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

SHIVAJI UNIVERSITY, KOLHAPUR
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शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
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. Artificial Intelligence (AI)

(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. Artificial Intelligence (AI)

(Under Faculty of Science and Technology)

Program Outcomes

Upon successful completion of the B.Sc. Artificial Intelligence (AI), the student should have met the following Outcomes:

1. Apply skills and concepts of Computer Science to understand, design and code computing models from problem statements.
2. Ability to design, develop and implement real world problems to software solutions
3. Apply mathematical and statistical models to explore and analyze the massive amount of data in various domains.
4. Design and develop Artificial Intelligence(AI) systems for analysing the varied, voluminous data in various domains.
5. Recognize the importance of innovation and develop a critical and research thinking approach to develop leading innovative intelligent software products.
6. Recognize social, professional, cultural, humane and ethical values and issues involved in the use of software technology and consider these adequately in developing and deploying systems
7. Be self-motivated and enhance self-learning as well as capability to adapt to emerging technologies and create innovative solutions for challenging issues of society.

Program Specific Outcome (PSO)

1. An ability to enhance the application of knowledge of theory subjects in diverse fields.
2. Encouraging students to convert their start-up idea to reality by implementing
3. Focuses on preparing the student for roles in computer applications and the IT industry.
4. Develop programming skills, networking skills, learn applications, packages, programming languages, and modern techniques of IT.
5. Information about various computer applications and the latest development in IT and communication systems is also provided.
6. Ability to identify, formulates, analyze and solve problems of programming using different languages.
7. Take up self-employment in the Indian & global software market.
8. The student will be able to know various issues, and the latest trends in technology development and thereby innovate new ideas and solutions to existing problems.

1. Introduction

A. The name of the program shall be B.Sc. Artificial Intelligence.

B. After completion, students will be able to apply intelligent computing principles and AI tools to build, train, and deploy intelligent systems across various domains such as healthcare, finance, robotics, and automation.

C. Job Opportunities:

D. The program addresses the increasing need for AI professionals in industries including machine learning, robotics, computer vision, NLP, and intelligent automation.

E. Graduates can begin their careers as AI Developers, ML Engineers, NLP Engineers, Computer Vision Specialists, and AI Research Assistants. With experience, they can progress to roles such as AI Architects, Robotics Engineers, or AI Consultants.

F. Entrepreneurial opportunities exist in AI product development, chatbots, automation tools, and AI-based services. Career paths span across industries such as manufacturing, automotive, healthcare, finance, education, and defense.

G. The curriculum is designed to enable:
H. Conceptual Learning: Foundational AI principles, algorithms, logic, and modeling
I. Skill-Based Learning: Programming (Python), tools (TensorFlow, OpenCV, PyTorch), and AI frameworks
J. Practical Application: Projects, AI labs, simulations, mini-projects, and hands-on case studies

2. Medium of Instruction:
The medium of instruction will be English only.

3. Admission Procedure
To be eligible for admission to the B.Sc. Artificial Intelligence, a candidate must have passed:

- HSC (10+2) with 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 Practicals should be conducted as per the scheme of lectures and practical's indicated in the course structure.

5. Teaching and Practical Scheme

- Contact session for teaching: 60 minutes each
- One Practical Batch: 20 students
- Practical evaluations to 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. Artificial Intelligence(AI) Part II is allowed even if the student fails in 20 subjects of First year B.Sc. Artificial Intelligence(AI)
3. Admission to B.Sc. Artificial Intelligence(AI) part III is allowed even if the students fail in 20 subjects of B.Sc. Artificial Intelligence(AI) Part II. But no student is allowed to take admission to the third year of B.Sc. Artificial Intelligence(AI) 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. Artificial Intelligence(AI) 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	------	-----

