Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

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दूरध्वनी - इपीबीएक्स - २०६०९०००, अध्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
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SU/BOS/Sci & Tech/ 535 **Date: 04/09/2025**

To,

The Principal / Director,
All Concerned Affiliated Colleges / Institutions,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **BCA** & **B. Sc.** degree **Programme** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, (Nature of Question paper and equivalence) of BCA & B. Sc. under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

No.	Course Syllabus
1	B.Sc. Data Science (Entire) Part - I (Sem - I – II)
2	B.Sc. Artificial Intelligence Part - I (Sem - I – II)
3	BCA Part - III (Sem - V – VI)

This Syllabus, shall be implemented from the academic year **2025-26** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in NEP-2020@suk (Online Syllabus)**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2025 & March / April 2026. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
Dy. Registrar

Encl. : As above.

Copy to: For Information and necessary action.

1	The I/c Dean, Faculty of Science & Technology	7	Appointment Section A & B
2	Director, Board of Examinations & Evaluation	8	Affiliation Section (T.1) (T.2)
3	The Chairpersan, Respective Board of Studies	9	P.G.Admission Section,
4	B.Sc Section,	10	Computer Centre,/IT Cell
5	Eligibility Section,	11	Internal Quality Assorance Cell (IQAC)
6	P.G Seminar Section		

SHIVAJI UNIVERSITY, KOLHAPUR

NAAC A++ Grade with CGPA 3.52

Multiple Entry and Multiple Exit Option (NEP-2020)

Syllabus for

B. Sc. Data Science(Entire)

(Under Faculty of Science and Technology)

PART- I SEMESTER- I & II

(Syllabus to be implemented from Academic year 2025-26)

Shivaji University, Kolhapur
B.Sc. Data Science (Entire)
(Under Faculty of Science and Technology)

Program Outcomes (PO):

Upon successful completion of the B.Sc. Data Science (Entire), the student should have met the following outcomes:

1. Apply skills and concepts of Computer Science and Data Science to understand, design, and implement data-driven solutions from problem statements.
2. Ability to design, develop, and implement real-world problems into data-based software solutions.
3. Apply mathematical, statistical, and machine learning models to explore, analyze, and interpret massive datasets in various domains.
4. Design and develop data processing and analytical systems for managing and extracting insights from varied, voluminous, and complex data sources.
5. Recognize the importance of innovation and develop a critical and research-oriented approach to build intelligent, efficient, and innovative data products.
6. Recognize social, professional, cultural, humane, and ethical values in the handling of data and consider privacy, security, and fairness in developing and deploying data-driven systems.
7. Be self-motivated and enhance lifelong learning skills as well as the capability to adapt to emerging data technologies to create innovative solutions for societal and industrial challenges.

Program Specific Outcomes (PSO):

Upon successful completion of the B.Sc. Data Science (Entire), students will be able to:
Program Outcomes

1. An ability to apply theoretical concepts of Data Science, Statistics, and Computer Science in diverse application areas.
2. Encouraging students to convert their data-centric start-up ideas into reality by implementing them with appropriate tools and technologies.
3. Focuses on preparing students for roles in data analytics, business intelligence, data engineering, and the IT industry.
4. Develop programming skills, data visualization skills, statistical analysis skills, and learn applications, tools, packages, programming languages, and modern techniques in data science.
5. Gain knowledge about various data processing frameworks, cloud-based solutions, and latest advancements in data science and big data technologies.

6.Ability to identify, collect, preprocess, analyze, and visualize data, and develop solutions using

different programming languages and analytical tools.

7. Take up self-employment or consultancy in the Indian and global data science market.

8. Understand various ethical, privacy, and legal issues in data usage and be aware of latest trends in technology to innovate new ideas and solutions to existing problems.

1. Introduction

A. The name of the program shall be B.Sc. Data Science (Entire).

B. After completion, students will be able to apply data-driven analytical thinking and modern data science tools and techniques, using open-source platforms, to analyze, interpret, and derive actionable insights from data to solve real-world problems.

C. **Job Opportunities:** The program addresses the growing demand for data professionals in domains such as data analytics, machine learning, AI, business intelligence, data engineering, and cloud-based big data solutions.

D. Graduates can begin their careers as data analysts, data engineers, or junior data scientists, and with experience, can progress to roles like machine learning engineers, AI specialists, or data science consultants.

E. Others may pursue entrepreneurial paths by developing analytics products, offering data consultancy, or building AI-enabled services.

F. Career opportunities exist in a wide range of industries including finance, healthcare, e-commerce, manufacturing, government, and research, with roles involving data modeling, visualization, machine learning, technical consulting, product development, and support.

G. The present curricula focus on the learning aspect from three dimensions:

H. Conceptual Learning: Fundamental principles of data science, statistics, mathematics, and computer science

I. Skills Learning: Hands-on training in tools like Python, R, SQL, Excel, Tableau, and cloud-based platforms

J. Practical / Hands-on: Capstone projects, mini-projects, internships, and real-world datasets

2. Medium of Instruction:

The medium of instruction will be English only.

3. Admission Procedure

To be eligible for admission to the B.Sc. Data Science (Entire), a candidate must have passed:

- HSC (10+2) from science stream,

OR

- A Three-Year Diploma Course (after SSC i.e. 10th Standard), of Board of Technical Education

conducted by Government of Maharashtra or its equivalent

4. Course Structure:

Lectures and Practical should be conducted as per the scheme of lectures and practical's indicated in the course structure.

5. Teaching and Practical Scheme

A. Contact session for teaching 60 minutes each.

B. One Practical Batch should be of 20 students.

C. Practical evaluation should be conducted after the commencement of university examination.

6. Assessment

1. The project will be evaluated by the university appointed examiners both internal as well as external.

2. The final practical examination will be conducted by the university appointed examiners both internal as well as external at the end of semester for each lab course and marks will be submitted to the university by the panel.

3. The practical examination will be conducted semester wise in order to maintain the relevance of the respective theory course with laboratory course.

