Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus

Bachelor of Science (Data Science)

Submitted by

Board of Studies,

Bachelor of Science (Data Science)

FYUGP-Scheme I-VIII Semester

Bachelor of Science (Honors/Research)
(Data Science - Major)
Four Year (Eight Semester Degree Course)
Teaching and Examination Scheme

B.Sc. Sem-I (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Linear Algebra	BDS1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Linear Algebra	BDS1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Programming with 'C++'	BDS1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Programming with 'C++'	BDS1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Office Automation	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

B.Sc. Sem-II (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Data Structure	BDS2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Data Structure	BDS2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Probability and Statistics	BDS2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Probability and Statistics	BDS2P04	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Computer Animation	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-III (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	JAVA Programming	BDS3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	JAVA Programming	BDS3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Digital Electronics and Microprocessor	BDS3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Digital Electronics and Microprocessor	BDS3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

B.Sc. Sem-IV (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Operating System and Linux	BDS4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Operating System and Linux	BDS4P07			2	1	-	-	-	-	25	25	25
3	DSC	Database Management System	BDS4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Database Management System	BDS4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)				2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)				2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-V (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	SQL and PL/SQL	BDS5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	SQL and PL/SQL	BDS5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Data Communication and Networks	BDS5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Data Communication and Networks	BDS5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Statistical Inference	BDS5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Statistical Inference	BDS5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BDS5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 1	BDS5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				**13**	**-**	**18**	**22**	**-**	**520**	**130**	**--**	**150**	**300**	**-**

B.Sc. Sem-VI (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Python Programming	BDS6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Python Programming	BDS6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Artificial Intelligence	BDS6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Artificial Intelligence	BDS6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Cyber Security	BDS6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Cyber Security	BDS6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 2	BDS6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 2	BDS6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	**22**		**440**	**110**		**225**	**325**	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem-VII (Honors) (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Machine Learning	BDS7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Machine Learning	BDS7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Compiler Construction	BDS7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Compiler Construction	BDS7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Computer Graphics	BDS7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Computer Graphics	BDS7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Operation Research	BDS7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Operation Research	BDS7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BDS7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3	BDS7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BDS7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BDS7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**125**	**225**	

B.Sc. Sem-VIII (Honors) (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Advance Java Programming	BDS8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advance Java Programming	BDS8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Time Series Analysis	BDS8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Time Series Analysis	BDS8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Soft Computing	BDS8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Soft Computing	BDS8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	R-Programming	BDS8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	R-Programming	BDS8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BDS8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4	BDS8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem-VII (Research) (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Machine Learning	BDS7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Machine Learning	BDS7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Compiler Construction	BDS7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Compiler Construction	BDS7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Computer Graphics	BDS7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Computer Graphics	BDS7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BDS7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3	BDS7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BDS7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BDS7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

'R' in the subject code indicates 'Research'.

B.Sc. Sem-VIII (Research) (Data Science - Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Advance Java Programming	BDS8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advance Java Programming	BDS8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Time Series Analysis	BDS8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Time Series Analysis	BDS8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Soft Computing	BDS8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Soft Computing	BDS8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4	BDS8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 4	BDS8P25R	-	-	2	1	-	-	-	-	-	50	25
5	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2+1)	-	-	-	-	175	175	175
Total				09	-	22	**20**		**360**	**90**		**225**	**325**	

'R' in the subject code indicates 'Research'.

Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Data Science)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Office Automation	Inter disciplinary program in Science (Data Science)	**BVS1P01**
II	**VSC**	Computer Animation	Inter disciplinary program in Science (Data Science)	**BVS2P03**
III	**VSC**	Web design using HTML and DHTML	Inter disciplinary program in Science (Data Science)	**BVS3P05**
V	**VSC**	Web Development using Java	Inter disciplinary program in Science (Data Science)	**BVS5P07**
VI	**VSC**	Shell Programming	Inter disciplinary program in Science (Data Science)	**BVS6P08**