B. Sc. Artificial Intelligence(AI) Part-I: Semester I & II Multiple Entry and Multiple Exit Option

(NEP-2020) Syllabus to be implemented from Academic Year 2025-26

Title: **B. Sc. Artificial Intelligence(AI)**

1. Year of implementation: Syllabus will be implemented from June 2025 onwards
2. Duration: B.Sc. AI Part I. The duration of course shall be one year(Twosemesters).
3. Pattern: Pattern of examination will be semester
4. Medium of Instruction: English
5. Structure Of Course:

Multiple Entry and Multiple Exit Option (NEP-2020)

B. Sc. Artificial Intelligence(AI) Part-I Program Structure B.Sc.

Artificial Intelligence(AI) Part - I (Level-4.5)

Semester	Subject Type	Course Code	Course Title
SEM – I	Course I:	Subject I DSC I:	Programming using C
		Subject I DSC II:	Operating System
		Subject I Practical I:	Practical based on Subject I DSC I
	Course II:	Subject II DSC I:	Mathematics - I for AI
		Subject II DSC II:	Mathematics - II for AI
		Subject II Practical I:	Practical based on Subject II DSC I & Subject II DSC II
	Course III:	Subject III DSC I:	Descriptive Statistics for AI - I
		Subject III DSC II:	Probability for AI
		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:	Database - I
		Subject I Practical II:	Practical based on Subject I DSC III & Course I DSC IV
	Course II:	Subject II DSC III:	Mathematics - III for AI
		Subject II DSC IV:	Mathematics - IV for AI
		Subject II Practical II:	Practical based on Subject II DSC III & Subject II DSC IV
	Course III:	Subject III DSC III:	Descriptive Statistics for AI - II
		Subject III DSC IV:	R Programming
		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. Artificial Intelligence(AI) 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. Artificial Intelligence (AI)

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. Artificial Intelligence (AI)

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. Artificial Intelligence (AI)

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. Artificial Intelligence (AI)

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		
	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. AI -I: **1100**
● Theory and Practical Lectures: **60** Minutes Each	● Total Credits for B.Sc. AI -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. Artificial Intelligence(AI) Part-I Semester-I Course Code:
Subject I DSC I: Course Title: Programming 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):

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: - - - : Programming using C**	**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. Artificial Intelligence(AI) Part-I Semester-I Course Code:
Subject I 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:Analyze and handle deadlocks using prevention and avoidance methods.
4:Understand memory and file management, and compare UNIX and Windows systems.

Credits 2	**SEMESTER-I** **Course I:- - -: 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. PROCESS MANAGEMENT: Process concepts, process state, process control block, scheduling queues, process scheduling, multithreaded programming, threads in UNIX, comparison of UNIX and windows. OPERATING SYSTEMS STRUCTURES: Operating system services and systems calls, system programs, operating system structure, operating systems generations.	
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. Artificial Intelligence (AI) 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. Artificial Intelligence(AI) Part-I Semester-I Course Code:

Subject II DSC I: Course Title: Mathematics - I for AI

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 concept of Counting principles.
2. To understand the concept of Recurrence relations.
3. To understand the concept of Logics.
4. To understand the concept of Algorithms.

Credits 2	SEMESTER-I Course II:- - -: Mathematics - I for AI	No. of hours per unit/ credits
Unit I:	**Counting Principles**	8
	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**	4
	2.1 Homogeneous and non-homogeneous solutions	
Unit III	**Logic**	8
	3.1 Predicates 3.2 Rules of inferences 3.3 Valid arguments and proofs 3.4 Proofs in Mathematics	
Unit IV	**Algorithms**	10
	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. Fibonacci Sequence) Evaluation (e.g. Horner's Method) 4.7 Searching Methods (Linear search, Binary search) Sorting Methods (Insertion sort, Merge Sort, Bubble Sort) 4.8 Time Complexity (Big-'O', Big- 'Omega') Brief introduction Growth rates of functions together with their comparisons.	