4. The final examinations shall be conducted at the end of the semester.

5. Nature of question paper:

Nature of question paper is as follows for University end semester examination

❖ **Theory Examination:**

Year	Semester	Activity	Marks (2 Credits)
1	I & II	1. Home Assignment 2. Class Assignment (Tutorial type) 3. Quiz 4. Midterm Test*	5 5 5 5
2	III & IV	1. Oral Examination 2. Group Discussion 3. Seminar 4. Midterm Test*	5 5 5 5
3	V & VI	1. Case Study 2. Field Work 3. Book Review/ Poster Presentation 4. Midterm Test*	5 5 5 5
4	VII & VIII	1. Seminar 2. Case Study/ Problem Solving 3. Book Review/ Poster Presentation 4. Midterm Test*	5 5 5 5
Note: 1. Midterm Test shall be conducted after completion of each unit 2. Book Review (Only from Reference Book)			

Each paper will carry 30 Marks

1. Question No.1 is compulsory and is of multiple choice questions. There will be 6 multiple choice questions each carrying 1 mark

2. Question No.2 will have 3 questions out of which 2 questions need to be solved. Each carries 6 Marks

3. Question No.3 will have 6 questions out of which 4 questions need to be solved. Each carries 3 Marks.

❖ **Practical Examination:**

1. Each paper carries 30 Marks
2. Duration of Practical Examination: 2 Hrs
3. Nature of Question paper: There will be 3 questions out of which any 2 questions to be attempted and each question carries 15 Marks.
4. Internal Marks: 20(Journal :10 Marks, Internal Viva:10 Marks)
5. Practical evaluation should be conducted after the commencement of University examination by External examination.
6. Theory/Practical Exams of Open Elective will be conducted by Internal Evaluator.

7. Standard of Passing:

1. Minimum 35% marks in each subject. There shall be separate passing for theory and practical.
2. Admission to B.Sc. Data Science Part II is allowed even if the student fails in 20 subjects of First year B.Sc. Data Science
3. Admission to B.Sc. Data Science part III is allowed even if the students fail in 20 subjects of B.Sc. Data Science Part II. But no student is allowed to take admission to the third year of B.Sc. Data Science unless they clear all the papers of the first year.

8. Board of Paper Setters /Examiners:

For each Semester end examination there will be a board of Paper setters and examiners for every course. While appointing paper setter/examiners, care should be taken to see that there is at least one person specialized in each unit of the course.

9. Credit system implementation:

As per the University norms

10. Clarification of Syllabus: The syllabus committee should meet at least once in a year to study and clarify any difficulties from the Institutes.

11. Eligibility of Faculty:

MCA (from any faculty) or M.Sc. (Computer Science) with at least B+ or equivalent

12. Revision of Syllabus:

As computer technology experiences a rapid rate of obsolescence of knowledge, revision of the syllabus should be considered every two/three years.

13. Fees Structure: As approved by the Shivaji University fee fixation committee.

14. Intake Capacity: 80

15. Award of Class:

Grading: Shivaji University has introduced a Seven-point grading system as follows:

B. Sc. Data Science(Entire) Part I Semester I & II
Multiple Entry and Multiple Exit Option
(NEP-2020) 2.0
Syllabus to be implemented from Academic Year 2025-26

Sr. No.	Marks Range out of 50	Grade Point	CGPA	Letter grade
1.	43-50	10	9.50-10.00	O: Outstanding
2.	38-42	9	8.50-9.49	A+:Excellent
3.	33-37	8	7.50-8.49	A:Very Good
4.	28-32	7	6.50-7.49	B+:Good
5.	23-27	6	5.50-6.49	B: Average
6.	18-22	5	4.50-5.49	C:Satisfactory
7.	0-17	0	0.0-4.49	F:Fail
8.	Absent	0	------	-----

Multiple Entry and Multiple Exit Option (NEP-2020)

B.Sc. Data Science (Entire) Program Structure

B.Sc. Data Science (Entire) Part - I (Level-4.5)

Semester	Subject Type	Course Code	Course Title
SEM – I	Course I:	Subject I DSC I:	C Programming
		Subject I DSC II:	Foundation of Data Science
		Subject I Practical I:	Practical based on Subject I DSC I
	Course II:	Subject II DSC I:	Web Technology
		Subject II DSC II:	Operating System
		Subject II Practical I:	Practical based on Subject II DSC I
	Course III:	Subject III DSC I:	Discrete mathematics
		Subject III DSC II:	Graph Theory
		Subject III Practical I:	Practical based on Subject III DSC I & Subject III DSC II
	OE - I		Business Statistics using MS Excel/Linux Practical – I
	IKS - I		Vedic Mathematics
SEM – II	Course I:	Subject I DSC III:	Python Programming
		Subject I DSC IV:	Data Structure using C
		Subject I Practical II:	Practical based on Subject I DSC III & Subject III DSC IV
	Course II:	Subject II DSC III:	Database Engineering
		Subject II DSC IV:	Business Intelligence and Analytics
		Subject II Practical II:	Practical based on Subject II DSC III
	Course III:	Subject III DSC III:	Descriptive Statistics
		Subject III DSC IV:	Probability Distribution
		Subject III Practical II:	Practical based on Subject III DSC III & Subject III DSC IV
	OE - II		Business Statistics using MS Excel/Linux Practical – II
	VEC - I		Democracy, Election and Constitution

Multiple Entry and Multiple Exit Option (NEP-2020)

B.Sc. Data Science(Entire) Programme Structure

B.Sc. Part - I (Level-4.5)

SEMESTER-I (Duration- Six Month)								
Sr. No.	Course Code	Teaching Scheme			Examination Scheme			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	Subject I DSC I:	2	-	2	30	11	20	07
2	Subject I DSC II:	2	-	2	30	11	20	07
3	Subject I Practical I:	-	4	2	30	11	20	07
4	Subject II DSC I:	2	-	2	30	11	20	07
5	Subject II DSC II:	2	-	2	30	11	20	07
6	Subject II Practical I:	-	4	2	30	11	20	07
7	Subject III DSC I:	2	-	2	30	11	20	07
8	Subject III DSC II:	2	-	2	30	11	20	07
9	Subject III Practical I:	-	4	2	30	11	20	07
10	OE-I(T/P):	-	4	2	30	11	20	07
11	IKS-I:	2	-	2	30	11	20	07
	Total (A)			22	330		220	

SEMESTER-II (Duration- Six Month)								
Sr. No.	Course Code	Teaching Scheme			Examination Scheme			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	Subject I DSC III:	2	-	2	30	11	20	07
2	Subject I DSC IV:	2	-	2	30	11	20	07
3	Subject I Practical II:	-	4	2	30	11	20	07
4	Subject II DSC III:	2	-	2	30	11	20	07
5	Subject II DSC IV:	2	-	2	30	11	20	07
6	Subject II Practical II:	-	4	2	30	11	20	07

7	Subject III DSC III:	2	-	2	30	11	20	07
8	Subject III DSC IV:	2	-	2	30	11	20	07
9	Subject III Practical II:	-	4	2	30	11	20	07
10	OE-II(T/P) :	-	4	2	30	11	20	07
11	VEC-I(Democracy, Election and Constitution)	2	-	2	30	11	20	07
	Total (B)			22	330		220	
	Total (A+B)			**44**	**660**		**440**	

Multiple Entry and Multiple Exit Option (NEP-2020)

B.Sc. Data Science (Entire)

Programme Structure

B.Sc. Part – II (Level-5.0)

