SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

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

Ref.No.SU/BOS/Science/150 **Date: 26/05/2026.**

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

The Head/Co-ordinator/Director
All Concerned Department (Science)
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of 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 degree programme under the Faculty of Science and Technology as per NEP-2020.

1.	B.Sc. Part II Medicinal Chemistry (Entire) (2.0)	6.	BCA Part III
2.	B.A./B.A.B.Ed Part III Geography (2.0)	7.	B.Sc. Part II Data Science
3.	B.Sc. Part II Artificial Intelligence	8.	B.Sc.-M.Sc. Part I AI & ML
4.	B.Sc.-M.Sc. Part IV Nano Science and Technology (1.0)	9.	MCA Part II (YCSRD)
5.	B.Sc.-M.Sc. Part III Nano Science and Technology (2.0)	10.	MCA Part II

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,

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.A.,OE-II & 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



Accredited By NAAC "A++"Grade

Programme with Multiple Entry and Multiple Exit Option

As Per NEP-2020 (NEP2.0)

Syllabus for

B.Sc. Artificial Intelligence and Machine Learning

(Under Faculty of Science and Technology)

SEMESTER-I AND II

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

Shivaji University, Kolhapur

B.Sc.AI ML

(Under Faculty of Science and Technology)

Program Outcomes (PO):

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

PO1. Fundamental Knowledge: Demonstrate strong understanding of core concepts in AI ML, Computer Science, Mathematics, and Statistics.

PO2. Programming & Tools Proficiency: Develop programs and analytical solutions using Python, SQL/MySQL, R (optional), spreadsheets, and visualization tools.

PO3. Data Handling & Engineering Skills: Collect, clean, transform, store, and manage structured and unstructured data using appropriate data engineering techniques.

PO4. Statistical & Analytical Thinking: Apply statistical methods, probability, and exploratory data analysis to interpret data and draw meaningful insights.

PO5. Machine Learning & AI Basics: Build and evaluate basic machine learning models for prediction, classification, and pattern recognition tasks.

PO6. Problem Solving & Critical Thinking: Analyze real-world problems and design data-driven solutions using logical and computational thinking.

PO7. Visualization & Communication: Create effective data visualizations and communicate insights through reports, dashboards, and presentations for technical and non-technical audiences.

PO8. Ethics, Security & Social Responsibility: Demonstrate awareness of data ethics, privacy, cybersecurity, and the social impact of data-driven decisions.

PO9. Teamwork & Project Management: Work effectively as an individual and as a team member in multidisciplinary environments; manage projects with professional responsibility.

PO10. Lifelong Learning & Career Readiness: Adapt to emerging tools and technologies in AI ML, AI & Analytics; pursue higher studies, research, or professional careers.

Program Specific Outcomes (PSO):

After successful completion of the B.Sc. AI ML program, graduates will be able to:

PSO1. Data Analysis & Visualization:Apply data analysis techniques and create meaningful visualizations using tools like Python (Pandas, Matplotlib/Seaborn), Excel, and BI tools to support decision-making.

PSO2. Database & Data Engineering Skills: Design, implement, and manage databases using SQL/MySQL, perform ETL processes, and handle large datasets using basic data engineering concepts.

PSO3. Statistical Modeling for AI ML:Use probability and statistics to analyze datasets, test hypotheses, and interpret results for real-world problem solving.

PSO4. Machine Learning Applications: Build, train, and evaluate basic machine learning models for classification, regression, and clustering using appropriate libraries.

PSO5. Programming for Data-Driven Solutions: Develop end-to-end AI ML solutions using Python programming, including data preprocessing, model development, and result interpretation.

PSO6. Domain-Based Data Applications: Apply AI ML techniques in domains such as business analytics, healthcare, agriculture, finance, and social data.

PSO7. Ethical & Responsible Use of Data: Follow ethical practices in data collection, privacy, security, and responsible AI while working with real-world datasets.

PSO8. Industry & Research Readiness: Demonstrate readiness for entry-level data roles, internships, research projects, higher studies (M.Sc./M.Tech./MBA Analytics), and competitive exams.

1. **Introduction**

B.Sc. AI ML is a three-year undergraduate degree program.

a) The course helps students learn how to work with data in a practical way.

b) Students learn programming, mainly Python and SQL, for data handling.

c) The program includes basic mathematics and statistics needed for data analysis.

d) Students learn how to collect, clean, and organize data from different sources.

e) The course introduces machine learning and artificial intelligence concepts.

f) Job opportunities:

i. Data Analyst: Students can work as data analysts and study data to support business decisions.

ii. Junior Data Scientist: Graduates can assist senior data scientists in building models and analyzing data.

iii. Business Analyst: Students can help companies understand business problems using data.

iv. Data Engineer Trainee: Graduates can support data pipelines, data cleaning, and data storage work.

v. Machine Learning Intern: Students can work on basic machine learning tasks under guidance.

vi. SQL and Database Executive: Students can manage databases and write queries for reports and analysis.

vii. Research Assistant: Students can assist in data collection and analysis in colleges and research centers.

viii. Higher Studies and Competitive Exams: Graduates can go for M.Sc. AI ML ,M.Sc. Computer Science, MBA Analytics, or prepare for government and private sector exams.

2. **Medium of Instruction:**

The, medium of instruction will be English only

3. **Admission Procedure**

TobeeligibleforadmissiontotheB.Sc.AI ML a candidate must have passed

- HSC (10+2) from science stream OR
- Three Year Diploma Course (after SSC i.e. 10^{th} Standard), of Board of Technical Education conducted by Government of Maharashtra or its equivalent

4. **Course Structure:**

LecturesandPracticalshouldbeconductedasperttheschemeoflecturesandpractical'sindicatedinthe course structure.

5. **Teaching and Practical Scheme**

a) Contact sessionforteaching60minuteseach.

b) OnePracticalBatchshouldbeof20students.

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

6. **Assessment**

1. The final practical examination will be conducted by the university appointed examiners 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.
2. The practical examination will be conducted semester wise in order to maintain the relevance of there respective theory course with laboratory course.
3. The final examinations shall be conducted at the end of the semester.