Reference Books:

1 Discrete and Combinatorial Mathematics by R.m. Grassl
2. Discrete Mathematics by Kenneth Rosen,Tata McGraw Hill
3. Graph Theory with Applications to Computer Science and Engineering by Narsing Deo, Prentice Hall, India
4. A First Step in Graph Theory by Raghunathan, Nimkar and Solapurrkar
5. Discrete mathematics by S.R.Patil and others, NIRALI Prakashan.
6. Discrete mathematics by Bhopatkar, Nimbkar, Joglekar, VISION Publication.
7. Discrete mathematics by Naik and Patil, PHADAKE Prakashan

B. Sc. Artificial Intelligence(AI) Part-I Semester-I Course Code:
Subject II DSC II: Course Title: Mathematics - II for AI
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 the concept of Graphs and operations on graphs and be 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 basics of Directed graph and Digraph.

Credits 2	**SEMESTER-I** **Course II: —- : Mathematics - II for AI**	**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

B.Sc. Artificial Intelligence (AI) Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I
Title of course: Practical based on Subject II DSC I & Subject II 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

B. Sc. Artificial Intelligence(AI) Part-I Semester-I
Course Code: Subject III DSC I: Course Title: Descriptive Statistics for AI - I
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. Apply various types of sampling methods to data collection,
2. Create and interpret frequency tables.
3. Display data graphically and interpret graphs.
4. Recognize, describe, and calculate the measures of central tendency and dispersion

Credits 2	**SEMESTER-I** **Course III: —--: Descriptive Statistics for AI - I**	**No. of hours per unit/ credits**
Unit I:	**Data Condensation and Measures of Central Tendency**	**15**
	Definition, importance, scope and limitations of statistics, Data Condensation: Qualitative & Quantitative. Scales of measurement: Nominal, Ordinal, interval and Ratio, Raw data, Attributes and variables, discrete and continuous variables,	

	Organization of data, Collection of data, classification and construction of frequency distribution, Graphical Representation: Histogram, Frequency polygon, Frequency curve. Ogive Curves, Boxplots, Examples Measures of Central tendency: Concept of central tendency, Criteria for good measures of central tendency, Types: Arithmetic mean, G.M., H.M., Median, Mode, Quantiles, Combined Mean, Weighted Mean, Corrected. Mean, Examples	
Unit II:	**Measures of Dispersion and Moments**	**15**
	Concept of dispersion and measures of dispersion, absolute and relative measures of dispersion Types: Range, Quartile Deviation, Mean Deviation, S.D. and Variance, Combined S.D., Numerical problems. Moments: Concept of moments, Types: Raw moment, Central moment, and moment about any arbitrary point "a" for ungrouped and grouped data (only first four moments), relation between central and raw moments (statement only), Sheppard's Correction, Measures of skewness: Types of skewness, Pearson's and Bowley's coefficient of skewness, Measures of skewness based on moments, Measures of Kurtoses: Types of kurtoses, Measures of kurtosis based on moments, Numerical problems.	

Reference Books:

1) S. C. Gupta and V. K. Kapoor, Fundamental of Mathematical Statistics (12th Edition), Delhi, Sultan Chand and Sons, 2020

2) T.C. Gupta. Fundamental of Statistics (7th Edition), Mumbai, Himalaya Publishing House, 2018.

3) Gentle, E. James, Numerical Linear Algebra for Applications in Statistics. Springer, 2018

4) Efron, Bradley, Hastie Trevor, Computer Age Statistical Inference. Algorithms, Evidence, and Data Science. Cambridge University Press, 2016.

5) S. P. Gupta, Sultan Chand, Statistical Methods, Delhi, 2014

6) B. L. Agarwal Basic Statistics (6th Edition), New Age International Private Ltd, Delhi, 2013.

7) Christian P. Robert, and Casella, George. Carlo Monte Statistical Methods. Springer, 2004

8) A. M. Goon, M. K. Gupta, B. Das Gupta. Fundamentals of Statistics, The World Press Private Ltd., Calcutta, 1968.

