



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

**SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA**

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शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र

दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दूरध्वनी ०२३१-२६०९०९४
०२३१-२६०९४८७



Ref.No.SU/BOS/Science/400

Date: 23/09/2026

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

Subject: Regarding revised syllabi of B.Sc. Part-I (Sem I & II) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

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 syllabi (nature of question paper etc.) of B.Sc. Part-I (Sem I & II) degree programme under the Faculty of Science and Technology as per National Education Policy 2020 (NEP 2020).

B.Sc. Part-I (Sem. I & II) as per NEP-2020 (2.0)	
1.	Data Science
2.	Artificial Intelligence

This syllabus, nature of question and equivalence shall be implemented from the academic year 2026-2027 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in>Syllabus>Syllabus as per NEP2020.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2026 & March/April 2027. 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,

[Signature]
Dy Registrar

Encl: as above

for information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR



NAACA++Grade withCGPA3.52

Multiple Entry and Multiple Exit Option (NEP-2020)

Syllabus for

B.Sc. Artificial Intelligence

(Under Faculty of Science and Technology)

PART-I SEMESTER-I &II

(Syllabus to be implemented from Academic year 2026-27)

B.Sc. Artificial Intelligence

Academic year 2026-27

1. Title: B.Sc. Artificial Intelligence
2. Year of implementation: Syllabus will be implemented from June 2026 onwards
3. Duration: B.Sc. Artificial Intelligence
Part- I. The duration of course shall be one year (Two semesters).
4. Pattern: Pattern of examination will be semester
5. Structure of Course:

Shivaji University, Kolhapur

B.Sc. Artificial Intelligence

(Under Faculty of Science and Technology)

Program Outcomes

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

1. Apply foundational concepts of computer science to analyze problems, design algorithms, and develop efficient computing solutions.
2. Design, develop, and implement robust software systems to address real-world challenges.
3. Utilize mathematical, statistical, and computational techniques to analyze and interpret complex datasets across domains.
4. Design and develop intelligent systems using Artificial Intelligence and Machine Learning techniques for solving data-driven problems.
5. Demonstrate critical thinking, creativity, and research aptitude to develop innovative AI-driven solutions.
6. Understand and apply ethical, social, cultural, and professional principles in the development and deployment of technology solutions.
7. Exhibit self-learning abilities, adaptability to emerging technologies, and readiness to address evolving societal and industrial challenges.

Program Specific Outcome (PSO)

1. Apply theoretical knowledge of computing and AI/ML across diverse application domains.
2. Transform innovative ideas into viable products, supporting startup development and entrepreneurship.
3. Demonstrate preparedness for roles in software development, data analytics, and AI/ML-based industries.
4. Develop proficiency in programming languages, tools, frameworks, networking concepts, and modern IT practices.
5. Stay informed about recent advancements in computing, AI, and communication technologies.

6. Identify, formulate, and solve computational and programming problems using appropriate methodologies and tools.
7. Pursue careers in the global IT sector or establish self-employment ventures in software and AI-based solutions.
8. Acquire a strong foundation to pursue advanced studies such as MCA, M.Sc. (AI/ML), or related disciplines.
9. Analyze current technological trends and develop innovative solutions to address existing and emerging challenges.

Programme Educational Objectives (PEOs)

1. Develop and deploy intelligent software solutions capable of handling uncertainty and complex decision-making scenarios.
2. Engage in research activities and contribute to advancements in Artificial Intelligence and Machine Learning.
3. Pursue continuous learning, adapt to technological changes, and demonstrate leadership and teamwork in professional environments.

1. Introduction

The first step towards a graduate professional degree in flourishing area of Artificial Intelligence and Machine Learning. The B.Sc. Artificial Intelligence will provide students with the Knowledge, Skills, and Abilities to meet the demands of the ever-changing IT industry. Beginning with the fundamental concepts of Computing, the programme enables students to appreciate the application of AI and ML techniques in Practice through fascinating modes of learning. B.Sc Artificial Intelligence will empower students to become future technology leaders who will truly transformative and embrace rapid technology growth and lead innovation, whether it be within the organization as a new start-ups or outside the organization's boundaries as an IT consultant.

2. Multiple Entry and Multiple Exit Option (NEP-2020):

- After successful completion of First year of AI and ML Student can exit with under graduate certificate in Artificial Intelligence
- After successful completion of Second year of BSc AI Student can exit with under graduate Diploma in Artificial Intelligence

- After successful completion of Third year of AI Student can exit with B.Sc. AI degree programme.

3. Medium of Instruction:

The medium of instruction will be English only

4. Admission Procedure

To be eligible for admission to B.Sc. (AI) a candidate must have:

- ✓ Passed HSC (10+2) from Science stream.

