable and its Probability distribution
Random variables, Types of random variable and its distribution. expectation of a random variable and its properties. Moments, Moment Generating Function and its properties.

Reference Books:
1. Business Management and Statistics,N G Das, J K Das, McGraw-Hill.
2. Statistical Methods, S.P.Gupta (2014), Sultan Chand & sons

3. Fundamentals of Mathematical Statistics, Gupta,S.C. and Kapoor, V.K.(2000): 10/e, Sultan Chand and Sons.
4. Principals of mathematical Analysis, Walter Rudin, McGraw-Hill.
5. StatisticalTechniquesDr. Pramod Fating, Dr. Milind Gulhane, Dr. Vijay Badge, Dr. SarangJavkhedkar – Sir Sahitya Kendra, Nagpur
6. Business Mathematics and Statistics, Dr. S. R. Arora, Dr. Kavita Gupta, Business Mathematics and Statistics, Taxmann.
7. Business Mathematics,Mrintunjay Kumar, Vikas Publishing House Pvt. Ltd.
8. Mathematics & Statistics, Ajay Goel, AlkaGoel, Taxmann.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
THREE YEAR BACHELOR OF SCIENCE (B. Sc.) DATA SCIENCE DEGREE COURSE
(C B S)

B. Sc. (Data Science)		**Semester - II**	
Course Name : Discrete Mathematics and Graph Theory(Paper – IV)		Course Code: (2DST04)	
Periods per week (1 Period is 60 minutes)		4	
Credits		4	
		Hours	Marks
Evaluation Scheme	Theory Examination	3	80
	Internal Assessment	--	20
		Total Marks	100

Learning Objectives:
To enable the students to understand and create mathematical arguments and solving them with logical skills. This course also enables the students to learn Number Theory, which is applied in data security, Networking, and machine Learning. The topics like Set Theory, Graph Relations, functions are used in various area of computer science such as cryptography, data structures and having key roles in various data science related tool and techniques.

Learning Outcomes: On completion of this course you should be able to:
1. Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, binary relations, graphs and trees
2. Produce convincing arguments, conceive and/or analyses basic mathematical proofs and discriminate between valid and unreliable arguments.
3. Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems

B.Sc. (Data Science)
Semester – 2
Paper – IV
Discrete Mathematics and Graph Theory (2DST04)

UNIT-I: Mathematical Logic and Set Theory Propositions and Logical Operations, Quantifiers, Conditional Statements and Tautologies, Methods of Proof, Principle of Mathematical Induction. Basic concepts of set theory, Operations on Sets, The power set.
Relations and Functions Relations: Ordered pairs and n-tuples, Product Sets and Partitions, Relations and Digraphs, Matrix of Relation, Paths in Relations and Digraphs, Properties of Relations, Equivalence Relations & Partitions, Compatible Relation, Manipulation of Relations, Composition of Relations, Transitive Closure of a relation, Partial order relation, Partially ordered set, Hasse Diagrams.

UNIT-II: Functions: Definition, Composition of functions, Types of Functions, Invertible Function, Permutation Function, Characteristics function of a set with Theorems.
Group Theory Binary Operations, Properties, Semigroups, Monoids, Subsemigroup, Submonoid, Isomorphism & Homomorphism, , Groups(only definitions and examples) Subgroups and Homomorphism, Cosets and Lagrange's Theorem, Normal subgroups.

UNIT-III: Rings, Lattices & Boolean Algebra Rings, Fields, Integral Domain, Ring Homomorphism (definitions & examples), Lattices: Properties, Types of Lattices, Sub lattices, Isomorphic Lattices, Complemented & Modular Lattices (definitions & examples), Boolean Algebra: Definition, Properties, Simplification of Switching Circuits.

Unit- IV: Graph Theory Basic concepts of Graph Theory, Digraphs, Basic definitions, Paths and Circuits, Reachability and Connectedness, Matrix representation of graphs, Subgraphs & Quotient Graphs, Isomorphic digraphs & Transitive Closure digraph, Euler's Path & Circuit (only definitions and examples). Trees, Binary Tree, Labeled Trees, Undirected Trees, Spanning Trees of Connected Relations, Prim's Algorithm to construct Spanning Trees, Weighted Graphs, Minimal Spanning Trees by Prim's Algorithm &Kruskal's Algorithm.