B. Sc. Artificial Intelligence(AI) Part-I Semester-I Course Code:
Subject III DSC II: Course Title: Probability for AI
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. Distinguish between random and non-random experiments
2. Use the basic probability rules, including additive and multiplicative laws
3. Understand the concept of conditional probability and independence of events.

Credits 2	**SEMESTER-I** **Course III: —- : Probability for AI**	**No. of hours per unit/ credits**
Unit I:	**Probability**	**15**
	1.1 Sample space: Concepts of experiments and random experiments Definitions: Sample space, Discrete sample space (finite and countably infinite). Events: Elementary event, Compound event. Algebra of events (Union, Intersection, Complementation). Definitions of mutually exclusive events, Exhaustive events, Impossible events, Certain event. Power set (P(2) (sample space consisting at most 3 sample points). Symbolic representation of given events and description of events in symbolic form. Illustrative examples. 1.2 Probability. Equally likely outcomes (events), a priori (classical) definition of probability of an event. Equi-probable sample space, simple examples of computation of probability of the events based on permutations and combinations. Definition of probability in terms of odd ratio with illustrative examples. Axiomatic definition of probability and results.	
Unit II:	**Conditional probability and Independence**	**15**
	2.1 Conditional Probability: Definition of conditional probability of an event. Multiplication theorem for two events. Examples on conditional probability. 2.2 Independence of events: Concept of independence of two events. Proof of the result that if A and B are independent then, I) A and B are Independent, ii) A and B are independent, iii) A and B are independent. Pairwise and Mutual independence for three events. Elementary examples. 2.3 Baye's theorem: Partition of sample space, Idea of posterior probability, statement and proof of Baye's theorem, illustrative examples on Baye's theorem.	

Reference Books:-

1. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
2. Gupta, S.C. and Kapoor, V K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg. R.V. and Craig R.G. (1989). Introduction to Mathematical Statistics, Ed. MacMillan Publishing Co., New York.

5. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co., London.

B.Sc. Artificial Intelligence(AI) 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:

After completion of this course students will be able to;

1. Compute various measures of central tendency, dispersion and moments.
2. Analyse the data and interpret the results.
3. Computation of probabilities by using Bayes theorem

LAB Work

1. Construction of Discrete frequency distribution
2. Construction of continuous Frequency distribution
3. Graphical representation
4. Diagrammatic representation
5. Compute Mean, Median, Mode and quartile for Individual data
6. Compute Mean, Median, Mode and quartile for Discrete frequency distribution
7. Compute Range, Q.D., S.D variance and its relative measures for Individual data.
8. Compute Range, Q.D., S.D variance and its relative measures for Discrete frequency distribution
9. Computation of moments, skewness and kurtosis for individual data.
10. Computation of probabilities by using Bayes theorem

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. Artificial Intelligence(AI) Part-I 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 handle file operations, exceptions, and use command line arguments in Python programs.
5. 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
6. Programming in Python, Pooja Sharma, BPB Publications

B. Sc. Artificial Intelligence(AI) Part-I Semester-II Course Code:
Subject I DSC IV: Course Title: Database - I
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 database concepts, need for DBMS, and its advantages over file systems.
2: Analyze DBMS types, architectures, and design ER models.
3: Apply keys, constraints, and normalization to design efficient databases.
4: Use SQL for data definition, manipulation, and querying with joins and subqueries.
5: Explain transaction management and apply ACID properties and control commands.