B.Sc. PROGRAMME

RULESFOR60:40EVALUATIONPATTERN

TobeimplementedfromJune2025

Nature of question paper and scheme of marking:

a) Theory(Semester exam)for each Theory paper: Maximum marks–30

Modality of Assessment

Students appearing for the B.Sc. will be evaluated as per the 60:40 scheme where in the term end exam will be of 30 marks each paper while 20 marks will be through internal evaluation for each paper.

A. Theory Examination

- ✓ Equal weight age shall be given to all units of the theory paper
- ✓ Total number of questions– 03
- ✓ Question one will carry-10 Marks,
- ✓ QuestionNo.1 will be of an objectivetype.10 objectives will carry-10 Marks.
- ✓ QuestionNo.2 will be descriptive one question to be attempted out of two and will carry10 Marks)
- ✓ Question No. 3 will be short answer type.Two questions are to be attempted out of three questions and will carry 10 Marks, 05 Marks each)
- ✓ **Nature of questions** -Multiple choice, Descriptive and Short answer type.
- ✓ All these questions will be answered in the same answer book.

SemesterEndTheoryAssessment30 marks

- The duration of this exam will be of 1 and half Hrs (90 minutes)
- For each unit there will be at least one question
- All questions shall be compulsory with internal choice within the questions

Internal Assessment 40%

Level	Semester	Activities Per Semester	4 credits	2 credits
4.5 (First year)	I&II	1 Home Assignment	10 marks	5 marks
		2Class Assignment(Tutorial type)	10 marks	5 marks
		3 Quiz	10 marks	5 marks
		4 Unit Test *	10 marks	5 marks
5.0 (Second Year)	III&IV	1 Oral Examination	10 marks	5 marks
		2 Group Discussion	10 marks	5 marks
		3 Seminar	10 marks	5 marks
		4 Unit Test*	10 marks	5 marks
5.5 (Third Year)	V &VI	1 Case Study / Problem solving	10 marks	5 marks
		2 Field Work / Seminar	10 marks	5 marks
		3 Book Review / Poster Presentation	10 marks	5 marks
		4 Unit Test*	10 marks	5 marks
6.0 (Fourth Year)	VII& VIII	1 Seminar	10 marks	5 marks
		2 Case Study / Problem Solving	10 marks	5 marks
		3 Book Review/ Poster Presentation	10 marks	5 marks
		4 Unit Test*	10 marks	5 marks

Note:

1. For two credit course, unit test of10marks shall be conducted and it is convertedinto5 marks.
2. For four credit course, unittestof10 marks shall be conducted.
3. Book Review (Any relevant Reference Book)

PRACTICALEXAMINATION

- There will be semester wise practical examination to be conducted at the end of each semester. The question paper along with marking scheme and skeleton / Question paper will be given by respective BOS before practical examination.
- Total marks -50 for each semester-I and II (will be evaluated by two internal examiners.)
- Total – 50 Marks for each semester - III and IV (Major, Minor, VSC and CEP courses will be evaluated by one internal examiner and one external examiner. OE, SEC, CC courses will be evaluated by two internal examiners.)
- Total-50 Marks (2 credit course) for each semester-V and VI (will be evaluated by two external examiners.)
- Total-100 Marks (4 credit course) for each semester-V and VI (will be evaluated by two external examiners)
- External examiners are provided by University. Internal examiners are from respective college fulltime regular faculty. If fulltime regular faculty is not available in college, then principal of the college shall invite internal examiner from fulltime regular faculty appointed in nearby college.

6. Standard of Passing:

1. Minimum 12 marks in each subject. There shall be separate passing for theory (semester end exam and Internal) and practical also.
2. Admission to B.Sc.AI ML Part II is allowed even if the student fail sin all the subjects of part I
3. Admission to B.Sc. AI ML Part III is allowed only if student is passed on all the subjects of B.Sc. AI ML Part I

7. 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.

a. Credit system implementation:

As per the University norms

b. Clarification of Syllabus:

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

c. Eligibility of Faculty:

M.Sc. (Computer Science) o r MCA (for many faculty) with at least B+ or equivalent

d. Revision of Syllabus:

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

e. Fees Structure:

As approved by the Shivaji University fee fixation committee.

f. Intake Capacity: 40

g. Award of Class:

Grading: Shivaji University has introduced grading system as follows:

B.Sc. AI & ML Part I Semester I & II

Multiple Entry and Multiple Exit Option

(NEP-2020)2.0

Syllabus to be implemented from Academic Year 2026-27

Table 1: Conversion of Marks out of 100 to grade point

Sr. No.	MarksRangeoutof100	Grade point	Letter grade
1	80–100	10	O: Outstanding
2	70–79	9	A+:Excellent
3	60–69	8	A:VeryGood
4	55–59	7	B+:Good
5	50–54	6	B:AboveAverage
6	45–49	5	C: Average
7	40–44	4	P: Pass
8	0– 39	0	F:Fail
9	Absent	0	Ab: Absent

Table2:ConversionofMarksoutof50togradepoint

Sr. No.	MarksRangeoutof50	Grade point	Letter grade
1	40–50	10	O: Outstanding
2	35–39	9	A+:Excellent
3	30–34	8	A:VeryGood
4	28–29	7	B+:Good
5	25–27	6	B:AboveAverage
6	23–24	5	C: Average
7	20–22	4	P: Pass
8	0– 19	0	F:Fail
9	Absent	0	Ab: Absent

Table3: Final Cumulative Grade Point Average (CGPA) and Final Grade for course

Sr. No.	CGPA Range	Grade	Grade Descriptions
1	9.50–10.00	O	Outstanding
2	8.86–9.49	A+	Excellent
3	7.86–8.85	A	Very Good
4	6.86–7.85	B+	Good
5	5.86–6.85	B	Above Average
6	4.86–5.85	C	Average
7	4.00–4.85	P	Pass
8	0.00–3.99	F	Fail
9	Nil	AB	Absent

Remarks:

1. B+ is equivalent to 55% marks and B is equivalent to 50 % marks. The final later grade is based on the grade points in each course of entire programme and not on marks obtained each course of entire programme.
2. The SGPA and CGPA shall be round off to two decimal points.