SEMESTER-III (Duration- Six Month)								
Sr. No.	Course Code	**Teaching Scheme**			**Examination Scheme**			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	Subject I Major V	2	-	2	30	11	20	07
2	Subject I Major VI	2	-	2	30	11	20	07
3	Subject I Major Practical III	-	4	2	30	11	20	07
4	Subject II Minor V	2	-	2	30	11	20	07
5	Subject II Minor VI	2	-	2	30	11	20	07
6	Subject II Minor Practical III	-	4	2	30	11	20	07
7	OE – III (T/P)	2	-	2	30	11	20	07
8	VSC – I (P) (Major specific)	2	-	2	30	11	20	07
9	SEC-I (T/P):	-	4	2	30	11	20	07
10	AEC-I(English)	-	4	2	30	11	20	07
11	CC-I	2	-	2	30	11	20	07
	Total (A)			22	330		220	

SEMESTER-IV (Duration- Six Month)								
Sr. No.	Course Code	Teaching Scheme			Examination Scheme			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	Subject I Major VII	2	-	2	30	11	20	07
2	Subject I Major VIII	2	-	2	30	11	20	07
3	Subject I Practical IV	-	4	2	30	11	20	07
4	Subject II Minor VII	2	-	2	30	11	20	07
5	Subject II minor VIII	2	-	2	30	11	20	07
6	Subject II Minor Practical IV	-	4	2	30	11	20	07
7	OE – IV (T/P)	2	-	2	30	11	20	07
8	SEC-II(T/P)	2	-	2	30	11	20	07
9	AEC-II(English)	-	4	2	30	11	20	07
10	VEC-II (Environmental studies)	-	4	2	30	11	20	07
11	CEP-I	2	-	2	30	11	20	07
	Total (B)			22	330		220	
	Total (A+B)			**44**	**660**		**440**	

Multiple Entry and Multiple Exit Option (NEP-2020)

B.Sc. Data Science(Entire)

Programme Structure

B.Sc. Part - III (Level-5.5)

SEMESTER-V (Duration- Six Month)								
Sr. No.	Course Code	Teaching Scheme			Examination Scheme			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	Subject I Major IX	2	-	2	30	11	20	07
2	Subject I Major X	2	-	2	30	11	20	07
3	Subject I Practical V	-	8	4	60	21	40	14

4	Subject II Major I (Elective)	2	-	2	30	11	20	07
5	Subject II Major Practical-1 (Elective)	-	4	2	30	11	20	07
6	OE – V (T/P)	-	4	2	30	11	20	07
7	VSC-II (Major specific) (P)	2	-	2	30	11	20	07
8	AEC-III (English)	2	-	2	30	11	20	07
9	OJT (On Job Training)	-	-	4	60	21	40	14
	Total (A)			22	330		220	

SEMESTER-VI (Duration- Six Month)

Sr. No.	Course Code	**Teaching Scheme**			**Examination Scheme**			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	Subject I Major XI	2	-	2	30	11	20	07
2	Subject I Major XII	2	-	2	30	11	20	07
3	Subject I Practical VI	-	4	2	30	11	20	07
4	Subject II Major II Elective:	2	-	2	30	11	20	07
5	Subject II minor VIII	2	-	2	30	11	20	07
6	Subject II Major Practical-II Elective	-	4	2	30	11	20	07
7	VSC-III (P) (Major specific)	2	-	2	30	11	20	07
8	SEC-III (T/P)	2	-	2	30	11	20	07
9	AEC IV (English)	-	4	2	30	11	20	07
10	IKS-II (Major specific)	-	4	2	30	11	20	07
11	FP	2	-	2	30	11	20	07
	Total (B)			22	330		220	
	Total (A+B)			**44**	**660**		**440**	

Multiple Entry and Multiple Exit Option (NEP-2020) B.Sc.

Data Science (Entire) Programme Structure

B.Sc. Part - VI (Level-6.0)

SEMESTER-VII (Duration- Six Month)								
	Course Code	**Teaching Scheme**			**Examination Scheme**			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
Major Mandatory	Major-XIII	4	--	4	60	21	40	14
	Major-XIV	4	--	4	60	21	40	14
	Major(p)-VII	--	8	4	60	21	40	14
	Major(p)-VII	--	4	2	30	11	20	07
Major Elective	Major-III (ELEC)	4	--	4	60	21	40	14
Research Methodology	RM-I	4	--	4	60	21	40	14
	Total (A)			22	330		220	
SEMESTER-VIII (Duration- Six Month)								
	Course Code	**Teaching Scheme**			**Examination Scheme**			
		Theory and Practical			University Assessment (UA)		Internal Assessment (IA)	
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
Major Mandatory	Major - XV	4	--	4	60	21	40	14
	Major - XVI	4	--	4	60	21	40	14
	Major(P) - IX	--	8	4	60	21	40	14
	Major(p) - X	--	4	2	30	11	20	07
Major Elective	Major-IV (ELEC)	4	--	4	60	21	40	14
OJT/FP	OJT	--	--	4	60	21	40	14
	Total (B)			22	330		220	
	Total (A+B)			**44**	**660**		**440**	

Multiple Entry and Multiple Exit Option (NEP-2020)

B.Sc. Data Science (Entire)

Integrated Programme Structure B.Sc. Part - IV (Level-6.0)

Semester-VII		
Course Code	**Major Mandatory**	
Major- XIII	(4 credits)	
Major – XIV	(4 credits)	
Major(P)-VII	(2 credits)	
Major (ELEC)	(4 credits)	
RM-I	Research Methodology (4 credits)	
RP - 4	(4 credits)	
Semester-VIII		
Course Code	**Major Mandatory**	
Major- XV	(4 credits)	
Major- XVI	(4 credits)	
Major(p) – VIII	Practical-II (2 credits)	
Major- (ELEC)	(4 credits)	
RP	(8 credits)	

● Student contact hours per week: **30** Hours (Min.)	● Total Marks for B.Sc. Data Science (Entire)-I: **1100**
● Theory and Practical Lectures: **60** Minutes Each	● Total Credits for B.Sc. Data Science (Entire)-I (Semester I & II): **44**
● **Requirement for Entry at Level 4.5: Completed all requirements of the 10+2**	
● DSC: Department Specific Core ● OE: Open Elective	● IKS: Indian Knowledge System ● VEC: Value Education Course
● Practical Examination is Semester wise before Theory Examination.	● Separate passing is mandatory for Theory, Internal and Practical Examination
● **Exit Option at Level 4.5:** Students can exit after Level 4.5 with under **Certificate Course in Computer Programming** if he/she completes the courses equivalent to minimum of **44** credits and an **additional 4 credits** core NSQF course / Internship.	