Credits 2	**SEMESTER-II** **Course I: —-: Database - I**	**No. of hours per unit/ credits**
Unit I:	**Introduction to DBMS and Database Design**	15
	What is a Database? Need for DBMS,Advantages of DBMS over File System, Components of DBMS, Applications of DBMS in AI, Types of DBMS: Hierarchical, Network, Relational, Object-Oriented, **DBMS Architecture**: Three-level schema, Data Models: Relational Model (structure, importance) ,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, 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 AI, 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 and Filtering Data: WHERE, ORDER BY, GROUP BY and HAVING Clause, Pattern Matching:	

	LIKE, IN, BETWEEN, IS NULL, Aggregate Functions: COUNT, SUM, AVG, MIN, MAX. **Types of Joins**: INNER, LEFT, RIGHT, FULL (basic use cases), Subqueries: Single-row, Multi-row, Nested Subqueries, Set Operations: UNION, INTERSECT, EXCEPT, **Introduction to Transactions and ACID Properties**:Atomicity, Consistency, Isolation, Durability Transaction Control Commands: COMMIT, ROLLBACK, SAVEPOINT	

Reference Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan,McGraw Hill
2. Ramez Elmasri, Shamkant B. Navathe, Pearson Education
3. Database Management Systems,Raghu Ramakrishnan, Johannes Gehrke,McGraw Hill
4. An Introduction to Database Systems,C.J. Date, Pearson Education
5. SQL: The Complete Reference,James R. Groff, Paul N. Weinberg,McGraw Hill
6. Database Management Systems,Dr. S.K. Singh,Pearson Education

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

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.

Practicals

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 for loop statements
6. Program based on while statements
7. Program based on break and continue statement
8. Program based on Array: Find maximum number between given array
9. Program based on Array: Display array in ascending order
10. Program based on function: Add two numbers
11. Program based on function: Find maximum between two numbers
12. Program based on function: Display square of a given number.
13. Implement normalization: 1NF, 2NF, 3NF, BCNF on a given database.
14. Implement basic SQL commands: CREATE, INSERT, UPDATE, DELETE on a sample database.
15. Write programs to design and manipulate relational models.

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

Course Objectives:

After completion of this course students will be able to:

1. Use the properties of set operations algebraically.
2. Introduce the fundamental of logic, relations and counting
3. Learn to impart adequate knowledge on the need of mathematics.
4. Understand the need of problem-solving techniques.

Credits 2	**SEMESTER-II** **Course II: —- : Mathematics - III for AI**	**No. of hours per unit/ credits**
Unit I:	**Relation and Counting Principle**	8
	1.1 Set: Definition and types of set, 1.2 Functions and types of function 1.3 Relations and types of relation, 1.4 Counting: Addition & Multiplication principle, 1.5 Permutation and Combination, 1.6 Cardinality of finite set, 1.7 Cardinality of union of sets (Addition principle), 1.8 Principle of inclusion & exclusion, examples	
Unit II:	**Calculus**	7
	2.1 Limit and Continuity of function, L'Hospital's rule, 2.2 Differentiability: Derivative of a function by first principle and examples, 2.3 Derivative rules: Chain rule, Product rule, Quotient rule and examples, 2.4 Integration of a function: Basic Rules and examples, 2.5 Fundamental theorem of calculus.	
Unit III:	**Logic**	7
	3.1 Statement and types of statements, truth value, 3.2 Logical connectives and Construction of truth table, 3.3 Statement pattern: Tautology, contingency and Contradiction, 3.4 Logical equivalence, laws of logic with examples.	
Unit IV:	**Propositional Calculus**	8
	4.1 Predicate, n-place Predicate, n-ary Pedicate. 4.2 Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, 4.3 Logical Equivalence involving Quantifiers. 4.4 Rules of Inference: Argument in propositional Logic, Validity Argument (Direct and Indirect methods) 4.5 Rules of Inference for Propositional Logic. 4.6 Building Arguments	

Reference Books:-

1. Discrete mathematics -D.M. Pandhare and M. D. Bhagat by Nirali Prakashan.
2. Discrete mathematics by S. R. Patil and others, Nirali Publications.
3. A Text book of Algebra and Calculus by S. R. Patil and Others Nirali Prakashan.
4. Calculus by Dr. S.B. Nimse

B. Sc. Artificial Intelligence(AI) Part-I Semester-II Course Code:
Subject II DSC IV : Course Title: Mathematics - IV for AI
Total Contact Hours: 30 hrs. (30 lectures of 60 min)
Credits: 02 Teaching Scheme: Theory – 2 Lectures / Week Total Marks: 50

Course Objectives:

After completion of this course students will be able to:

1: Solving system of linear equations.
2: Finding Eigen values and Eigen vectors.
3: Understanding the concept of vector space.
4: Understanding the concept of linear transformation.