Title: **B.Sc. AI ML Part I**

1. Year of implementation: Syllabus will be implemented fromJune2026 onwards
2. Duration: B.Sc. AI ML Part I. The duration of course shall be one year (Two semesters).
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. AI ML Program Structure

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

Semester	Subject Type	Course Code	Course Title
SEM –I	Course I:	Subject I DSCI:	Object Oriented concepts and Programming using C++
		Subject I DSCII:	Linux Utilities and Shell Programming
		Subject I Practical I:	Practical Based on Subject I DSC-I and Subject I DSC-II
	Course II:	Subject I IDSCI:	Basic Algebra
		Subject II DSCII:	Calculus
		Subject II Practical I:	Mathematics Practical - I
	Course III:	Subject III DSCI:	Descriptive Statistics – I
		Subject III DSCII:	Elementary Probability Theory
		Subject III Practical I:	Statistics Practical - I
	OE-I		Business Statistics using MS Excel/Linux Practical – I
	IKS-I		Vedic Mathematics
SEM –II	Course I:	Subject I DSC III:	Database Management System
		Subject I DSC IV:	Python Programming
		Subject I Practical II:	Practical Based on Subject I DSC-III and Subject I DSC-IV
	Course II:	Subject II DSC III:	Differential Equations - I
		Subject II DSCIV:	Discrete Mathematics
		Subject II Practical II:	Mathematics Practical - II
	Course III:	Subject III DSC III:	Statistical Methods
		Subject III DSC IV:	Discrete Probability Distributions
		Subject III Practical II:	Statistics Practical - II
	OE-II		Business Statistics using MS Excel/Linux Practical – II
	VEC-I		Democracy, Election and Constitution

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)	Practical hours (Per week)	Credit	Max. Marks	Min. Marks	Exam Hours	Max. Marks	Min. Marks	Exam Hours
1	Subject I DSC I: Object Oriented concepts and Programming using C++	2	-	2	30	12		20	08	
2	Subject I DSC II: Linux Utilities and Shell Programming	2	-	2	30	12		20	08	
3	Subject I Practical I: Practical Based on Subject I DSC-I and Subject I DSC-II	-	2	2	30	12		20	08	
4	Subject II DSC I: Basic Algebra	2	-	2	30	12		20	08	
5	Subject II DSC II: Calculus	2	-	2	30	12		20	08	
6	Subject II Practical I: Mathematics Practical - I	-	2	2	30	12		20	08	
7	Subject III DSC I: Descriptive Statistics – I	2	-	2	30	12		20	08	
8	Subject III DSC II: Elementary Probability Theory	2	-	2	30	12		20	08	
9	Subject III Practical I: Statistics Practical - I	-	2	2	30	12		20	08	
10	OE I: Business Statistics using MS Excel Practical – I	2	-	2	30	12		20	08	
11	IKS I: Vedic Mathematics	2	-	2	30	12		20	08	
	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)	Practical hours (Per week)	Credit	Max. Marks	Min. Marks	Exam Hours	Max. Marks	Min. Marks	Exam Hours
1	Subject I DSC III: Database Management System	2	-	2	30	12		20	08	
2	Subject I DSC IV: Python Programming	2	-	2	30	12		20	08	
3	Subject I Practical II: Practical Based on Subject I DSC-III and Subject I DSC-IV	-	2	2	30	12		20	08	

4	Subject II DSC III: Differential Equations - I	2	-	2	30	12		20	08	
5	Subject II DSC IV: Discrete Mathematics	2	-	2	30	12		20	08	
6	Subject II Practical II: Mathematics Laboratory course–II	-	2	2	30	12		20	08	
7	Subject III DSC III: Statistical Methods	2	-	2	30	12		20	08	
8	Subject III DSC IV: Discrete Probability Distributions	2	-	2	30	12		20	08	
9	Subject III Practical II: Statistics Practical - II	-	2	2	30	12		20	08	
10	OE II: Business Statistics using MS Excel Practical – II	2	-	2	30	12		20	08	
11	VEC I: Democracy, Election and Constitution	2	-	2	30	12		20	08	
	Total (B)			22	330			220		
	Total (A+B)			**44**	**660**			**440**		

• Student contact hours per week:**30** Hours (Min.)	• TotalMarksforB.Sc.AI ML -I: **1100**
• TheoryandPracticalLectures:**60**MinutesEach	• TotalCreditsforB.Sc.AI ML -I: • (Semester I & II):**44**
• **RequirementforEntryatLevel4.5: Completed all requirements of the 10+2**	
• DSCTH: Department Specific Core Theory • DSCPR: Department Specific Core Practical • MINTH: Minor Theory • MINPR: Minor Practical • OETH: Open Elective Theory	• OEPR: Open Elective Practical • SECTH: Skill Enhancement Course Theory • SECPR: Skill Enhancement Course Practical • IKS: Indian Knowledge System • VEC: Value Education Course
• **Exit Option at Level 4.5:** Students can exit after Level 4.5 with under **Certificate Course inComputerProgramming**ifhe/shecompletesthecoursesequivalenttominimumof**44**creditsandan **Additional 4credits** core NOSQL course/Internship.	