Basket for ELECTIVE (DSE) Category Courses (Data Science)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Data Mining	BDS5T12
		B. Microcontroller and Embedded Systems	
VI	Elective 2	A. Business Analytics	BDS6T16
		B. Design and Analysis of Algorithm	
VII (Honors)	Elective 3	A. Big Data Analytics	BDS7T21
		B. Internet of Things	
VIII (Honors)	Elective 4	A. Social Media Analytics	BDS8T27
		B. Predictive Modelling Analysis	
VII (Research)	Elective 3	A. R-Programming	BDS7T20R
		B. Data Visualization	
VIII (Research)	Elective 4	A. Health Care Analytics	BDS7T25R
		B. Natural Language Processing	

'R' in the subject code indicates 'Research'.

Bachelor of Science (Honors/Research)
(Data Science - Major)
Four Year (Eight Semester Degree Course)

The objectives of the Program

1. The primary objective of this program is to provide a foundation of computing principles for effectively using information systems and enterprise softwares.

2. It helps students to demonstrate proficiency with statistical analysis of data.

3. This programme provides students with options to specialize in various software system.

4. To produce outstanding Computer Scientists who can apply the theoretical knowledge into practice in the real world and develop standalone live projects themselves

5. To provide opportunity for statistical analyses with professional statistical software

6. To develop among students the programming techniques and the problem solving skills through programming

7. To prepare students to apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

8. To acquaint students to Work effectively with a range of current, standard, Office Productivity software applications

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Discipline knowledge: Acquiring knowledge on basics of Computer Science and ability to apply to design principles in the development of solutions for problems of varying complexity
2. Problem Solving: Improved reasoning with strong mathematical ability to Identify, formulate and analyze problems related to computer science and exhibiting a sound knowledge on data structures and algorithms.
3. Design and Development of Solutions: Ability to to prepare students to apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively
4. Programming a computer: Exhibiting strong skills required to program a computer for various issues and problems of day-to-day scientific applications.
5. Application Systems Knowledge: Possessing a minimum knowledge to practice existing computer application software. Provide opportunity for statistical analyses with professional statistical software
6. Communication: Must have a reasonably good communication knowledge both in oral and writing.
7. Ethics on Profession, Environment and Society: Exhibiting professional ethics to maintain the integrality in a working environment and also have concern on societal impacts due to computer-based solutions for problems.
8. Lifelong Learning: Should become an independent learner. So, learn to learn ability.

9. Motivation to take up Higher Studies: Inspiration to continue educations towards advanced studies on Computer Science.

B.Sc. Sem-I (Data Science –Major)
SC-DSC (Paper I)
BDS1T01

Linear Algebra

Credits : 2 **Duration :30 Hours**

Course Objectives:

1.To cover certain solution of system of linear equations, vector space and orthogonality concepts for analyzing problems that arise in physical science.
2. To analyze the problems connected Eigen value, Hermitian and Unitary linear transformations.
3. To solve QR and LU decomposition and to learn the applications of linear algebra in computer science.

Course Outcomes: At the end of the course the student should be able to

1. Observe the various types of matrix, determinant and its properties.
2. Understand the concepts of system of linear equations and solving by various methods.
3. Understand the concepts of vector space, subspace and basis.
4. Understand the concepts of orthogonality, Hermitian and unitary transformations.

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, doubledual, 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 ComponentAnalysis, Singular-Value Decomposition, Latent Semantic Analysis,
Case Studies:
Recommender Systems, Page Ranking.

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.

B.Sc. Sem-I (Data Science –Major)
SC-DSC (Paper II)
BDS1T02

PROGRAMMING USING 'C++'

Credits : 2 **Duration :30 Hours**

Course Objectives:
1. To provide basic characteristics of OOP through C++.
2. To impart skills on various kinds of overloading and inheritance.
3. To introduce pointers and file handling in C++ together with exception handling mechanism.

Course Outcomes:
After completion of this course, students will be able to:
1. Realize the need and features of OOP and idealize how C++ differs from C.
2. Infer knowledge on various types of overloading.
3. Choose suitable inheritance while proposing solution for the given problem.
4. Handle pointers and effective memory management.
5. Illustrate application of pointers in virtual functions.