B. Sc. Part- I Data Science (Entire) (Semester I)
Course Code: Subject I DSC I: Course Title: C Programming
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):

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

1 Understand the concept of design tools (Algorithm and Flowchart) to give solutions to the problem.

2 Use basics of C language syntax as identifiers, keywords, variables, data types and operators

3 Apply the concept of branching, looping, decision-making statements and Array for a given problem.

4 Apply basic pointer concepts to access data, arrays, and implement pass-by-reference in functions.

5 Perform basic file operations such as open, close, read, write, and append using file handling functions in C

Credits 2	**SEMESTER-I** **Course I:--- : C Programming**	**No. of hours per unit/ credits**
Unit I:	**Program Basics**	(15)
	Overview of C: History and Features of C; Structure of a C Program; Creating, Compilation and Executing process of C Program Using gcc compiler. **Basics of C program:** Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf **Operators and Expressions**: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence . **Control Flow Statements:** If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. **Arrays Declaration and Initialization**, 1-Dimensional Array, 2-Dimensional Array **String processing**: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets) simple programs covering arrays and strings	
Unit II:	**Basics of Function,Pointer and File Operation**	(15)
	Working with functions Functions in C, types of functions: library function and user defined function, function declaration, function definition, and calling a function **Basics of Pointer**: declaring pointers, accessing data though pointers, NULL pointer, array access using pointers, pass by reference effect **File Operations**: open, close, read, write, append Access to files: In built file handlingfunctions (rewind() ,fseek(), ftell(),feof(), fread(), fwrite()), simple programs covering pointers and files.	

Reference Books:

1. P. K. Sinha & Priti Sinha 2022), Foundations of Computing(BPB)
2. Yashwant Kanetkar(2021), Let Us C : Authentic guide to C programming language (18th Edition)
3. V. Raja Raman (2019), Programming in C (PHI – EEE), 2nd edition, PHI Learning PrivateLimited.
4. S. Byron Gottfried (2018) Programming with C (TMH), 4th edition.
5. E. Balaguruswamy (2017), Programming in ANSI C (TMH),7th Edition McGraw Hill 6. Kamthane (2008)

B. Sc. Part- I Data Science (Entire) (Semester I)
Course Code: Subject I DSC II: Course Title: Foundation of Data Science
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
On completion of the course, the students will be able to:

1. To understand core concepts of Data Science, Big Data, and machine learning basics.
2. To explain data science roles, project stages, applications, and security issues.
3. To apply data collection and preprocessing techniques like cleaning and transformation.
4. To analyze data sources using APIs and manage multi-source data effectively.

Credits 2	**SEMESTER-I** **Course I:----: Foundation of Data Science**	**No. of hours per unit/ credits**
Unit I:	**Introduction to Data Science**	
	Introduction: Defining data science and big data, Recognizing the different types of data, Gaining insight into the data science process, **Data Science Process**: Overview, Different steps, MachineLearning Definition and Relation with Data Science.Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues. Data Collection and Data Pre-Processing **Data Collection Strategies** – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.	(15)
Unit II:	**Data visualization**	(15)
	Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes **Data visualization**: Introduction, Types of data visualization, Data for visualization: Data types,Data encodings, Retinal variables, mapping variables to encodings, Visual encodings. **Applications of Data Science** :Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science.	

Reference Book:

1. Data Science from Scratch, Joel Grus, O'Reilly Media
2. Introduction to Machine Learning with Python, Andreas C. Müller and Sarah Guido, O'Reilly Media
3. Python for Data Analysis, Wes McKinney, O'Reilly Media
4. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, and Peter Gedeck, O'Reilly Media
5. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media
6. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer

B.Sc. Part- I Data Science (Entire) Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I
Title of course: Practical based on Subject I DSC I

Course Outcomes (COs):
On completion of the course, the students will be able to:
1 Understand basic structure if C Programming, declaration and usage of variables, use of data type and operators.
2 Implement control structures to develop a C program.
3 Apply and write C Program to implement one dimensional array
4 Define a user defined function to give a solution to a given problem.

List of Laboratory Assignments

1. Program based on input (printf()) and output(scanf()) functions.
2. Program based on operators and expressions
3. Program based on branching statements
4. Program based on switch statement
5. Program based on loop statements
6. Program based on break and continue statement
7. Program based on 1-D Array.
8. Program based on 2-D Array.
9. Program based on function.
10. Program based on file operations
11. Program based on pointers

B. Sc. Part- I Data Science (Entire) (Semester I)
Course Code: Subject II DSC I: Course Title: Web Technology
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes:
On completion of the course, the students will be able to:
1:Understand basic concepts of Internet, WWW, websites, web pages, browsers.
2:Create simple web pages using HTML elements like text, lists, tables, images, hyperlinks, and forms.
3:Apply CSS for styling web pages, managing layouts, and controlling fonts, colors, margins, and positioning.
4:Use JavaScript for interactivity through events, loops, conditions, functions, arrays, and objects.
5:Manipulate DOM using JavaScript and perform basic form validation**.**

Credits 2	SEMESTER-I Course II:----: Web Technology	No. of hours per unit/ credits
Unit I:	**Fundamentals of Web and HTML**	15
	Introduction to Internet and Web, Concept of World Wide Web (WWW), Websites and Web Pages, Difference between Website and Web Page, Web Browsers – Definition and Examples (Chrome, Firefox, Edge, Safari), Web Servers – Basic concept of server-client model, URL (Uniform Resource Locator) – Structure and components, HTTP and HTTPS – Basics of data transfer and security, Introduction to Web Development, Overview of Frontend and Backend Development,Role of HTML, CSS, and JavaScript in Web Development **Introduction to HTML** What is HTML, HTML Documents, Basic structure of an HTML document,Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags. Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.	
Unit II:	**Fundamentals of CSS and JavaScript**	15
	Introduction to Cascading Style Sheets Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding, Properties, Margin properties), CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Navigation Bar, Image Sprites, Attribute sector), CSS Color. **Introduction to JavaScript** Features and Importance of JavaScript, JavaScript Syntax and Structure, Variables and Data Types (var, let, const), Operators and Expressions, Control Structures,Conditional Statements: if, else, switch, Loops: for, while, do-while, Functions in JavaScript, Arrays and Objects, Accessing Elements: getElementById, querySelector.	

Reference Books:

1. HTML and CSS: Design and Build Websites, Jon Duckett, Wiley
2. Learning Web Design, Jennifer Niederst Robbins, O'Reilly Media
3. JavaScript and JQuery: Interactive Front-End Web Development, Jon Duckett, Wiley
4. Web Design with HTML, CSS, JavaScript and jQuery Set, Jon Duckett, Wiley
5. Beginning Web Programming with HTML, XHTML, and CSS, Jon Duckett, Wiley

B. Sc. Part- I Data Science (Entire) (Semester I)
Course Code: Subject II DSC II: Course Title: Operating System
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
On completion of the course, the students will be able to:
1:Understand basic concepts and operations of operating systems.
2:Explain process management, scheduling, and multithreading.
3:Apply synchronization techniques to handle concurrency problems.
4:Analyze and handle deadlocks using prevention and avoidance methods.
5:Understand memory and file management, and compare UNIX and Windows systems.