B.Sc.AI ML – Part I

DSC: AI ML Total Work–Load

Paper No.	Title of the Paper	Total Marks	Internal Marks	Lectures/week(60min.)
Semester I				
Subject I DSCI:	Object Oriented concepts and Programming using C++	30	20	2
Subject I DSCII:	Linux Utilities and Shell Programming	30	20	2
Subject II DSCI:	Basic Algebra	30	20	2
Subject II DSCII:	Calculus	30	20	2
Subject III DSCI:	Descriptive Statistics – I	30	20	2
Subject III DSCII:	Elementary Probability Theory	30	20	2
DSC Practical–I				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures per week/Batch**
Subject I Practical I:	Practical Based on Subject I DSC-I and Subject I DSC-II	50	-	4
Subject II Practical I:	Mathematics Practical - I	50	-	4
Subject III Practical I:	Statistics Practical - I	50	-	4
OE-I	Business Statistics using MS Excel Practical – I	50	-	2
IKS-I	Vedic Mathematics	50	-	2
Semester II				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures/week(60min.)**
Subject I DSCIII:	Database Management System	30	20	2
Subject I DSCIV:	Python Programming	30	20	2
Subject II DSCIII:	Differential Equations - I	30	20	2
Subject II DSCIV:	Discrete Mathematics	30	20	2
Subject III DSCIII:	Statistical Methods	30	20	2
Subject III DSCIV:	Discrete Probability Distributions	30	20	2
DSC Practical–II				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures per week/Batch**
Subject I Practical II:	Practical Based on Subject I DSC-III and Subject I DSC-IV	50	-	4
Subject II Practical II:	Mathematics Practical - II	50	-	4
Subject III Practical II:	Statistics Practical - II	50	-	4
OE–II	Business Statistics using MS Excel-II	50	-	2
VEC-I	Democracy, Election and Constitution	50	-	2

B.Sc. Part -I AI and ML (Semester I)

Paper No.	Title of the Paper	Total Marks	Internal Marks	Lectures Per week(60 min.)
Semester I				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures Per week(60 min.)**
Subject I DSCI:	Object Oriented concepts and Programming using C++	30	20	2
Subject I DSCII:	Linux Utilities and Shell Programming	30	20	2
Subject II DSCI:	Basic Algebra	30	20	2
Subject II DSCII:	Calculus	30	20	2
Subject III DSCI:	Descriptive Statistics – I	30	20	2
Subject III DSCII:	Elementary Probability Theory	30	20	2
DSC Practical–I				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures per week/Batch**
Subject I Practical I:	Practical Based on Subject I DSC-I and Subject I DSC-II	30	20	4
Subject II Practical I:	Mathematics Practical - I	30	20	4
Subject III Practical I:	Statistics Practical-I	30	20	4
OE/IKS				
OE-I	Business Statistics using MS Excel – I	30	20	2
IKS-I	Vedic Mathematics	30	20	2

Course Code: Subject I DSCI:

Course Title: Object Oriented concepts and Programming using C++

Total Contact Hours:30 hrs

Credits:02 **Teaching Scheme: Theory–2Lectures/Week** **TotalMarks:50**

Course Outcomes (COs)

After completion of this course students will be able to:

1. Describe and explore programming basics and object-oriented programming (OOP) concepts.
2. Understand tokens, expressions, and control structures; use functions and pointers in a C++ program; and manage input and output operations.
3. Explain arrays and strings, and develop programs using them.
4. Implement OOP concepts in C++: define classes; describe and use constructors and destructors; and apply static members, friend functions/classes, virtual functions, and abstract classes.
5. Implement inheritance and polymorphism using C++.
6. Demonstrate error handling using exception handling mechanisms.

Unit	Contents	Number of lectures
1	Object Oriented (OO) concepts- Features – abstraction, encapsulation, inheritance, polymorphism, advantages and applications of OO concepts. Introduction to C++ - Data types, new operator and keywords, using namespace concept, cin and cout, simple C++ program, introduction to reference variables, classes and objects, usage of 'this' pointer, access specifiers, defining data members and member functions. Array of objects, inline functions – concept and applications, call by reference, return by reference, function and operator overloading and default arguments, static class members, friend concept – function, class, constructors and destructors, types of constructors, memory allocation (new and delete operators), overloading unary and binary operators, overloading using friend function, typecasting and type conversion.	15
2	Inheritance- Types of inheritance with examples, constructors and destructor in derived classes, virtual base classes, virtual functions and pure virtual functions, abstract base classes, managing input and output using C++: stream classes. Templates- Introduction to templates, class templates, function templates and overloading of function templates, templates with multiple parameters. Exception handling in C++ – try, catch and throw primitives.	15

Reference Books:

1. Behrouz A. Forouzan, Richard F. Gilberg, C++ Programming: An Object-Oriented Approach, McGraw Hill, First Edition, 2022, ISBN: 978-9355321305.
2. Herbert Schildt, The Complete Reference C++, McGraw Hill Education, 4th edition, 2017, ISBN: 978-0070532465.
3. Stanley Lippman, Josée Lajoie, Barbara Moo, C++ Primer, Addison-Wesley, 5th edition, 2012, ISBN: 978-0321714114.
4. Stephen Prata, C++ Primer Plus, Pearson Education India, 6th edition, 2015, ISBN: 978-9332546189.

Course Code: Subject I DSC II: Course Title: Linux Utilities and Shell Programming

TotalContactHours:30hrs

Credits:02 **Teaching Scheme: Theory–2Lectures/Week** **TotalMarks:50**

Course Outcomes (COs):

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

CO 1: Learn architecture and basics of Linux Operating System.

CO 2: Understand the kernel-shell and general-purpose utilities.

CO 3: Understand the working and use of NANO editor.

CO 4: Learn Regular expressions using metacharacters.

CO 5: Learn filters with the help of regular expression.

CO 6: Learn advanced BASH shell Programming.