Reference Books

1. Discrete Mathematical Structures (3rd Edition) by Kolman, Busby & Ross PHI.
2. Discrete Mathematical Structures with Applications to Computer Science by Tremblay & Manohar, Tata McGraw- Hill. 35th reprint
3. Combinatorial Mathematics, C.L.Liu (McGraw Hill) 3rd edition
4. Discrete Maths for Computer Scientists & Mathematicians by Mott, Kandel, Baker.2nd edition
5. Elements of Discrete Mathematics by C. L. Liu. 4th edition
6. Discrete Mathematics by Lipschutz. 3rd edition
7. Discrete Mathematics by R.Johnsonbaugh. 8th edition
8. Higher Engineering Mathematics by B.S. Grewal, 40th Edition, Khanna Publication

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THREE YEAR BACHELOR OF SCIENCE (B. Sc.) DATA SCIENCE DEGREE COURSE
(C B S)

B. Sc. (Data Science)		**Semester - II**	
Course Name : Data Structures (Paper – V)		Course Code: (2DST05)	
Periods per week (1 Period is 60 minutes)		4	
Credits		4	
		Hours	Marks
Evaluation Scheme	Theory Examination	3	80
	Internal Assessment	--	20
		Total Marks	100

Learning Objectives:
1. To impart the basic concepts ofsingle and double Linked List,
2. To understand concepts about searching and sorting techniques
3. To Understand basic concepts about recursion, trees and graphs.
4. To understand the algorithms and develop the step by step solutions of problems with the help of data structures.

Learning Outcomes: On successful completion of this course, the students are able:
1. To analyze algorithms and their correctness.
2. To implement various searching and sorting techniques in different problems.
3. To have knowledge of concepts related with Shortest sort and tree and able to apply them.

B.Sc. (Data Science)
Semester – 2
Paper – V
Data Structures (2DST05)

UNIT - I:
LINKED LIST : Linked List, Representation of Single, Double, Header, Circular Single and Double Linked list, All possible operations on Single and Double linked List using Dynamic representation, Polynomial Representation and its Manipulation.

UNIT - II :
STACKS : Stacks terminology, Representation of Stacks in Memory, Operation on Stacks, Polish Notations, Translation of infix to postfix & prefix expression, Infix to Postfix Conversion, Evaluation of Postfix Expression, Recursion, Problems on Recursion, Quick Sort and Tower of Hanoi Problem.

UNIT - III :
QUEUE : Representation of Queues in Memory, Circular Queue. Dequeue and Priority Queue. Operations of above Structure using Array and Linked Representation. SORTING AND SEARCHING: Selection Sort, Insertion Sort, Merge Sort, Efficiency of Sorting Methods, Big-O Notations. Hash Tables, Hashing Technique, Collision Resolution Technique.

UNIT - IV :
TREES : Basic Terminologies, Representation of Binary Trees in Memory, Traversing of Binary tree, Binary Search Tree, Operation on Binary Search Tree, Heap Tree, Operation on Heap Tree, Heap Sort Method GRAPHS : Basic Terminologies, Definition and Representation of Graphs in Memory: Linked List and Matrix Representation. Traversing graphs : BSF, DFS Method.

Text Books:
1. Classical Data Structures : D. Samanta. PHI, New Delhi.
2. DATA STRUCTURE : LIPSCTUZ SCHUM OUTLINE SERIES
3. Data structure Using C++ : Y. Kanetkar
4. Data Structures Using C++: Tennenbaum
5. Data structures by Tremblay Sorenson
6. Data structures by Bhagatsingh Naps

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THREE YEAR BACHELOR OF SCIENCE (B. Sc.) DATA SCIENCE DEGREE COURSE
(C B S)

B. Sc. (Data Science)		**Semester - II**	
Course Name : Statistics lab		Course Code: (2DSP01)	
Periods per week (1 Period is 60 minutes)		4	
Credits		2	
		Hours	Marks
Evaluation Scheme	Practical Examination	6-8*	50
		Total Marks	50

StatisticsLab (Based on syllabus)

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(C B S)

B. Sc. (Data Science)		**Semester - II**	
Course Name : Data Structure lab		Course Code: (2DSP02)	
Periods per week (1 Period is 60 minutes)		4	
Credits		2	
		Hours	Marks
Evaluation Scheme	Practical Examination	6-8*	50
		Total Marks	50

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