Credits 2	**SEMESTER-I** **Course II:- - -: Operating System**	**No. of hours per unit/ credits**
Unit I:	**OPERATING SYSTEMS OVERVIEW**	(15)
	OPERATING SYSTEMS OVERVIEW: Introduction, operating system operations, process management, memory management, storage management, protection and security, distributed systems. OPERATING SYSTEMS STRUCTURES: Operating system services and systems calls, system programs, operating system structure, operating systems generations. PROCESS MANAGEMENT: Process concepts, process state, process control block, scheduling queues, process scheduling, multithreaded programming, threads in UNIX, comparison of UNIX and windows.	
Unit II:	**DEADLOCKS and FILE SYSTEM**	(15)
	DEADLOCKS: System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery from deadlock banker's algorithm. MEMORY MANAGEMENT: Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, allocation of frames, thrashing, case study - UNIX. FILE SYSTEM: Concept of a file, access methods, directory structure, file system mounting, file sharing, protection. File system implementation: file system structure, file system implementation, directory implementation.	

Reference Book:

1. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Wiley
2. Modern Operating Systems, Andrew S. Tanenbaum, Herbert Bos, Pearson
3. Operating Systems: Internals and Design Principles, William Stallings, Pearson
4. Operating System: A Concept-Based Approach, D.M. Dhamdhere, McGraw Hill Education
5. Operating Systems: Principles and Practice, Thomas Anderson, Michael Dahlin, Recursive Books

B.Sc. Part- I Data Science (Entire) Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I
Title of course: Practical based on Subject II DSC I

Course Outcomes

On completion of the course, the students will be able to:
1:Understand the structure of web pages using HTML elements like text, lists, tables, images, and forms.
2:Apply CSS to style web pages, manage layouts, and create navigation bars.
3:Use JavaScript to handle events, control statements, loops, and functions for dynamic behavior.
4:Manipulate HTML elements using JavaScript and perform basic DOM operations.
5:Develop web forms with JavaScript-based validation for interactive user input handling.

List of Practical's:

1. Program based on basic HTML structure – Create a simple web page using headings, paragraphs, and line breaks.
2. Program based on hyperlinks and navigation – Create a web page with internal links and external links.
3. Program based on HTML lists and tables – Design a page displaying information using ordered list, unordered list, and tables.
4. Program based on images and multimedia – Create a web page that displays images, adds a background image, and embeds a video.
5. Program based on HTML forms – Develop a registration form with text fields, radio buttons, checkboxes, and a submit button.
6. Program based on CSS styling – Apply inline, internal, and external CSS to style headings, paragraphs, lists, and tables.
7. Program based on CSS box model – Create a division with border, margin, padding, and background color to understand box layout.
8. Program based on webpage layout using CSS – Design a web page with header, footer, sidebar, and main content using CSS positioning.
9. Program based on CSS navigation bar – Create a horizontal or vertical navigation bar with hover effects.
10. Program based on JavaScript events – Write a program to display alert messages on button click.
11. Program based on JavaScript control statements – Develop a JavaScript program to check if a number is even or odd.
12. Program based on loops in JavaScript – Write a program that prints numbers from 1 to 10 using for loop.
13. Program based on functions in JavaScript – Create a function to calculate and display the square of a number.
14. Program based on DOM manipulation – Change the content or style of an HTML element on button click using JavaScript.
15. Program based on form validation – Validate that all fields in a form are filled before submission using JavaScript

B. Sc. Part- I Data Science (Entire) (Semester I)
Course Code: Subject III DSC I: Course Title: Discrete Mathematics
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes:

After completion of this course students will be able to:

1. To understand matrix operations, types, inverse, rank, and transformations.
2. To solve systems of linear equations using Gauss and Gauss-Jordan methods.
3. To apply eigenvalues, eigenvectors, Cayley-Hamilton theorem, and diagonalization.
4. To understand vector spaces, subspaces, basis, dimension, and spanning sets.
5. To apply inner product space concepts like orthogonality and projections.

Credits 2	**SEMESTER-I** **Course III:-----: Discrete Mathematics**	**No. of hours per unit/ credits**
Unit I:	Counting Principles	(08)
	1.1 Functions and counting, 1.1.1 Cardinality of finite sets., 1.1.2 Cardinality of union of sets (Addition principle), 1.1.3 Principle of Inclusion and Exclusion 1.1.4 Multiplication Principle.1.1.5 Listing of functions from one set to another 1.2 Combinatorial Arguments Pigeonhole Principle (Statement only)	
Unit II:	Recurrence Relations	(07)
	2.1 Homogeneous and nonhomogeneous solutions	
Unit III:	Logic	(08)
	3.1 Predicates,3.2 Rules of inferences, 3.3 Valid arguments and proofs 3.4 Proofs in Mathematics	
Unit IV:	Algorithms	(07)
	4.1 Definition, 4.2 Pseudocode conventions, 4.3 Examples, 4.4 Characteristics of an algorithm, 4.5 Time complexity., 4.6 Examples of type: Iterative, Recursion (e.g. Fibonaci Sequency), Evaluation (e.g. Horner's Method) Searching Methods (Linear search, Binary search), Sorting Methods (Insertion sort, Merge Sort, Bubble Sort), Time Complexity (Big-'O', Big- 'Omega') Brief introduction, Growth rates of functions together with their comparisons.	

Reference Books:

1. Elements of Discrete Mathematics by C.L. Liu
2 Discrete Mathematics by Olympia Nicodemi
3 Discrete Mathematical Structure for Computer Science by Alan Doer and K. Levasicur.
4 Discrete and Combinatorial Mathematics by R.m. Grassl
5. Discrete Mathematics by Kenneth Rosen,Tata McGraw Hill

B. Sc. Part- I Data Science (Entire) (Semester I)

Course Code: Subject III DSC II: Course Title: Graph Theory

Total Contact Hours: 30 hrs. (30 lectures of 60 min)

Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes:

After completion of this course students will be able to:

1. To understand concept of Graphs and operations on graphs and able to find its solution.
2. To understand the concepts of connecting graphs.
3. Understand the concepts of Tree and its elementary properties.
4. Grasping the basic of Directed graph and Digraph.