OR

- ✓ Diploma (10+3) in any stream

Reservation policy will be as per university norms.

5. Course Structure:

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

6. Teaching and Practical Scheme

- Each contact session for teaching 60 minutes each.
- One Practical Batch should be of 30 students.
- Practical evaluation should be conducted after the commencement of university examination.

7. Project Work:

- Project work may be done individually or in groups in case of bigger projects. However, if project is done in groups, each student must be given a responsibility for a distinct module and care should be taken to see the progress of individual modules is independent of others.
- Students should take guidance from assigned guide and prepare a Project Report on "Project Work" in two copies to be submitted to the principal of the college.
- The project report should contain an Introduction to Project, which should clearly explain the project scope in detail. Also DFDs, ERDs, UML diagrams, database designs and a list of output reports should be included.
- The project Work should be of such a nature that it could prove useful or should be relevant from the commercial/Societal angle.
- The project report will be duly assessed by the assigned guide and internal marks will be communicated by the Director of the Institute/Head of the Department.
- The project report should be prepared in a format prescribed by the University, which also specifies the contents and methods of presentation. IEEE Computer Society templates are recommended in this regard.

- g) The external viva shall be conducted by a panel of minimum two examiners out of which one will be external and other will be internal examiner.

8. 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 or 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 30Marks

1. Question No. 1 is compulsory and is of multiple-choice questions.
There will be 6 multiple choice questions each carrying 1 mark
2. QuestionNo.2willhave3questionsoutofwhich2questionsneedtobe solved.
Each carries 6 Marks
3. QuestionNo.3willhave6questionsoutofwhich4questionsneedtobe 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.

9. Standard of Passing:

- i) Minimum 40% marks in each subject. There shall be separate passing for theory and practical.
- ii) Admission to B.Sc. Artificial Intelligence Part II is allowed even if the student fails in 20 subjects of First year B.Sc. Artificial Intelligence
- iii) Admission to B.Sc.. Artificial Intelligence part III is allowed even if the student fails in 20 subjects of B.Sc.. Artificial Intelligence Part II. But no student is allowed to take admission to third year of B.Sc.. Artificial Intelligence unless they clear all the papers of first year.

10. 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 setters/examiners, care should be taken to ensure that there is at least one person specialized in each unit of the course.

11. Credit System Implementation:

As per the University norms.

12. Clarification of Syllabus:

The syllabus committee should meet at least once in a year to study and clarify any difficulties faced by the institutes.

13. Eligibility of Faculty:

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

14. Revision of Syllabus:

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

15. Award of Class:

There will be numerical marking for each question. At the time of declaration of the result, the marks obtained by the candidate shall be converted into grade points as shown below.

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

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:VeryGood
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
Academic Year 2026–27
Syllabus to be implemented from Academic Year 2026–27

1. Title:

B.Sc. Artificial Intelligence

2. Year of Implementation:

The syllabus will be implemented from June 2026 onwards.

3. Duration:

B.Sc. Artificial Intelligence Part I. The duration of the course shall be one year (two semesters).

4. Pattern:

The pattern of examination will be semester-based.

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-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: Programming using C	2	-	2		11		07
2	Subject I DSC II: Operating System	2	-	2		11		07
3	Practical based on Subject I DSC I	-	4	2		11		07
4	Subject II DSC I: Basic Algebra	2	-	2		11		07
5	Subject II DSC II: Calculus	2	-	2		11		07
6	Subject II Practical I: Mathematics Practical - I	-	4	2		11		07
7	Subject III DSC I: Descriptive Statistics – I	2	-	2		11		07
8	Subject III DSC II: Elementary Probability Theory	2	-	2		11		07
9	Subject III Practical I: Statistics Practical - I	-	4	2		11		07
10	OE I: Business Statistics using MS Excel Practical – I	-	4	2		11		07
11	IKS I: Vedic Mathematics	2	-	2		11		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: Python Programming	2	-	2		11		07
2	Subject I DSC IV: Database - I	2	-	2		11		07

3	Subject I Practical II: Practical based on Subject I DSC III & Course I DSC IV	-	4	2		11		07
4	Subject II DSC III: Differential Equations - I	2	-	2		11		07
5	Subject II DSC IV: Discrete Mathematics	2	-	2		11		07
6	Subject II Practical II: Mathematics Laboratory course-II	-	4	2		11		07
7	Subject III DSC III: Statistical Methods	2	-	2		11		07
8	Subject III DSC IV: Discrete Probability Distributions	2	-	2		11		07
9	Subject III Practical II: Statistics Practical - II	-	4	2		11		07
10	OE II: Business Statistics using MS Excel Practical – II	-	4	2		11		07
11	VEC I: Democracy, Election and Constitution	2	-	2		11		07
	Total (B)			22	330		220	
	Total (A+B)			44	660		440	

1. Student contact hours per week: 30 Hours (Min.)	1 Total Marks for B.Sc. AI -I: 1100
1. Theory and Practical Lectures: 60 Minutes Each	6. Total Credits for B.Sc. AI -I (Semester I & II): 44
2 Requirement for Entry at Level 4.5: Completed all requirements of the 10+2	
1. DSC: Department Specific Core 2. OE: Open Elective	1.IKS: Indian Knowledge System 2.VEC: Value Education Course
1. Practical Examination is Semester wise before Theory Examination.	1.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 additional 4 credits core NSQF course / Internship.	