Credits 2	Contents	No. of hours per unit/ credits
Unit I:	**Introduction to Linux:** Operating System Basics, History of Linux, Architecture of Linux, Operating System Services, Shell, Types of Shell, Kernel, Login and Logout, General Purpose Utilities (banner, cal, date, calendar, who, tty, uname, password, lock, echo, tput, bc, clear, script, wc, echo, test, expr), Finding Information of commands. File and Directory Manipulation commands. **Regular Expressions & Filters:** Regular Expressions: Metacharacters, Controlling Repeated Characters through *, +, and ?, Using and Modifying the '.' Metacharacter, Matching from a List of Options, Matching Metacharacters Literally. Filters: cat, tac, head, tail filters and options, sed and sed options, grep and grep options, Line Addressing, Multiple Instruction (-E and -F), Context Addressing, Writing Selected Lines to a File.	(15)
Unit II:	**NANO Editor:** Installing the Nano Text Editor in Linux, Nano Command Keys, Create a New File using Nano, Open an Existing File Using Nano, Edit Files Using Nano Text Editor in Linux, Cut and Paste Lines of Text Using Nano, Valid Shortcuts in Nano Text Editor, Search Text Using Nano, Spell Check Using Nano, Save Your Work Using Nano, Save with Backups. **BASH Shell Scripting:** Shell Scripts, Operators in BASH shell (Arithmetic, Relational, Logical, Assignment, Reassignment, Bit wise), Getting input from keyboard (read command), Conditional Control Statement, Iterative Control Statements, Using test and [ ] to evaluate expressions, String Manipulation, Arrays, Shell Functions.	(15)

Reference Book:

1. LINUX with Operating System Concepts by Richard Fox, CRC Press
2. Linux Commands- Instant Reference by Bryan PF affenberge
3. The Design of the Unix Operating System- Bach
4. Unix Shell Programming- Yashwant Kanetkar
5. Unix Concepts and Application – Sumitabha das
6. Linux : The Complete Reference- Richard Peterson

Course Code: Subject I Practical I: Practical Based on Subject I DSC-I and Subject I DSC-II

Credits:02 **TotalMarks:50**

Course Outcomes (COs): On completion of the course, the students will be able to:	
CO1	Apply the concepts of object-oriented programming using C++
CO2	Demonstrate how to handle run-time errors with exception handling
CO3	Students will use basic Linux commands to create, view, copy, move, and delete files and folders.
CO4	Students will run simple shell commands and scripts to perform basic system tasks.

List of Laboratory Assignments

Subject I DSC-I

Sr. No.	**PracticalbasedonAIML-101-T**
1	Simple C++ programs on variables, data types, input, output, decision statements
2	Simple C++ programs on loops, alias, const, standard namespace
3	Programs on using access specifiers, use of static variables, alias, const
4	Programs on creating classes and objects, implementing member functions and data with different access specifiers
5	Programs on using this pointer, constructors, destructors, function inline, static and constant
6	Programs related to creating and using array of objects
7	Programs based on functions overloading
8	Programs based on operator overloading
9	Programs on multi-level inheritance
10	Programs on multiple inheritance
11	Programs on virtual classes
12	Programs on exception handling
13	Programs based on templates

Subject I DSC-II

1. Demonstration of General-Purpose Utilities.
2. Implement file and directory operations: touch, cp, mv, rm, mkdir, rmdir, cd.
3. Write a shell script that prompts the user for a name of a file or directory and reports if it is a regular file, a directory, or another type of fil. Also perform an ls command against the file or directory with the long listing option.
4. Pattern matching with grep: Search files for patterns using basic regex (*, ?, ^, $, .) and options like -i, -v, -n.
5. Text processing with filters: Use head, tail, wc, and grep to extract and manipulate data files.
6. Advanced filtering: Apply sed for substitutions (s/pattern/replace/g).
7. Write a shell script which copies files from one directory to another during copy command.
8. Create a data file which contains given format and perform the given operations on that data file using sed.
9. Write a shell script using if statements to check file exists or not.
10. Write a shell script to find out given word contains vowel and also the entered vowel is small case or capital.

Course Code: Subject II DSC I: Course Title: Basic Algebra

TotalContactHours:30hrs

Credits:02 Teaching Scheme: Theory–2Lectures/WeekTotalMarks:50

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Apply De-Moivre's theorem.
2. Find rank, eigen values, eigen vectors of the matrix.
3. solve system of linear homogeneous and non-homogeneous equations.
4. Understand Hermitian and Skew Hermitian matrices.

UNIT–1: ALGEBRA OF COMPLEX NUMBERS (15hrs.)

1.1. Sums and Products, Moduli, Polar form, Geometrical representation of Complex Numbers, Exponential form, arguments of Products and Quotients.

1.2. De-Moivre's Theorem and examples

1.3 Applications of De-Moivre's Theorem

1.3.1 n^{th} roots of unity.

1.3.2 Expansion of $\cos n\theta$, $\sin n\theta$

1.3.3 Circular functions and hyperbolic functions.

1.3.4 Relations between circular and hyperbolic functions.

1.3.5 Inverse circular and hyperbolic functions.

UNIT–2: MATRICES (15hrs.)

2.1. Introduction

2.2 Definitions of Hermitian and Skew Hermitian matrices.

2.3. Properties of Hermitian and Skew Hermitian matrices.

2.4. Rank of a Matrix, Row-echelon for m and reduced row echelon form, normal form.

2.5. System of line are homogeneous and non-homogeneous equations.

2.5.1. Condition for consistency.

2.5.2. Nature of the general solution.

2.5.3. Gaussiane limination and Gauss Jordon method

(Using row-echelon form and reduced row echelon form).

2.5.4. Examplesbasedon2.4.1,2.4.2and 2.4.3.

2.6. Characteristic equation, eigen values and eigen vectors of a matrix and examples

2.7. Cayley Hamilton theorem and examples.

Recommended Books:

1. **Applied Mathematics** by Ch. V. Ramana Murthy, N. C. Shrinivas, S. Chand and Company Ltd., 1st Edition, 2001.
   Scope: Unit-I: Chapter No. 1: Art.1.2toArt.1.13, Art.1.15, Art.1.17 toArt.1.19, Art.1.23
2. **Higher Engineering Mathematics** by H. K. Dass, Er. Rajnish Verma, S. Chand and Company Pvt. Ltd. 3rd Revised Edition 2014.
   Scope: Unit-II: Art. 19.1toArt. 19.3, Art. 21.1 to Art. 21.6, Art. 21.27 to Art. 21.30, Art. 20.1 To Art. 20.4

Reference Books:

1. **Elementary Linear Algebra (**Application Version**)**, Howard Antonand Chris Rorres, 10th Edition, 2010.
2. **Complex Variables and Applications,** James Ward Brown and Ruel V. Churchill, Mc-Graw Hill, 8th Edition, 2009.
3. **Modern Algebra**, A.R. Vasishtha, Krishna Prakashan, Meerut1994.
4. **A Text Book of Matrices**- Shanti Narayan (Revised by P. K. Mittal), S. Chand and Co., 11th Edition, reprint 2007.