Credits 2	**SEMESTER-I** **Course III: - - - : Graph Theory**	**No. of hours per unit/ credits**
Unit I:	Graphs and operations on graphs	8
	1.1 Definition and elementary results, 1.2 Types of graphs ,1.3 Isomorphism 1.4 Adjacency matrix and incidence matrix, 1.5 Subgraphs and induced graphs 1.6 Complement of a graph, Self-complementary graphs, 1.7 Union, intersection of graphs	
Unit II:	Connected Graphs	7
	2.1 Definitions and elementary results of walk, trail, path and circuit 2.2 Definitions of connected, disconnected graphs 2.3 Dijkstra's shortest path algorithm 2.4 Definition of Euler's and Hamilton Graph and Example.	
Unit III:	Trees	8
	3.1 Definition and elementary results, 3.2 Center of a tree, 3.3 Spanning tree and fundamental circuits and cut-sets, 3.4 Binary trees and elementary results 3.5 Kruskal's algorithm for weighted spanning trees.	
Unit IV:	Directed Graphs	7
	4.1 Definition, types of directed graphs, 4.2 Directed (rooted) trees, arborescence and Polish notation, 4.3 Isomorphism of digraphs, 4.4 Connectedness in digraphs 4.5 Euler digraph, 4.6 Network and flows: Definition, examples, construction of flows, Maxflow, Min cut theorem.	

Reference Books:

1.Elements of Discrete Mathematics by C.L. Liu

2 Discrete Mathematics by Olympia Nicodemi

3 Discrete Mathematical Structure for Computer Science by Alan Doer and K.Levasicur.

4 Discrete and Combinatorial Mathematics by R.m. Grassl

5. Discrete Mathematics by Kenneth Rosen,Tata McGraw Hill

6. Graph Theory with Applications to Computer Science and Engineering by Narsing Deo, Prentice Hall, India

B.Sc. Part- I Data Science (Entire) Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I
Title of course: Practical based on Subject III DSC I & Subject III DSC II

Course Outcomes (COs)
After completion of this course students will be able to:
1: Understand and solve recurrence relations and apply them in algorithm analysis.
2: Apply searching and sorting techniques to solve computational problems efficiently.
3: Use combinatorial methods and logical reasoning to construct valid mathematical proofs.
4: Analyze and apply graph algorithms like Kruskal's and Dijkstra's for real-world problems.
5: Represent and evaluate expressions using prefix, postfix notations, and understand tree-based structures like arborescence.

Mathematics Practical- I

1. Recurrence relation.
2. Linear Searching Methods.
3. Combinatorial arguments.
4. Sorting Methods.
5. Proofs of valid arguments using laws of inferences
6. Kruskal's algorithm.
7. Dijkstra's shortest path algorithm.
8. Fundamental circuit and fundamental cut set.
9. Polish prefix, Postfix, notations, and arborescence

Course Code: IKS - I: Course Title: Vedic Mathematics
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes:

After completion of this course students will be able;

CO1: To perform simple arithmetic calculations with speed and accuracy

CO2: To generate tables of any number

CO3: To perform products of large numbers quickly

Unit	Contents	Hours Allotted
1	Introduction to Vedas, History of Vedas History and Evolution of Vedic Mathematics Introduction of Basic Vedic Mathematics Techniques in Multiplication (Special Case, Series of 9, Series of 1 etc.), Tables etc., Various techniques to carry out basic operations covering Addition, Subtraction, Multiplication, Division, Complements and Bases, Vinculum number. Comparison of Standard Methods with Vedic Methods.	15
2	General multiplication (Vertically Cross- wise), Multiplications by numbers near base. Verifying answers by use of digital roots, Divisibility tests, Division of numbers near base, Comparison of fractions. Different methods of Squares (General method, Base method, Duplex method etc.) Cubes, Cube roots, Square Roots, General division. Quadratic Equations, Simultaneous Equations, Use of various Vedic Techniques for answering numerical aptitude questions from Competitive Examinations.	15

Reference Books

1.Bhatiya Dhaval, Vedic Mathematics Made Easy, Jaico Publishing House.

2.Thakur Rajesh Kumar, Vedic Mathematics for students taking Competitive Examinations. Unicorn Books 2015 or Later Edition.

3.Gupta Atul, Power of Vedic Mathematics with Trigonometry ,JaicoBooks

4. V. G. Unkalkar, Magical World of Mathematics (Vedic Mathematics), Vandana Publishers, Bangalore.

5. Bhatiya Dhaval, Vedic Mathematics Made Easy, Jaico Publishing House.

6.Thakur Rajesh Kumar, Vedic Mathematics for students taking Competitive Examinations. Unicorn Books 2015

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B. Sc. Part- I Data Science (Entire) (Semester II)
Course Code: Subject I DSC III: Course Title: Python Programming
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs)
After completion of this course students will be able to:

1. To understand the basics of Python programming, variables, operators, and control flow statements.
2. To implement user-defined functions, built-in modules, and string operations.
3. To work with data structures like lists, tuples, and dictionaries, and apply list comprehensions.
4. To apply object-oriented programming concepts such as classes, objects, inheritance, and polymorphism.

Credits 2	SEMESTER-II Course I: —- : Python Programming	No. of hours per unit/ credits
Unit I:	**Introduction to Python**	15
	Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language. Control Flow Statements: The if, The if…else, The if…elif…else Decision Control Statements, Nested if Statement, The while Loop, The for Loop, The continue and break Statements. Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.	
Unit II:	**Lists,Files and exception**	15
	Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram. Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.	

Reference Books:

1. Python Programming: An Introduction to Computer Science, John M. Zelle, Franklin, Beedle & Associates
2. Think Python: How to Think Like a Computer Scientist, Allen B. Downey, O'Reilly Media / Green Tea Press
3. Learning Python, Mark Lutz, O'Reilly Media
4. Python: The Complete Reference, Martin C. Brown, McGraw Hill Education
5. Core Python Programming, Wesley J. Chun, Pearson Education

B. Sc. Part- I Data Science (Entire) (Semester II)
Course Code: Subject I DSC IV: Course Title: Data Structure using C
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
After completion of this course students will be able to:
1: Understand the concepts of algorithms, performance analysis, and data structure types.
2: Apply array operations such as traversal, insertion, deletion, searching, sorting, merging, and handle sparse matrices.
3: Implement stack operations and applications like expression evaluation, recursion, and infix to postfix conversion.
4: Perform queue operations including circular queues, deques, and priority queues using arrays and linked lists.
5: Develop and manipulate different types of linked lists and understand hashing with collision resolution techniques.