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I

Course Code: Subject I DSC I: Course Title: Programming using C

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.

Credits	Contents	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 through pointers, NULL pointer, array access using pointers, pass by reference effect File Operations: open, close, read, write, append Access to files: In built file handling functions (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 Private Limited.
4. S. Byron Gottfried (2018) Programming with C (TMH), 4th edition.
5. E. Balaguru swamy (2017), Programming in ANSI C (TMH),7th Edition McGraw Hill
6. Kamthane (2008)

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)

PART I SEM I

Course Code: Subject I DSC II: Course Title: Operating System

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	Contents	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. Dhamdhare, 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 of 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 Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I
Title of course: Subject II DSC I : Discrete Mathematics

Course Outcomes (COs):

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

1. Apply basic counting principles and combinatorial arguments.
2. Solve linear recurrence relations with constant coefficient.
3. Analyze the logical structure of statements symbolically, including the proper use of logical connectives.
4. Construct truth tables, prove or disprove a hypothesis and evaluate the truth of a statement using the principles of logic.

Credits 2	Contents	No. of hours per unit/ credits
Unit I:	Counting Principles Functions: Definition, Types of mapping, Injective, Surjective & Bijective functions, Inverse function, Composition of functions. Counting: Addition & Multiplication principle, Permutation and Combination. Cardinality of finite set. Cardinality of union of sets (Addition principle). Principle of Inclusion and Exclusion. Examples. Combinatorial Arguments. Pigeonhole Principle (Statement only). Examples.	(15)
Unit II:	Recurrence Relation & Logic Recurrence Relation Introduction. Linear Recurrence relation with constant coefficient. Homogeneous solutions and Examples. Particular and Total Solution, Examples. Logic Propositions and Logical connectives: Definition, Types of Propositions, Truth values and Truth Tables, Tautology and Contradiction, Logical equivalence. Rules of inferences. Valid arguments and proofs. Methods of Proofs: Direct and indirect Examples.	(15)

Reference Books

1. Discrete mathematics by S. R. Patil and others, NIRALI Prakashan.
2. Discrete mathematics by Bhopatkar, Nimbkar, Joglekar, VISION Publication.
3. Discrete Mathematical Structure for Computer Science by Alan Doer and K. Levasicur.
4. Discrete Mathematics by Olympia Nicodemi.
5. Elements of Discrete Mathematics by C. L. Liu.
6. Discrete and Combinatorial Mathematics by R. M. Grassl.
7. Discrete Mathematics by Kenneth Rosen, Tata McGraw Hill.
8. Discrete mathematics by Naik and Patil, PHADAKE Prakashan.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)

PART I SEM I

Title of course: Subject II DSC II : Algebra

Course Outcomes (COs):

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

1. Apply fundamental concepts in Number theory to solve problems on congruence.
2. Solve problems based on Fermat's theorem and residue classes.
3. Use fundamental concepts in Mathematics like sets, relations and functions.
4. learn basic concepts like poset, lattice, Boolean algebra and apply them to find CNF and DNF.

Credits 2	Contents	No. of hours per unit / credits
Unit I:	Divisibility of integers Introduction Divisibility: Division algorithm (Statement only). Greatest Common Divisor (GCD), Least Common Multiple (LCM), examples. Euclidean algorithm, examples. Prime numbers, Euclides Lemma, Fundamental theorem of Arithmetic (without proof), examples. Congruence relation and its properties Fermat's Theorem (Statement only), examples. Residue Classes: Definition, addition modulo n, multiplication modulo n, Examples.	(15)
Unit II:	Relations & Boolean Algebra Relations Ordered pairs, Cartesian product. Relations, Types of relations, Equivalence relation, Partial ordering relation, Examples. Digraphs of relations, matrix representation and composition of Relations, Examples. Transitive closure, Warshall's algorithm, Examples. Equivalence class, Partition of a set. Boolean algebra Hasse diagram. Lattice: Definition, principle of duality. Basic properties of algebraic systems defined by Lattices. Distributive and complemented lattices. Boolean lattices and Boolean algebras. Boolean expressions and Boolean functions. Disjunctive and conjunctive normal forms and examples.	(15)