UNIT I

Introduction to Object Oriented Programming: Introduction, Characteristics of OOPs, Advantages of OOPs, Disadvantages of OOPs, **Data Types, Operators and Expressions:** Identifiers & Keywords, Data Types, C++ Operators, Type Conversion. **Input and Output Streams:** Comments, Declaration of Variables, Simple C++ Programs, Manipulator Functions, Input and Output (I/O) **Control Statements:** Conditional Expressions, Loop Statements, Nested Control Structures, Breaking Control Statements.

UNIT II

Function and Program Structures: Introduction, Defining a Function, Return Statement, Types of Functions, Actual & Formal Arguments, Local & Global Variables, Default Arguments, Structure of C++ Program, Order of the Function Declaration, Scope Rules, Storage Class Specifiers, Recursive Function **Arrays:** Introduction, Array Notation, Array Declaration, Array Initialization, Processing with Arrays, Character Array. **Pointers and Strings:** Introduction, Pointer Arithmetic, Pointers and Functions, Pointers and Arrays, Pointer and Strings.

Structures and Unions Introduction, Declaration of Structure, Processing with Structures, Initialization of Structures, Functions and Structures, Array of Structure, Pointer and Structure, Unions.

UNIT III

Classes and Objects: Introduction, Structures and Classes, Declaration of Class, Member Functions, Defining the Object of a Class, Accessing a Member of Class, Array of Class Objects, Pointer and Classes. **Special Member Function:** Introduction, Constructors, Destructors, Inline Member Functions, Static Class Members, Friend Function, This Pointer. **Single and Multiple Inheritance:** Introduction, Single Inheritance, Types of Base Classes, Type of Derivation, Multiple Inheritance, Member Access Control.

UNIT IV

Overloading Functions and Operators: Function Overloading, Operator Overloading, Overloading of Binary Operators, Overloading of Unary Operators. **Polymorphism and Virtual Functions:** Polymorphism, Virtual Functions, Pure Virtual Functions, Abstract Base Classes, Virtual Base Classes.

Books:

1. D. Ravichandran, Programming with C++, McGraw-Hill.
2. E. Balaguruswamy, Object Oriented Programming with C++, McGraw-Hill.
3. RohitKhurana, Object Oriented Programming with C++, Vikas Publishing House Pvt. Ltd.
4. Anirban Das, GoutamPanigrahi, Object Oriented Programming with C++, Vikash Publishing House Pvt. Ltd.
5. Herbert Schildt, The Complete Reference – C++, McGraw-Hill.

B.Sc. Sem-I (Data Science)

BVS1P01

OFFICE AUTOMATION

Credits : 2 **Duration : 60 Hours**

Course Objectives:

1.To understand functionality of Operating Systems and its applications.
2.To understand the working with the user interface.
3.To understand Word Processing, their usage, details of word processing screen, Opening, saving and printing a document
4.To understand Worksheet creation, inserting and editing data in cells..
.

Course Outcomes :

After completing this course satisfactorily, a student will be able to:
1. understand functionality of Operating Systems and its applications.
2. Working with the user interface.
3. prepare documents, letters and do necessary formatting of the document.
4. Worksheet creation, inserting and editing data in cells.
5. Opening/saving a presentation and printing of slides and handouts.

UNIT I

Introduction to windows Operating System Advantages of windows operating system, using different windows applications simultaneously, operating with windows, GUI, use of help features, starting an application, essential accessories, creating shortcuts, windows explorer, control panel, my computer, my documents, recycle bin, finding folders and files, changing system settings, system tools, use of run command, setting peripherals, drivers, editing graphics in windows.

UNIT II

Introduction, basics, starting Word, creating document, parts of Word window, mouse and keyboard operations, designing a document; Formatting- selection, cut, copy, paste; Toolbars, operating on text; Printing, saving, opening, closing of document; Creating a template; Tables, borders, pictures, text box operations; Mail Merge.