Credits 2	**SEMESTER-II** **Course I: —-: Data Structure using C**	**No. of hours per unit/ credits**
Unit I:	**Basics of Data Structure**	15
	Introduction Definition of data structure, data structure operations and Classification. Algorithms : Complexity, Time Space tradeoff, Complexity of Algoritms, Asymptotic Notations for Complexity of Algorithms. **Stack** Introduction to Stack, Operations on the Stackinit(), push(), pop(), isEmpty(), isFull(), peek(), time complexity of operations , Memory Representation of Stack, Array Representation of Stack, Applications of Stack, Evaluation of Arithmetic Expressions, Matching Parentheses, Infix to Postfix Conversion, Postfix Evaluation. **Queue Introduction** to Queue, Operations on the Queue, Memory Representation of Queue, Array Representation of Queue, Linked List Representation of Queue, Applications of Queue.	
Unit II:	**Introduction to Advance Data Structure**	15
	Linked Lists: Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List. Applications of Linked Lists. **Hashing and Collision:** Hashing, Hash Tables, Types of Hash Functions,Collision, Collision Resolution with Open Addressing and Chaining. **Searching**: Linear Search and Binary Search Sorting: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort	

Reference Books:

1. Data Structures Using C, Reema Thareja, Oxford University Press
2. Fundamentals of Data Structures in C, Ellis Horowitz, Sartaj Sahni, Universities Press
3. Data Structures Through C, Yashavant Kanetkar, BPB Publications
4. Data Structures with C, Seymour Lipschutz, McGraw Hill Education
5. An Introduction to Data Structures with Applications, Jean-Paul Tremblay, McGraw Hill Edu.

B.Sc. Part- I Data Science (Entire) Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II
Title of course: Practical based on Subject I DSC III & Subject III DSC IV

Course Outcomes

After completion of this course students will be able to:
1:Implement basic array operations including traversal, insertion, deletion, searching, and sorting.
2:Perform sparse matrix operations and represent matrices efficiently using arrays.
3:Apply stack operations and solve problems like parenthesis matching and expression conversion.
4:Evaluate arithmetic expressions using stacks for infix to postfix conversion and postfix evaluation.
5:Implement simple and circular queues using arrays for various queue operations.
6:Perform linked list operations such as insertion, deletion, and traversal in singly linked lists.
7:Represent and add polynomials using linked lists.
8:Implement hashing with collision resolution using linear probing and chaining techniques.

List of Practical's:

1. Program based on input and output functions
2. Program based on operators and expressions
3. Program based on branching statements
4. Program based on switch statement (Python alternative: if-elif-else)
5. Program based on looping statements
6. Program based on break and continue statement
7. Program based on Array: Find maximum number between given array
8. Program based on Array: Display array in ascending order
9. Program based on function: Find maximum between two numbers
10. Program based on function: Display square of a given number.
11. Program based on array operations – Implement traversal, insertion, deletion, searching, and sorting in one-dimensional array.
12. Program based on sparse matrix – Convert a normal matrix to sparse matrix and perform addition of two sparse matrices.
13. Program based on stack using arrays – Implement push, pop, and peek operations with applications like parenthesis matching..
14. Program based on queue using arrays – Implement simple queue.
15. Program based on singly linked list – Perform insertion, deletion, and traversal in a singly linked list.

B. Sc. Part- I Data Science (Entire) (Semester II)
Course Code: Subject II DSC III: Course Title: Database Engineering
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
After completion of this course students will be able to:

1. To understand the fundamentals of DBMS, its architecture, types, and advantages over file systems.
2. To design ER diagrams and convert them into relational schemas with appropriate keys and constraints.
3. To analyze relational designs using normalization techniques and identify data anomalies.
4. To apply SQL commands for defining and manipulating data, including filtering and aggregation.
5. To use joins, subqueries, and set operations to retrieve data from multiple tables.
6. To understand transaction management and apply ACID properties using SQL commands.

Credits 2	**SEMESTER-II** **Course II: —-: Database Engineering**	**No. of hours per unit/ credits**
Unit I:	**Introduction to DBMS and Database Design**	15
	Introduction to Database, Need for DBMS, Advantages of DBMS over File System, Components of DBMS, Applications of DBMS in Data Science, Types of DBMS: Hierarchical, Network, Relational, Object-Oriented, **DBMS Architecture**: Three-level schema, Data Models: Relational Model. **Entity, Attribute, Relationship, ER Diagrams**: Symbols, Notations, and Examples, Mapping ER Model to Relational Schema, Types of Keys: Primary, Candidate, Super, Foreign, Integrity Constraints: Domain, Entity, Referential, **Normalization** : Problems of Un-Normalized Database, Features of Good Relational Design, **Data Anomalies**: Insertion, Deletion, Update, Functional Dependencies and Inference Rules, **Normalization**: 1NF, 2NF, 3NF, BCNF, 4NF, Concepts of Lossless Join and Dependency Preservation.	
Unit II:	**SQL Basics and Data Manipulation**	15
	Introduction to SQL and its importance in Data Science, Data Definition Language (DDL): CREATE, ALTER, DROP, Basic Constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, Data Manipulation Language (DML): INSERT, UPDATE, DELETE, SELECT Statement, **Filtering Data** : WHERE, ORDER BY,GROUP BY and HAVING Clauses, **Pattern Matchin**g: LIKE, IN, BETWEEN, IS NULL, **Aggregate Functions**: COUNT, SUM, AVG, MIN, MAX. Types of Joins: INNER, LEFT, RIGHT, FULL (basic use cases). **Set Operations:** UNION, INTERSECT, EXCEPT, **Transactions and ACID Properties**:Atomicity, Consistency, Isolation, Durability, Transaction Control Commands: COMMIT, ROLLBACK, SAVEPOINT	

Reference Books:

1. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill Education
2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, Pearson Education
3. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education

4. SQL: The Complete Reference, James R. Groff, Paul N. Weinberg, Tata McGraw Hill
5. Learning SQL, Alan Beaulieu, O'Reilly Media
6. Introduction to Database Systems, C.J. Date, Pearson Education
7. Practical SQL, Anthony DeBarros, No Starch Press

B. Sc. Part- I Data Science (Entire) (Semester II)
Course Code: Subject II DSC IV: Course Title: Business Intelligence and Analytics
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
After completion of this course students will be able to:
1: Understand the concept, evolution, and need for Business Intelligence in modern organizations.
2: Identify types of business analytics and approaches to data discovery.
3: Understand BI users at different management levels and their reporting needs.
4: Describe basic BI system architecture, tools, and dashboard principles.
5: Identify BI applications in marketing, finance, operations, and human resources.