Reference Books

1. Algebra by S. R. Patil and Others Nirali Prakashan.
2. Algebra by Bhopatkar, Nimkar, Joglekar, VISION Publication.
3. Algebra by Naik and Patil, PHADAKE Prakashan.
4. A Foundation Course in Mathematics, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House.
5. Elementary Number Theory, Seventh edition: David M. Burton, McGraw-Hill.
6. Lattices & Boolean Algebras: First Concepts by V. K. Khanna, Vikas Publishing House, Second Edition, 2008

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)

PART I SEM I

Title of course: Practical based on Subject II DSC I and Subject II DSC II

Pr. No	Title of the Practical	No. of Practical
1	Combinatorial arguments	1
2	Recurrence relation	1
3	Proofs of valid arguments using truth table	1
4	Proofs of valid arguments using laws of inferences	1
5	Euclidean algorithm	1
6	Examples using Fermat's theorem	1
7	Warshall's algorithm	1
8	Disjunctive and Conjunctive normal forms (DNF & CNF)	1
9	C – Programs: finding g. c. d and l. c. m., determination of primes	1
10	C – program for Euclidean algorithm	1
11	C – program for Warshall's algorithm	1
12	C – program to determine the value of $\phi(n)$ (Euler ϕ function).	1

Batch: One batch of 20 students.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I

Subject III DSC I: Descriptive Statistics – I

Course Outcomes: The students will acquire knowledge of

- i. Meaning and scope of Statistics, various statistical organizations.
- ii. Population, sample and various methods of sampling.
- iii. Various measures of central tendencies and dispersion.
- iv. Moments, skewness and kurtosis.

Unit - 1

(15 hrs.)

1.1 Introduction to Statistics: Meaning of Statistics as a Science, Importance of Statistics, Definition of Statistics, Various fields where Statistics is used, Names of various statistical organizations in India.

- **Population and Sample:** Statistical population. Finite population, Infinite population, Census method, Sampling method, Advantages of sampling method over census method.
- **Methods of sampling (Description only):** Sample and Random sample, Simple random sampling with and without replacement (SRSWR and SRSWOR), Stratified random sampling, Systematic sampling.

1.2 Nature of Data: Primary and Secondary data, Time series data, Quantitative and Qualitative data, Attributes, Variables, Discrete and Continuous variables, Scales of measurement - Nominal, Ordinal, Interval and Ratio scale, illustrative examples.

- **Presentation of Data: Classification:** Raw data and its classification, Discrete frequency distribution, Continuous frequency distribution, Cumulative frequency distribution, Inclusive and Exclusive methods of classification, Open end classes, Relative frequency distribution, illustrative examples.

Unit - 2

(15 hrs.)

2.1 Measures of Central Tendency: Mathematical and positional, Concept of central tendency of statistical data, statistical average, requirements of good statistical average.

- **Arithmetic Mean (A.M.):** Definition, Effect of change of origin and scale, Deviation of observations from A.M., Mean of pooled data, Weighted A.M.
- **Geometric Mean (G.M.):** Definition, illustrative examples.
- **Harmonic Mean (H.M.):** Definition, Relation: $A.M \geq G.M \geq H.M$ (proof for $n = 2$ positive observations), illustrative examples.
- **Median:** Definition, Derivation of formula for grouped frequency distribution.
- **Mode:** Definition, Derivation of formula for grouped frequency distribution. Empirical relation between mean, median and mode. Graphical method of determination of Median and Mode.
- **Partition values:** Quartiles, Deciles and Percentiles. Comparison between averages in accordance with requirements of good average. Situations where one kind of average is preferable to others, illustrative examples.

2.2 Measures of Dispersion: Concept of dispersion, Absolute and Relative measures of dispersion, Requirements of a good measure of dispersion.

- **Range:** Definition, Coefficient of range.
- **Quartile Deviation (Q. D. or Semi-inter quartile range):** Definition, Coefficient of Q.D.,
- **Mean Deviation (M.D.):** Definition, Coefficient of M.D., Minimal property of M.D.,
- **Mean Square Deviation (M.S.D.):** Definition, Minimal property of M.S.D.,
- **Variance and Standard Deviation (S.D.):** Definition, Effect of change of origin and scale, variance and S.D. of pooled data (proof for two groups).
- **Coefficient of Variation:** Definition and use. Illustrative examples.

2.3 Moments, Skewness and Kurtosis:

- **Moments:** Raw moments and central moments for ungrouped and grouped data. Effect of change of origin and scale on central moments, relation between central moments and raw moments (up to 4th order). Sheppard's corrections.
- **Skewness:** Concept of skewness of a frequency distribution, types of skewness. Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness, measure of skewness based on moments.
- **Kurtosis:** Concept of kurtosis of a frequency distribution, Types of kurtosis, Measure of kurtosis based on moments. Illustrative examples.