Course Code: **Subject II DSC II**

Course Title**: Calculus**

Total Contact Hours**: 30hrs**

Credits**: 02** Teaching Scheme**: Theory–2Lectures/Week** TotalMarks**:50**

Course Learning Outcomes: Upon successful completion of the course students will able to:

CO1. Find higher derivatives of product two differentiable functions using Leibnitz theorem.

CO2. learn conceptual variations while advancing from one variable to several variables in calculus.

CO3. Understand the consequences of mean value theorems for differentiable functions.

CO 4. apply L' Hôpital's rule to various indeterminate forms.

Unit– 1: Differentiation (15hrs.)

1.1. Successive Differentiation

1.1.1. Higher order derivatives: notations.

1.1.2. Calculation of n^{th} derivative: Standard results

1.1.3. Determination of n^{th} derivative of rational functions: Examples.

1.1.4. The n^{th} derivative of product of the powers of sine and cosines: Examples.

1.1.5. Leibnitz's Theorem. The n^{th} derivative of product of two functions.

1.1.6. Examples on Leibnitz's Theorem.

1.2. Partial differentiation

1.2.1. Introduction to functions of two and more variables

1.2.2. Partial derivative: first order and higher order–examples.

1.2.3. Geometrical interpretation of partial derivatives of first order.

Unit–2: Mean Value Theorems and Indeterminate forms (15hrs.)

2.1. Mean Value Theorems

2.1.1. Rolle's Mean Value Theorem, Geometrical interpretation.

2.1.2. Lagrange's Mean Value Theorem, Geometrical interpretation.

2.1.3. Meaning of sign of derivative

2.1.4. Cauchy's Mean Value Theorem.

2.1.5. Examples on 2.1.1, 2.1.2,2.1.3 and 2.1.4

2.2. Indeterminate forms

2.2.1. Indeterminate forms: L' Hôpital's rule for $\frac{0}{0}$ and $\frac{\infty}{\infty}$ form(Statement only).

2.2.2. The indeterminate forms $0 \times \infty, \infty - \infty, 0^0, 1^\infty, \infty^0$

2.3. Expansion of functions

2.3.1. Maclaurin's theorem (statement only): Examples.

2.3.2. Taylor's theorem (statement only):Examples.

Recommended Books:

1. **Differential Calculus,** Shanti Narayan and P.K. Mittal, S. Chand publishing, 15th edition (2016).

Scope:

Unit1–1.1: Chapter5:5.1to5.5

1.2:Chapter11:11.6,11.6.1,11.7.1

Unit2–2.1: Chapter8:8.1,8.2,8.3,8.5

2.2:Chapter10:10.1to10.6

2.3:Chapter6:6.1,6.2

Reference Books:

1. **Differential Calculus**,GorakhPrasad,PothishalaPvt.Ltd.,19thedition(2016).
2. **Aspects of Calculus**, GabrielKlambauer,Springer-Verlag (1986).
3. **Differential Calculus**, HariKishan, Atlantic Publishers& Dist. (2007).
4. **Calculus**,GeorgeB.ThomasJr.,JoelHass,ChristopherHeil&MauriceD.Weir, Pearson Education, 14th edition (2018).

Course Code: **Subject II DSC II Practical I** Course Title**: Mathematics Practical - I**

TotalContactHours**:30hrs**

Credits**:02** TotalMarks**:50**

Pr. No	**Title of the Practical**	**No. of Practical's**
1.	Example son De-Moivre's Theorem	1
2.	n^{th} roots of unity	1
3.	Expansion of $\cos n\theta$, $\sin n\theta$	1
4.	Solution of system of linear homogeneous equations.	1
5.	Solution of system of linear non-homogeneous equations.	1
6.	Eigen values and Eigen vectors of matrix	1
7.	Cayley Hamilton Theorem (Verification and finding inverse of matrix)	1
8.	Examples of n^{th} derivative	1
9.	Examples on Leibnitz's Theorem.	1
10.	Examples on partial differentiation	1
11.	Lagrange's Mean Value Theorems.	1
12.	Cauchy's Mean Value Theorems.	1
13.	L' Hospital's rule for $0\times\infty$ and $\infty-\infty$ form.	1
14.	L'Hospital'srulefor$0^0,1^\infty,\infty^0$form.	1
15.	Examples on expansion of functions	1

Course Code: **Subject III DSC I:**

Course Title**: Descriptive Statistics – I** Total Contact Hours**: 30 hrs**

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

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.
v.

CONTENTS:

Unit-1 **(15hrs.)**

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(15hrs.)

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 4^{th} 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., Sri venkatramana T. and Madhava Rao K. S. (1996): Statistics: ABeginner'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. GuptaV.K.&KapoorS.C.:FundamentalsofMathematicalStatistics.-Sultan&Chand.
6. HoggR.V.andCragR.G.:IntroductiontoMathematicalStatisticsEd.4.
7. HoelP.G.(1971):IntroductiontoMathematicalStatistics,AsiaPublishingHouse.

Course Code: **Subject III DSC II:** Course Title**: Elementary Probability Theory** Total Contact Hours**: 30 hrs**

Credits**:02** Teaching Scheme**: Theory–2Lectures/Week** TotalMarks**:50**

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 **(15hrs.)**

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(Ω)** (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.

- **Axiomaticdefinitionofprobabilityandproofoftheresults**: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 **(15hrs.)**

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 Bare 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).IntroductiontoMathematicalStatistics,JohnWileyandSons,NewYork.
4. Hogg,R.V.andCraigR.G.(1989).IntroductiontoMathematicalStatistics,Ed.MacMillan Publishing Co., New York.
5. Mayer,P.(1972).IntroductoryProbabilityandStatisticalApplications,AddisonWesley 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,VLSPrakash(2008).FirstCourseinProbabilityandStatistics,NewAgeInternational 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).