Credits 2	**SEMESTER-II** **Course II: —-- :Mathematics - IV for AI**	**No. of hours per unit/ credits**
Unit I:	**Matrices and System of Linear Equations**	8
	1.1 Matrices, Types of matrices, 1.2 Algebra of matrices, Matrix Transformation, 1.3 inverse of matrix, Rank of matrix, 1.4 System of Linear equations, 1.5 Results on system of linear equations (Statements Only), 1.6 Solutions of System of Linear Equations 1.7 Gauss Elimination Method and examples 1.8 Gauss Jordan method and examples	
Unit II:	**Eigen values and Eigen vectors**	7
	2.1 Eigen values and Eigen Vectors of matrix: Definition and examples, 2.2 Cayley -Hamiltonian theorem (Statement only) and examples, 2.3 Diagonalization: Definition and examples.	
Unit III:	**Vector Space**	8
	3.1 Vector Space: Definition and examples, 3.2 Basic properties of vector space, 3.3 Sub Space: Definition and examples, 3.4 Linear Dependence and Independence, 3.5 Linear combination and spanning, Basis and Dimension, 3.6 General inner product space: Definition and examples.	

Unit IV:	**Linear transformation**	7
	4.1 Linear transformation: Definitions and examples, 4.2 The Kernel and Range of a linear transformation, examples 4.3 The Matrix of a Linear Transformation and examples.	

Reference Books:

1) A textbook of Linear Algebra, Nirali Prakashan
2) A textbook of Linear Algebra, Vision Publication.
3) Elementary Linear Algebra with Applications, Howard Anton, Chris Rorres, John Wiley and sons. 7th Edition (1994).
4) Linear Algebra Linear Algebra with applications, Howard Anton , Chris Rorres

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

Course Outcomes (COs)

After completion of this course students will be able to:
1: Use set theory, permutations, combinations, and inclusion-exclusion in counting problems.
2: Understand logic, relations, and basic counting principles.
3: Apply calculus concepts like limits, derivatives, integrals, and L'Hospital's Rule.
4: Solve linear systems using Gaussian methods and apply eigen concepts for matrix operations.
5: Develop mathematical problem-solving skills for real-world and engineering contexts.

Practical Work:

1. Permutation and Combination with examples
2. Principle of inclusion & exclusion and examples
3. L'Hospital's rule
4. Derivative and integration with examples
5. Logical equivalence with examples
6. Gaussian Elimination Method.
7. Gauss Jordan Method.
8. Eigen values and Eigen vectors of a matrix
9. Cayley-Hamiltonian theorem and Examples
10. Diagonalization

B. Sc. Artificial Intelligence(AI) Part-I Semester-II
Course Code: Subject III DSC III : Course Title: Descriptive Statistics for AI - II
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. Study correlation between two variables by using diagrams and graphs.
2. Study methods to quantify correlation between two or three variables
3. Perform the analysis for tri-variate data
4. Estimate the value of dependent variable for given values of independent variable

Credits 2	**SEMESTER-II** **Course III:- - -: Descriptive Statistics for AI - II**	**No. of hours per unit/ credits**
Unit I:	**Correlation**	15
	Concept of bivariate data, scatter diagram. Concept of correlation, positive correlation, negative correlation, cause and effect relation, Karl Pearson's coefficient of correlation, Properties of correlation coefficient, interpretation of correlation coefficient, Spearman's Rank Correlation coefficient (formula with and without ties), Multiple and Partial Correlation: Concept, definition, formulae and properties, Examples.	
Unit II:	**Regression**	15
	Concept of regression. Derivation of lines of regression by method of least squares, Regression Coefficients, and their significance. Properties of regression coefficients, Point of intersection and acute angle between regression lines, Multiple regression: Concept of multiple regressions. Yule's Notations, Fitting of multiple regression planes. Partial regression coefficients, interpretations, Logistic regression, Numerical problems.	