UNIT III

Introduction to MS EXCEL, navigating, Excel toolbars and operations, Formatting; copying data between worksheets; entering formula, chart creation; data forms, data sort; Functions in ExcelROUND( ), SQRT ( ), MAX( ), MIN( ), AVERAGE( ), COUNT( ), SUMIF( ), SUMIF( ), ABS( ), ROMAN( ), UPPER( ), LOWER( ), CELL( ), TODAY( ), NOW( ).

UNIT IV

Introduction to MS POWER POINT Working with Power Point Window, Standard Tool Bar, Formatting tool bar, Drawing tool Bar, Moving the Frame, Inserting Clip Art, Picture, Slide, Text Styling, Send to back, Entering data to graph, Organization Chart, Table,Design template, Master Slide, Animation Setting, Saving and Presentation , auto Content Wizard.

Books

1.MS Office XP for Everyone By Sanjay Saxena (Vikas Publi, Noida)
2.MS-Office 2000(for Windows) By Steve Sagman
3.A First Course in Computers – Sanjay Saxena

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
C. Components of Environment: Atmosphere (Structure and composition),hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto- cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.
C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr **P.U. Meshram, Allied Publishers, New Delhi.**
8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)

SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	TOTAL	**30 HRS**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, MotilalBanarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution ofCivil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

B.Sc. Sem-II (Data Science –Major)
SC-DSC (Paper I)
BDS2T03

DATA STRUCTURES

Credits : 2 **Duration :30 Hours**

Course Objectives:
1. To understand basic data structures arrays, records, linked structures, stacks, queues, trees, and graphs
2. To understand algorithms for arrays, records, linked structures, stacks, queues, trees, and graphs
3. To understand the computational efficiency of the principal algorithms for sorting and searching

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to:
1.Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
2. Describe common applications for arrays, records, linked structures, stacks,queues, trees, and graphs
3.Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
4. Demonstrate different methods for traversing trees
5. Compare alternative implementations of data structures with respect to performance
6.Describe the concept of recursion, give examples of its use
7.Discuss the computational efficiency of the principal algorithms for sorting and searching

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.

Reference Books

1. Classical Data Structures: D. Samanta, PHI, New Delhi.

2. Data Structure: SchaumLipschutz, Outline Series
3. Data structure Using C++: Y. Kanetkar
4. Data Structures Using C++: Tanenbaum
5. Data structures by Tremblay Sorenson
6. Data structures by Bhagatsingh Naps

B.Sc. Sem-II (Data Science –Major)
SC-DSC (Paper II)
BDS2T04
Probability and Statistics

Credits : 2 **Duration :30 Hours**

Course Objectives:
1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationships of real-time data.
3. To apply estimation and testing methods to make inference and modeling techniques for decision making.

Course Outcomes : At the end of this course the students are expected to
1. Have an understanding of the probability concepts.
2. Analyze the problems connected with statistics.
3. Understand how to make the transition from a real problem to a probability model for that problem.
4. Expose students to practical applications.

Unit I
Descriptive Statistics
Statistics and Measures of Central Tendency:
Mean, Median, Mode, Weighted mean, Geometric Mean and Harmonic Mean Measures ofDispersion:Range, Mean Deviation, Standard Deviation, Quartile Deviation, Co-efficient of variationSkewness and Kurtosis :Absolute Measures of skewness, relative measures of skewness, Karl Pearson's co-efficient ofskewness, 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, Probableerror, 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 VonMises, Cramer and Kolmogorov's approaches to Probability.Random Experiment, sample space, an event, mutually exclusive and exhaustive events.Axiomaticdefinition 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 variableand its properties. Moments, Moment Generating Function and its properties.

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 Mathematicsand Statistics, Taxmann.
7. Business Mathematics,Mrintunjay Kumar, Vikas Publishing House Pvt. Ltd.
8. Mathematics & Statistics, Ajay Goel, AlkaGoel, Taxmann.