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

Credits**:2** TotalMarks**:50**

Prerequisites: Knowledge of the topics in the theory papers.

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 Practicals:

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 practical's.

Notes:

a. Students must complete all experiments using MS - Excel.
b. Case study – Different data sets from newspapers, internet, and magazines may be collected and students will be asked to use statistical techniques/tools which they have learnt.
c. MS-Excel should be used at the time of practical examination for calculation.
d. Student must complete the entire practical to the satisfaction of the teacher concerned.
e. Student must produce laboratory journal along with completion certificate signed by Head of the Department, at the time of practical examination.

Laboratory Requirements:

Laboratory should be well equipped with at least 20 computers along with necessary Software's, at least two printers, sufficient back up facility (UPS/ Inverter/ Generator).

Nature of Practical Question Paper:

a. In the practical question paper there shall be four questions each of 16 marks, a student has to attempt any two questions.
b. Computations should be completed using MS-Excel and should be demonstrated to examiner. Experiment aim, formulae, results etc. should be written on practical answer paper.
c. 8 marks are reserved for case study, 5 marks are reserved for the journal and 5 marks for the oral examination.
d. Practical examination is of four hours duration which includes viva (oral) examination and on line demonstration.

B. Part- IAI ML(Semester II)

Paper No.	Title of the Paper	Total Marks	Internal Marks	Lectures Per week(60 min.)
Semester II				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures Per week(60 min.)**
Subject I DSC III:	Database Management System	30	20	2
Subject I DSC IV:	Python Programming	30	20	2
Subject II DSC III:	Differential Equations - I	30	20	2
Subject II DSC IV:	Discrete Mathematics	30	20	2
Subject III DSC III:	Statistical Methods	30	20	2
Subject III DSC IV:	Discrete Probability Distributions	30	20	2
DSC Practical–II				
Paper No.	**Title of the Paper**	**Total Marks**	**Internal Marks**	**Lectures per week/Batch**
Subject I Practical II:	Practical Based on Subject I DSC-III and Subject I DSC-IV	50	-	4
Subject II Practical II:	Mathematics Practical - II	50	-	4
Subject III Practical II:	Statistics Practical - II	50	-	4
OE/ VEC				
OE-II	Business Statistics using MS Excel-II	50	-	2
VEC-I	Democracy, Election and Constitution	50	-	2

Course Code: **Subject I DSC III**
Course Title**: Database Management System**

TotalContactHours**:30hrs**
Credits**:02** Teaching Scheme**:Theory–2 Lectures/Week** TotalMarks**: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	**Contents**	**No. of hours per unit/ credits**
	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 ,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	

Postgre SQL will be used as the primary database platform for delivering both theoretical concepts and practica 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

Course Code: **Subject I DSC IV**
Course Title**: Python Programming**

TotalContactHours**:30hrs**
Credits**:02** Teaching Scheme**: Theory–2 Lectures/Week** TotalMarks**:50**

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

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

Credits 2	**Contents**	**No. of hours per unit/ credits**
Unit I:	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, Loops, 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.	15
Unit II:	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.	15

Reference Books:

1. Glimpses Of Python Programming Development, Dr.Bhoite S.D. , Mr. Budake R.D.
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

Course Code: **Subject I Practical II**

Course Title: **Practical Based on Subject I DSC-III and Subject I DSC-IV**

Credits**:02** Teaching Scheme**: Practical's– 2Lectures/Week** TotalMarks**:50**

Course Outcomes(COs):

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

CO1: Implement Basic SQL Queries

CO2: Implement CRUD (Create, Read, Update, Delete

CO3:Students will collect, clean, and organize small datasets for analysis.

CO4:Students will perform basic data analysis and present results using simple charts and reports.

List of Laboratory Assignments

Subject I DSC-III

1. Practical on DDL Command
2. Practical on DML Command
3. Practical on TCL Command
4. Aggregation Functions: Table Name: `Students`
   Find the minimum, maximum, average age, and the total number of students in the `Students` table.
5. Group By and Having Clauses:

   Table Name: `Courses`
   Group the courses by `Credits` and show the count of courses for each credit value, only for groups having more than one course.
6. Table Name: `Students` Retrieve all students ordered by `Name` in ascending order.
7. Write SQL queries to find the youngest (minimum age) and oldest (maximum age) students in the Students table.
8. Write an SQL query to calculate the average number of credits for all courses in the Courses table.
9. Table Names: Enrollments (with columns: EnrollmentID, StudentID, CourseID, Grade), 'Courses'
   Write an SQL query to find the average grade for each course, but only include courses that have at least 1 enrollments.
10. Practical on joining

Subject I DSC-IV

1. Write a program to take two numbers from the user and display their addition, subtraction, multiplication, and division.
2. Write a program to check whether a given number is even or odd.
3. Write a program to find the largest number among three user input numbers.
4. Write a program to generate the Fibonacci series up to n terms.
5. Write a program to check whether a given number is prime or not.
6. Write a program to create a list of numbers and find the sum and average of the list.
7. Write a program to reverse a string entered by the user.
8. Write a program to create a simple function to add two numbers and call it.
9. Write a program to read a text file and count the number of lines and words
10. Write a program to handle division by zero using exception handling.

Course Code: **Subject II DSC III**

Course Title**: Differential Equations - I**

Credits**:02** Teaching Scheme**: 2Lectures/Week** TotalMarks**:50**

Course Learning Outcomes: Upon successful completion of the course students will able to:

CO 1.classify differential equations.

CO2. Solve different types of differential equations.

CO 3. find orthogonal trajectories.

CO4. Apply the knowledge of differential equations to tackle problems occurring in physics and engineering.

Unit1.Ordinarydifferentialequationsof first order and first degree (15hrs.)