Reference Books:

1) S. C. Gupta and V. K. Kapoor, Fundamental of Mathematical Statistics (12th Edition), Delhi, Sultan Chand and Sons, 2020
2) T.C. Gupta. Fundamental of Statistics (7th Edition), Mumbai, Himalaya Publishing House, 2018.
3) Gentle, E. James, Numerical Linear Algebra for Applications in Statistics. Springer, 2018.
4) Efron, Bradley, Hastie Trevor, Computer Age Statistical inference Algorithms, Evidence, and Data Science. Cambridge University Press, 2016.
5) S. P. Gupta, Sultan Chand, Statistical Methods, Delhi, 2014
6) B. L. Agarwal Basic Statistics (6th Edition), New Age International Private Ltd, Delhi, 2013
7) Christian P. Robert, and Casella, George. Carlo Monte Statistical Methods. Springer, 2004.
8) A. M. Goon, M. K. Gupta, B. Das Gupta. Fundamentals of Statistics, The World Press Private Ltd., Calcutta, 1968.

B. Sc. Artificial Intelligence(AI) Part-I Semester-II Course Code:
Subject III DSC IV : Course Title: R 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. Learn Fundamentals of R.
2. Covers how to use different functions in R, how to read data into R, accessing R packages, writing R functions, debugging, and organizing data using R functions.
3. Cover the Basics of statistical data analysis with examples.
4. The whole syllabus will give an idea to collect, compile and visualize data using statistical functions.

Credits 2	**SEMESTER-II** **Course III: ------ R Programming**	**No. of hours per unit/ credits**
Unit I:	**Introduction to R**	15
	What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), packageDescription(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and –inf. **R Data Types:** Vectors, Lists, Matrices, Arrays, Factors, Data Frame – **R - Variables:** Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - **R Operators:** Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - **R Decision Making**: if statement, if – else statement, if – else if statement, switch statement – **R Loops**: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.	
Unit II:	**R utilities**	15
	R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - **R-Strings** – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - **R Vectors** – Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting - **R List** -Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - **R Matrices** – Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- **R Arrays:** Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - **R Factors** –creating factors, generating factor levels gl().	

Reference Books:

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017Seema Acharya, Data. Analytics using R, McGrawHill Education (India), 2018.
2. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015.

B.Sc. Artificial Intelligence (AI) 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: Show the installation of R Programming Environment.
2: Utilize and R Data types for developing programs.
3: Make use of different R Data Structures.
4: Develop programming logic using R Packages.
5: Analyze the datasets using R programming capabilities
6: Apply R programming for reading, cleaning, visualizing and analyzing data

Lab Work

1. Visualizing the relation between two variables using scatter plot
2. Karl Pearson's Correlation Coefficient
3. Spearmann's Rank Correlation Coefficient
4. Simple Linear Regression
5. Multiple Linear Regression
6. Write a program to demonstrate the use of conditional statements (if, if-else, ifelse) in R.
7. Implement R-Loops with different examples.
8. Learn the basics of functions in R and implement with examples.
9. Implement data frames in R. Write a program to join columns and rows in
10. Data frame using cbind() and rbind() in R
11. Implement different String Manipulation functions in R.
12. Implement different data structures in R (Vectors, Lists, Data Frames).
13. Create pie charts and bar charts using R
14. Create a data set and do statistical analysis on the data using R
15. Use the apply(), lapply(), and sapply() functions on matrices and lists to perform operations like sum and mean.

B.Sc.Artificial Intelligence(AI)
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