Books Recommended:

1. Bhat B. R., Srivenkatramana T. and Madhava Rao K. S. (1996): Statistics: A Beginner's Text, Vol. 1, New Age International (P) Ltd.
2. Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., and Dasgupta B.: Fundamentals of Statistics Vol. I and II, World Press, Calcutta.
4. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
5. Gupta V.K. & Kapoor S.C.: Fundamentals of Mathematical Statistics.- Sultan & Chand.
6. Hogg R. V. and Crag R. G.: Introduction to Mathematical Statistics Ed.4.
7. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I

Subject III DSC II: Elementary Probability Theory

Course Outcomes: Students will be able to;

- i. Distinguish between random and non-random experiments
- ii. Use the basic probability rules, including additive and multiplicative laws
- iii. Understand concept of conditional probability and independence of events.
- iv. Understand concept of univariate random variable and its probability distributions

CONTENTS:

Unit - 1

(15 hrs.)

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 $|\mathbf{P}(\Omega)$** (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 proof of the results:** i) $P(\Phi) = 0$, ii) $P(A^c) = 1 - P(A)$,
iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only),
iv) If $P(A \subset B)$, $P(A) \leq P(B)$ v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$.
- **Conditional Probability:** Definition of conditional probability of an event. Multiplication theorem for two events. Examples on conditional probability.

Unit - 2

(15 hrs.)

2.1 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^c are independent, ii) A^c and B are independent, iii) A^c and B^c are independent. Pairwise and Mutual independence for three events. Elementary examples.

- **Baye's theorem:** Partition of sample space, Idea of posterior probability, statement and proof of Baye's theorem, illustrative examples on Baye's theorem.
- **Univariate Probability Distributions (finite sample space):** Definition of discrete random variable. Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.) of a discrete random variable, Properties of c.d.f. (statements only). Probability distribution of function of random variable.
- **Median and mode:** Median and mode of a univariate discrete probability distribution. Examples.

2.2 Mathematical expectation (Univariate random variable): Definition of expectation

of a random variable. Expectation of a function of a random variable, Results on expectation of a

functions of a random variable: i) $E(c) = c$, where c is a constant, ii) $E(aX + b) = aE(X) + b$, where a and b are constants,

- **Mean and variance:** Definitions of mean and variance of univariate distribution,

$$V(aX + b) = a^2V(X)$$

- **Raw and central moments:** Definition of raw and central moments.
- **Probability generating function (p.g.f.):** Definition of probability generating function (p.g.f.) of a random variable, Mean and variance by using p.g.f., Effect of change of origin and scale on p.g.f.

Books Recommended:

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.
6. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, Mc Graw Hill Book Company.
7. Rao, VLS Prakash (2008). First Course in Probability and Statistics, New Age International Publishers, New Delhi.
8. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.
9. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia).

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I

Course Code: **Subject III Practical I** Course Title: **STATISTICS PRACTICAL - I**

Course Outcomes: Students will able to;

- i. Acquire knowledge of computations using MS-Excel.
- ii. Represent statistical data diagrammatically and graphically.
- iii. Compute various measures of central tendency, dispersion, moments, skewness and kurtosis.
- iv. Interpret summary Statistics of computer output.

List of Practical's:

1. Data handling and computations using MS-Excel.
2. Diagrammatic and Graphical presentation.
3. Use of random numbers to draw SRSWOR, SRSWR sample.
4. Use of random numbers to draw Stratified and Systematic sample.
5. Measures of central tendency.
6. Measures of the dispersion.
7. Moments, skewness and kurtosis.
8. Computation of probabilities using Baye's theorem.
9. Case study equivalent to 2 practicals.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I

OE-I: Business Statistics using MS Excel/Linux
Practical – I

Course Outcomes:

After completing this course, the student will be able to:

- i. Organize and manage business data using MS Excel operations such as data entry, sorting and filtering.
- ii. Compute measures of central tendency and dispersion using Excel functions.
- iii. Construct frequency distribution tables and represent data using histograms and charts in Excel.
- iv. Analyze the relationship between variables using correlation techniques in Excel.
- v. Compute and interpret index numbers for analyzing changes in business data using Excel.

List of Practicals

1. Introduction to MS Excel and data entry, sorting and filtering.
2. Measures of Central Tendency using Excel functions.
3. Measures of Dispersion using Excel.
4. Data Visualization using Charts (Bar, Pie, Line).
5. Frequency Distribution and Histogram in Excel.
6. Correlation Analysis using Excel.
7. Index Numbers using Excel.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM I
Course Code: IKS - I: Course Title: Vedic Mathematics

Course Outcomes:

After completion of this course students will be able;

1. To perform simple arithmetic calculations with speed and accuracy.
2. To generate tables of any number.
3. To perform products of large numbers quickly.
4. Apply basic Vedic techniques for fast addition, subtraction, multiplication, and division.
5. Use complements, bases, and vinculum numbers to simplify arithmetic calculations.
6. Solve quadratic and simultaneous equations and apply Vedic techniques to competitive exam problems.