Credits 2	**SEMESTER-II** **Course II: —--: Business Intelligence and Analytics**	**No. of hours per unit/ credits**
Unit I:	**Foundations and Strategic Dimensions of Business Intelligence**	15
	Definition and Evolution of Business Intelligence (BI), Importance of BI in modern organizations, Data, Information, Knowledge, Wisdom (DIKW hierarchy), Overview of Business Analytics: Descriptive, Predictive, Prescriptive Analytics (only conceptual), Hypothesis-driven vs Data-driven discovery, **Strategic Role of BI:** Link between Business Strategy and BI, BI Users: Strategic, Tactical, Operational Levels, Role of Business Leaders (CEO, CFO, CMO, CHRO, COO) in BI, Information as a Strategic Resource, BI reporting needs at different management levels, Types of BI Reports: Summary, Dashboards, Automated Reports	
Unit II:	**Business Intelligence Systems, Tools, and Applications**	15
	BI System Architecture Overview, Introduction to Data Warehousing Concepts: Introduction to Data Warehouse, Basics of ETL (Extract, Transform, Load), Data Marts and Data Lakes, OLAP: Concept and examples, Dashboards: Design principles, features, and best practices, Introduction to BI Tools: Tableau, Microsoft Power BI, Spreadsheets for BI **Applications of BI in Business Domains:** Marketing Analytics: Customer Segmentation, Sales Trends, Logistics & Operations: Supply Chain Visualization, Basic Planning, Finance: Basic Risk & Forecasting Concepts, Fraud Detection Cases, Human Resources: Employee Productivity Dashboards, Attrition Trends	

Reference Books:

1. Business Intelligence, Efraim Turban, Ramesh Sharda, Dursun Delen, David King, Pearson.
2. Business Analytics: The Science of Data-Driven Decision Making, U. Dinesh Kumar, Wiley India.
3. Data Mining for Business Intelligence, Galit Shmueli, Nitin R. Patel, Peter C. Bruce, Wiley.
4. Business Intelligence and Analytics, Ramesh Behl, McGraw Hill India.
5. Fundamentals of Business Analytics, R. N. Prasad, Seema Acharya, Wiley India.

B.Sc. Part- I Data Science (Entire) Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II
Title of course: Practical based on Subject II DSC III

Course Outcomes (COs)

After completion of this course students will be able to:

1: Implement Python programs using input/output, operators, branching, loops, arrays, and functions.

2: Implement database normalization and design relational schemas.

3: Implement SQL commands to create, update, and query databases.

4: Implement queries and subqueries for data retrieval.

5: Implement transaction management concepts including serializability and concurrency control.

List of Practical's:

1. Implement normalization: 1NF, 2NF, 3NF, BCNF on a given database.
2. Implement basic SQL commands: CREATE, INSERT, UPDATE, DELETE on a sample database.
3. Write programs to design and manipulate relational models.
4. Implement queries and subqueries for data retrieval.
5. Implement information retrieval and ranking using any programming language.
6. Implement document retrieval and ranking algorithms.
7. Write programs demonstrating serializability in transactions.
8. Write programs on concurrency control mechanisms.

B. Sc. Part- I Data Science (Entire) (Semester II)
Course Code: Subject III DSC III: Course Title: Descriptive Statistics
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
After completion of this course students will be able to:
1. Acquire knowledge of Meaning and Scope of Statistics, various statistical organizations.
2. Understand the basic knowledge of data collection and various statistical elementary tools.
3. Understand the basic concept of Measures of Central Tendency and Dispersion.

Credits 2	SEMESTER-II Course III: —--: Descriptive Statistics	No. of hours per unit/ credits
Unit I:	**Introduction to Statistics**	15
	Introduction to Statistics: Concept, Definition of Statistics and Scope of statistics, Nature of Data: Primary and Secondary data, Qualitative and quantitative data, Discrete and continuous data, frequency, cumulative frequency, frequency distribution..Population and Sample: Statistical population. Finite population, Infinite population, Census method, Sample, sampling method, Advantages of sampling method over census method. SRS, SRSWR and SRSWOR Representation of Data: Discrete frequency distribution, Continuous frequency distribution, Cumulative frequency distribution, Inclusive and Exclusive methods of classification, Open end classes, illustrative examples. Representation of data by graphical method: Histogram, frequency polygon, frequency curve, Ogive curve. Representation of data by diagrammatic Method: Bar diagram (Simple), Pie chart.	
Unit II:	**Measures of central Tendency**	15
	Measures of central Tendency: Meaning of averages, Requirements of good average. Arithmetic mean (A.M.), Combined mean, Median, Quartiles, Mode, Relation between mean, median and mode. Merits and Demerits of Mean, Median and Mode, determination of Median and Mode by Graph. Numerical Examples.Measures of Dispersion: Meaning of dispersion, Absolute and Relative measures of dispersion Requirements of good dispersion. Q.D, M.D, S.D. Variance and Combined variance, Coefficient of Variation (C.V) Concept of Skewness, Numerical Examples.	

Reference Books:

1. Statistical Methods, by Dr. S. P. Gupta, Sultan Chand and Sons Publication.
2. Introduction to Statistics, by C.B. Gupta.
3. Mathematical Statistics, by H.C. Saxena and J.N. Kapur.
4. Business Statistics, by S.S. Desai.
5. Business Statistics, by G.V. Kumbhojkar.
6. Fundamentals of Statistics, by S.C.Gupta.

B. Sc. Part- I Data Science (Entire) (Semester II)
Course Code: Subject III DSC IV: Course Title: Probability Distribution
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Outcomes (COs):
After completion of this course students will be able to:
1:- acquire knowledge of concepts of probability
2:- understand concept of random variable and its probability distributions

Credits 2	**SEMESTER-II** **Course III: —- : Probability Distribution**	**No. of hours per unit/ credits**
Unit I:	**Probability**	15
	Probability: - Trial, Sample Space, Events, Types of event, Classical definition of Probability, Addition law of probability, Conditional Probability. Multiplication law of probability, Concept of independent events. Examples without use of permutations and computations. Concept of Probability Mass Function (p.m.f) and Probability Density Function (p.d.f), Mean and variance. Simple, examples.	
Unit II:	**Concept of Random variable and Probability distribution.**	15
	Concept of Random variable and Probability distribution. Binomial Distribution, Definition, mean, variance, additive property of binomial distribution and examples. Poisson Distribution, Definition, mean, variance, additive property of Poisson distribution and examples. Simple examples to find probabilities and parameters. Normal Distribution Definition, mean, variance and Limiting case (binomial and Poisson distribution)Definition of Standard Normal variate and its p.d.f. Properties of normal curve, Examples to find probabilities for given area under standard normal curve.	

Reference Books:-
1) Elements of Statistics by D. N. Elance.
2) Introduction to Statistics, by C.B. Gupta.
3) Mathematical Statistics, by H.C. Saxena and J.N. Kapur.

B.Sc. Data Science Multiple Entry and Multiple Exit Option
(NEP-2020)
PART I SEM II
Title of course: Practical based on Subject III DSC III & Subject III DSC IV

Course Outcomes:
After completion of this course students will be able to;
1. Study measures of Central Tendency and Dispersion.
2. Apply binomial and Poisson distributions.

Lab work is based on Introduction to Statistics & Probability Distribution. This laboratory course will consist of 25 to 30. Programming exercises with focus on covering the hands-on aspects covered in theory course.

B.Sc. Data Science
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART I SEM II
Title of course: **VEC- I Democracy, Election and Constitution**

Syllabus will be provided by Shivaji University as per NEP.