B.Sc. Sem-II (Data Science)
BVS2P03
COMPUTER ANIMATION

Credits : 2 **Duration : 60 Hours**
Course Objectives:

1. To Understand the concept of 2D and 3D Animation.
2. To Execute creative concepts and ideas through a variety and combination of techniques including hand drawn, computer generated, 2D and 3D storyboards and animatics.
3. To Understand how animation works.
4. To Understand the basic concepts of multimedia technology which will help them to get started easily in multimedia.

Course Outcome: After completion of this course, students will be able to:
1. Get knowledge about various terms like, images, text, fonts, file formats. Understanding these things is very necessary.
2. produce traditional style animation as well as puppet animation and the knowledge of the principles of animation to be built upon in subsequent courses leading up to the Portfolio course.
3. apply skills learned in this class in other areas including motion graphics, stop motion and basic traditional animation

Unit I
Animation, Introduction to 2D and 3D Animation. Advantages of animation, Different tools of 2D Animation.
GIMP Features and Capabilities, Toolbox, Image Window, Dialog and Docking, Working with images,
Pencil2D , Overview of Pencil2D, Traditional Animation Workflows, How to rotate image, Scrolling background in Camera layer

Unit II
Opentoonz , Production Workflow, Interface Overview, Managing Projects,Setting Up a Scene, Scanning Paper Drawings, Cleaning-up Scanned Drawings, Drawing Animation Levels, Editing Animation Levels, Managing Palettes and Styles, Painting Animation Levels, Working in Xsheet/Timeline, Creating Movements, Editing Using Spreadsheet and Curves, Creating Cutout Animation, Create animations using Plastic tool, Applying Effects, Using the Particles Effect, Previewing and Rendering

Unit III
Blender, History and Installation, Interface : Blender Interface, Adding New Objects, Moving Things Around, Modeling : Mesh, Edit Mode, Sculpt Mode, Retopology
Lighting and Procedural Textures : Setting Up a Basic Scene, The Scene Camera, Procedural Materials and Textures., UV Mapping : Creating a UV Map, Texture Painting, Projection Painting, Normal Maps and Bump Maps
Curves and NURBS : Metaballs, Curves, Spins, Nurbs,

Unit IV
Basic Rigging and Animation : Keyframing with the Timeline, The Dopesheet ., Parenting, Graph Editor, Pivot Point: The Center of Rotation, Basic Tracking: Eyes That Follow, Rigging

with Bones, Rigging a Simple Character, Advanced Rigging ..: Forward Kinematics vs. Inverse Kinetics, Blender 2.5 Rigs, Walk Cycles., Shape Keys, Lip Syncing.
Making Movies : Disabling, Color Management, Rendering Formats, Alpha, Lighting Adjustments, The Video Sequence Editor, Crash Management and Rendering Speed, Introduction to Game Engine.

Books :

https://docs.gimp.org/odftest/en.pdf
https://opentoonz.readthedocs.io/en/latest/using_the_toonz_farm.html
https://www.pencil2d.org/doc/tutorials
Beginning Blender Open Source 3D Modelling, Animation, and Game Design, Lance Flavell, Apress.
https://www.academia.edu/7984869/Beginning_Blender_Open_Source_3D_Modeling_Animation_and_Game_Design_Companion_eBook_Available_Full_Color_Inside_BOOKS_FOR_PROFESSIONALS_BY_PROFESSIONALS_Beginning_Blender_Open_Source_3D_Modeling_Animation_and_Game_Design

Reference Book :

Learning Blender A Hands-On Guide to Creating 3D Animated Characters, Oliver Villar
Blender Basics Classroom Tutorial Book 4th Edition, James Chronister. https://www.cdschools.org/cms/lib04/pa09000075/centricity/domain/81/blenderbasics_4thedition2011.pdf
Blender 3D Basics Beginner's Guide: A quick and easy-to-use guide to create 3D modeling and animation using Blender 2.7, Gordon Fisher

SEM 2 : CONSTITUION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity

- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

1. It is possible to create a map of the intellectual growth of a culture usingastronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phasetransitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the pastdramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	**8**
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	**8**
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	**7**
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	**7**
	TOTAL	**30 HRS**

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao.Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan,Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin% 20of%20Astronomy.pdf