UNIT I (15 HOURS)

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.

UNIT II (15 HOURS)

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

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.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

Course Code: Subject I DSC III: Course Title: Python Programming

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 work with data structures like lists, tuples, and dictionaries, and apply list comprehensions.
3. To handle file operations, exceptions, and use command line arguments in Python programs.
4. To apply object-oriented programming concepts such as classes, objects, inheritance, and polymorphism.

Credits 2	Contents	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

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

Course Code: Subject I DSC IV: Course Title: Database - I

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	Contents	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 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, Operations: UNION, INTERSECT, EXCEPT, Introduction to Transactions and ACID Properties: Atomicity, Consistency, Isolation, Durability Transaction Control Commands: COMMIT, ROLLBACK, SAVEPOINT	

[**Note:** PostgreSQL will be used as the primary database platform for delivering both theoretical concepts and practical exercises in this course.]

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.

[Note: PostgreSQL will be used as the primary database platform for delivering both theoretical concepts and practical exercises in this course.]

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II
Title of course: Subject II DSC III : Graph theory

Course Outcomes (COs):

After completion of this course students will be able to:

1. Achieve command of the fundamental definitions and concepts of graph theory.
2. Model problems using graphs and solve these problems algorithmically.
3. Illustrate fundamentals of spanning tree, circuits and cut-sets.
4. Apply this knowledge in (especially) computer science applications.

Credits 2	Contents	No. of hours per unit/ credits
Unit I:	Graphs and operations on graphs Definition and elementary results Types of graphs Isomorphism Matrix representation of graphs: Adjacency matrix and incidence matrix Subgraphs and induced graphs Complement of a graph, Self complementary graphs Union, intersection of graphs, Ring sum of two graphs Definitions: walk, trail, tour, path and circuit, Definitions of connected, disconnected graphs Dijkstra's shortest path algorithm Connectivity: Isthmus, cut-vertex, Edge connectivity & vertex connectivity	15
Unit II:	Tree Graphs Tree: Definition Properties of Trees: Theorem: A tree with n vertices has $n - 1$ edges. Theorem: A connected graph G with n vertices and $n - 1$ edges is a tree Theorem: A graph with n vertices is a tree if and only if it is circuit free and has $n - 1$ edges. Theorem: A graph G is a tree if and only if it is minimally connected. Centre of a tree Spanning tree: Definition and examples Fundamental circuit and cut-set: Definition, examples. Binary trees and elementary results, examples. Kruskal's algorithm, examples.	15

Reference Books:

1. Discrete Mathematics by Kenneth Rosen, Tata McGraw Hill
2. Graph Theory with Applications to Computer Sc. & Engg. by Narsing Deo, PHI, 2009
3. A First Step in Graph Theory by Raghunathan, Nimkar and Solapurkar
4. Discrete mathematics by S.R.Patil and others, NIRALI Prakashan.
5. Discrete mathematics by Bhopatkhar, Nimbkar, Joglekar, VISION Publication.
6. Introduction to Graph theory by S. Arumugham and S. Ramachandran, published by Scitech Publications, Chennai-17
7. Introduction to Graph Theory, Mamta Chaudhary, Vani Sharma and Pooja Yadav, Sultan Chand & Sons, Educational Publishers, New Delhi.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

Title of course: Subject II DSC IV : Group and Coding Theory

Course Outcomes (COs):

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

1. Learn Group structure and its properties.
2. Understand fundamental properties of sub-groups, cyclic groups, permutation groups.
3. identify different types of group structure and apply them in Cryptography
4. Compile the concepts, properties, aspects of Algebra and apply them in computer science.

Credits 2	Contents	No. of hours per unit/ credits
Unit I:	Groups Binary Operation Group: Definition and Examples Elementary Properties of Groups Order of a group, order of an element Examples $(\mathbb{Z}_n, +)$ and $(U(n), *)$ Subgroup definition, Finite subgroup test, subgroups of $\mathbb{Z}_n$ Generator, cyclic group, finding generators of $\mathbb{Z}_n$ (Corollary without proof)	15
Unit II:	Permutation group and Coding Theory Permutation group, definition, composition of two permutations, representation as product of disjoint cycles, inverse and order of a permutation, even / odd permutations. Cosets: Definition, Examples and Properties, Lagrange Theorem (without Proof) Definitions: Ring, Integral domain, Field. Coding of Binary Information and Error detection Decoding and Error Correction Public Key Cryptography	15

Reference Books:

1. Groups and Coding theory by Kalyanrao Takale and others, Nirali Prakashan (Golden series), 2020.
2. Groups and Coding theory by Parshuram Ahire, Vision Publications, 2020.
3. Contemporary Abstract Algebra by J. A, Gallian (Eighth Edition), Cengage Learning India Private Limited, Delhi. Fourth impression, 2015.
4. Discrete Mathematical Structures by Bernard Kolman, Robert C. Busby and Sharon Ross (6th Edition) Pearson Education Publication.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

Title of course: Practical based on Subject II DSC III and Subject II DSC IV

List of Practical's:

Pr. No	Title of the Practical	No.of Practical
1	Union, intersection & Ring sum of two graphs	1
2	Dijkstra's Shortest path algorithm	1
3	Fundamental circuit and fundamental cut set	1
4	Kruskal's algorithm	1
5	Examples on Group	1
6	Examples on subgroup and finite subgroup test	1
7	Examples on finding generators and subgroups of Z_n	1
8	Examples on permutations (order, inverse, even/odd)	1
9	Examples on parity check matrix and group code	1
10	C – Program to check whether given number has odd parity or even parity	1
11	C – program to convert given input string into cipher text	1
12	C – program to Convert given graph into matrix form	1

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)

PART I SEM II

Course Code: **Subject III DSC III** Course Title **Statistical Methods**

Course Outcomes: The students will acquire knowledge of

- i. the time series data and its analysis,
- ii. rates of vital events, its computation and interpretation,
- iii. how to compute and interpret index numbers,
- iv. cost of living index number and its utility,

Unit 1:

(15 hrs.)

1.1 Analysis of Time Series Data:

- Meaning and need of time series data analysis.
- Components of time series: (i) secular trend (ii) seasonal variations (iii) cyclical variations (iv) random or irregular variations.
- Additive model and multiplicative model.
- Utility of time series data analysis.
- Measurement of secular trend by using: (i) moving average method (ii) progressive average method (iii) least square method.
- Measurement of seasonal variations by simple average method.

1.2 Demography:

- Introduction and need of vital statistics;
- Vital events and rates of vital events,
- Measurement of fertility: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR) and Total Fertility Rate (TFR);
- Measurement of mortality: Crude death rate (CDR), Specific Death Rate (SDR), Age Specific Death Rate (ASDR), Infant Mortality Rate (IMR), Standardized Death Rate (STDR) by i) direct method ii) indirect method ;
- Measurement of Population Growth: Gross Reproduction Rate (GRR), Net Reproduction Rate (NRR), relation between GRR and TFR; Introduction to Life tables.

Unit 2

(15 hrs.)

2.1 Index Numbers:

- Meaning and utility of index numbers.
- Price, Quantity and Value index numbers.
- Problems in the construction of index numbers.
- Types of index numbers: Un-weighted and weighted index numbers.
- Methods of computing un-weighted index numbers: (a) Simple aggregate method and (b) Average of price or quantity relative method (using A.M. or G.M.).
- Methods of computing weighted index numbers: (a) Laspeyre's method (b) Paasche's method and (c) Fisher's method.

2.2 Tests of Index Numbers:

- Unit test, time reversal test and factor reversal tests.
- Cost of living index numbers, construction of cost of living index numbers by using (i) Family budget method and (ii) Aggregate expenditure method.
- Purchasing power of money; difference between money wages and real wages.
- Meaning and interpretation of BSE (Bombay Stock Exchange) and NSE (National Stock Exchange) indices.

Books Recommended:

1. Bhat B. R., Srivenkatramana T and Madhava Rao K. S. (1997): Statistics: a Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Chatfield C. "The Analysis of Time Series –An Introduction", Chapman & Hall, 2004.
3. Croxton F. E., Cowden D.J. and Kelin S. (1973): Applied General Statistics, Prentice Hall of India.
4. Goon A. M., Gupta M. K., Das Gupta B. (1999): Fundamentals of Statistics, Vol.I and II, World Press, Calcutta.
5. Gupta S. P. (2002): Statistical Methods, Sultan Chand and Sons, New Delhi.
6. Gupta V.K. & Kapoor S.C. Fundamentals of Applied Statistics.- Sultan & Chand
7. Hoel P. G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
8. Kendall M.G. "Time Series", Charles Griffin, 1978.
9. Snedecor G.W. and Cochran W. G. "Statistical Methods", Iowa State University Press.
10. Srivastav D. S: A Text book of Demography.
11. Waiker and Lev.: Elementary Statistical Methods.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

Course Code: **Subject III DSC IV**
Course Title **DISCRETE PROBABILITY DISTRIBUTIONS**

Course Outcomes: The students will acquire knowledge of

- i. One point, Two point and Bernoulli distributions,
- ii. Discrete uniform, Binomial and Hypergeometric distributions,
- iii. Poisson, Geometric and Negative binomial distributions.
- iv. Applications of these distributions in real-life situations.

Unit 1:

(15 hrs.)

1.1 Some standard discrete distributions on finite sample space-I:

- One point distribution: p. m. f., mean and variance,
- Two point distribution: p. m. f., mean and variance,
- Bernoulli distribution: p. m. f., p. g. f., mean, variance.
- Discrete Uniform Distribution: p. m. f., mean and variance.

1.2 Some standard discrete distributions on finite sample space-II:

- Binomial Distribution: Genesis of the distribution, Binomial random variable, p. m. f. with parameters (n, p) , recurrence relation for obtaining successive probabilities, mean, variance and mode of the distribution; skewness, p. g. f., Additive property of binomial variates; distribution of sum of independent and identically distributed Bernoulli variables, numerical problems.
- Hypergeometric Distribution: Genesis of the distribution, p. m. f. with parameters (N, M, n) , Computation of probability of different events, recurrence relation for successive probabilities, mean and variance of distribution assuming $n \leq N - M \leq M$, Approximation of Hypergeometric to binomial distribution (Statement only), numerical problems.

Unit 2:

Some standard discrete probability distributions on countable infinite sample space: **(15 hrs)**

2.1 Poisson distribution: Genesis of the distribution; probability mass function (p. m. f.) of Poisson distribution with parameter λ , mean, variance, probability generating function (p. g. f.); Recurrence relation for obtaining successive probabilities; Additive property of Poisson distribution; Poisson distribution as a limiting case of Binomial distribution (Statement Only); numerical problems.

2.2 Geometric and Negative Binomial distributions:

- Geometric Distribution: Genesis of the distribution, probability mass function (p. m. f.) of Geometric distribution with parameter p , mean and variance, cumulative distribution function (c. d. f.), probability generating function (p. g. f.); Lack of memory property; numerical problems.
- Negative Binomial Distribution: Genesis of the distribution, probability mass function (p. m. f.) of Negative binomial distribution with parameters (k, p) . Geometric distribution as a particular case of Negative binomial distribution; mean, variance and p. g. f.; recurrence relation for obtaining successive probabilities; numerical problems.

Books Recommended:

1. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
2. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.

3. Hogg R. V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
4. Mood A.M., Graybill F.A.: Introduction to theory of Statistics.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

Course Code: **Subject III Practical II**
Course Title: **Statistical Practical II**

Course Outcomes:

After completion of this course, students will be able to:

- i. analysis and interpret time series data,
- ii. compute and interpret population mortality, fertility and growth rates,
- iii. compute and interpret price, quantity and value index numbers,
- iv. understand the applications of discrete probability distributions.

List of Practical's:

1. Analysis of Time Series data. (Measurement of trend by moving average, progressive average and least square methods, Seasonal indices by simple average method).
2. Demography-I (Measurement of Mortality rates).
3. Demography-II (Measurement of Fertility and reproduction rates).
4. Computation of Index numbers.
5. Applications of discrete uniform and Binomial distributions.
6. Applications of Hypergeometric distribution.
7. Applications of Poisson distribution.
8. Applications of Geometric and Negative Binomial distributions.
9. Case study equivalent to 2 Practicals.

B.Sc. Part- I Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART I SEM II

OE-II: Business Statistics using MS Excel/Linux Practical – II

Course Outcomes:

After completing this course, the student will be able to:

- i. Fit and interpret simple linear regression models using MS Excel.
- ii. Analyze time series data and determine trends using moving averages in Excel.
- iii. Apply basic probability concepts and compute probabilities using Excel functions.
- iv. Compute probabilities for binomial and normal distributions using Excel.
- v. Perform hypothesis testing and interpret results using Excel tools for business decision making.

List of Practical's

1. Linear Regression using Excel.
2. Time Series Analysis using Moving Averages.
3. Probability Calculations using Excel functions.
4. Binomial Distribution using Excel.
5. Normal Distribution using Excel.
6. Poison Distribution using Excel.
7. Business Data Analysis Project using Excel.

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

Course Outcomes:

After completion of this course students will be able to;

1. The overall course of political science develops the understanding of the basic concepts of Politics, Political theory and Political science.
2. Social democracy thus aims to create the conditions for capitalism to lead to greater democratic, egalitarian and solidaristic outcomes
3. A course focused on democracy, elections, and the constitution typically aims to equip students with a strong understanding of democratic principles.
4. Understand the concept, principles, and types of democracy, including direct and representative democracy.
5. Explain the role of decentralization and the 73rd and 74th Constitutional Amendments in grassroots governance.
6. Evaluate the structure and process of elections at national, state, and local levels, and the role of the State Election Commission.