1.1 Introduction.

1.2 Exact differential equations.

1.2.1 Necessary and sufficient condition for exactness.

1.2.2 Differentialequationsreducibletoexact,integratingfactorswithrules.

1.3 Linear differential equations.

1.4 Differential equations reducible to linear.

1.5 Applications of differential equations of first order and first degree:

1.5.1 Law of growth.

1.5.2 Law of decay.

1.5.3 Newton's law of cooling.

1.5.4 Orthogonal trajectories to Cartesian and Polarcurves.

1.6 Examples based on 1.1to 1.5.

Unit2.Lineardifferentialequationswithconstant coefficients (15hrs.)

2.1Introduction.

2.2 Auxiliary equation, Complementary function.

2.3 Types of complementary functions:

2.3.1 Distinct real roots, repeated real roots, complex roots, repeated complex roots,

2.4 Particular integrals:

2.4.1 Particular integrals of the functions: e^{ax},sinax,cosax,x^m,$e^{ax}.V$and$x.V$.

2.5 Applications to Electrical circuits.

2.6 Examples based on 2.1to 2.5.

Recommended Book:

1. M.D. Raisinghania, Ordinary and Partial Differential Equations, 20th Revised Edition 2022; S. Chand and Company Pvt. Ltd. New Delhi.
   Scope: Part 1 : Unit 2: 2.12 to 2.32, Unit3: 3.1to 3.8, Unit 5 : 5.1 to 5.25.

Reference Books:

1. Dr.A.B. Mathur and V.P. Jaggi, Advanced Engineering Mathematics, KhannaPublishers,2nd edition, 2001.
2. R.K. Ghosh and K.C. Maity ,An Introduction to Differential Equations, Book and Allied(P) Ltd., Seventh Edition, 2000.
3. D.A. Murray, Introductory Course in Differential Equations, Khosala Publishing House, Delhi.
4. Zafar Ahasan, Differential Equations and Their Applications, Second Edition,PHI2004.

Course Code: **Subject II DSC IV**

Course Title**: Discrete Mathematics**

Credits**:02** Teaching Scheme**: Lectures/Week** TotalMarks**:50**

Course Learning Outcomes: Upon successful completion of the course students willable to:

CO1.analyze the logical structure of statements symbolically, including the proper use of logical connectives, predicates, and quantifiers.

CO2.constructtruthtables, proveord is provea hypothesis, and evaluate the truth of a statement using the principles of logic.

CO3.understand and apply the fundamental concepts in graph theory.

CO4. acquire the basic knowledge of graphs name lyvertex, edge, special types of graph, isomorphic graphs, matrix representation of graphs.

Unit-1Propositional Calculus (15hrs.)

1.1 **Revision**

1.1.1 Propositional Logic.

1.1.2 Propositional equivalence.

1.2 **Predicates and Quantifiers:**

1.2.1 Pedicate, n-place Pedicate, n-ary Pedicate.

1.2.2 Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains.

1.2.3 Logical Equivalence involving Quantifiers.

1.3 **Rules of Inference:**

1.3.1 Argument in propositional Logic.

1.3.2 Validity Argument (Direct and Indirect methods)

1.3.3 Rules of Inference for Propositional Logic.

1.3.4 Building Arguments

1.4 NumericalProblemsbasedon1.2to1.3

Unit-2GraphTheory (15hrs.)

2.1 **Graphs:**

2.1.1 Basic Terminology

2.1.2 Special types of Graphs(Complete graph, Regular graph, Bipartite and complete Bipartite graph)

2.1.3 Isomorphism

2.1.4 Adjacency and Incidence Matrix of Graph

2.1.5 Problems based on 2.1.2 to 2.1.4

2.2 **Operations on Graph:**

2.2.1 Sub graphs, vertex deletion, Edge addition.

2.2.2 Complement of a graph and self- complementary graphs.

2.2.3 Union, Intersection and Product of graphs.

2.2.4 Problems based on 2.1.1 to 2.1.3

Recommended Book:

1. Discrete Mathematics, S.R. Patil, M.D.Bhagat, R.S. Bhamare, S.M.Waingade, N.M. Phatangare and K. D. Masalkar, Nirali Prakashan, Pune.

Reference Books:

1. Discrete Mathematics, D.S. Malik and M.K. Sen, Cengage Learning India Pvt. Ltd, New Delhi.
2. Discrete Mathematical Structures (sixth edition), Kolman, Busby, Ross, Pearson Education (Prentice Hall).
3. Introduction to Graph Theory, Mamta Chaudhary, Vani Sharma and Pooja Yadav, Sultan Chand & Sons, Educational Publishers, New Delhi.
4. Schums Outline of Discrete Mathematics, Seymour Lipschutz, MarcLipson, Revised Third Edition-McGraw-Hill (2009).

Course Code: **Subject II Practical II**

Course Title**: Mathematics Practical–II**

Credits**: 02** Teaching Scheme**: Practical's– 2Lectures/Week** Total Marks**: 50**

Pr. No	**Title of the Practical**	**No. of Practical's**
1.	Differential equations reducible to exact	1
2.	Linear differential equations	1
3.	Bernoulli's Differential equations	1
4.	Law of growth	1
5.	Law of decay	1
6.	Newton's law of cooling	1
7.	Orthogonal Trajectories to Cartesian Curves	1
8.	Orthogonal Trajectories to Polar Curves	1
9.	Linear differential equations with constant coefficients (example son finding C.F.)	1
10.	Particular integrals of the functions:e^{ax},sinax,cosax	1
11.	Particular integras of the functions:$x^m, e^{ax}.V \text{and} x.V$	1
12.	Test the validity of the argument using truth table.	1
13.	Show the implications without using truth table.	1
14.	Draw the graph represented by the given adjacency matrix.	1
15.	Find the incidence matrix of the given graphs.	1

Course Code: **Subject III DSC III**

Course Title **Statistical Methods**

Credits**: 02** Teaching Scheme**: Practical's– 2Lectures/Week** Total Marks**: 50**

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 itsutility,

Unit1: (15hrs.)

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.

Unit2 (15hrs.)

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 IndexNumbers:

- 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. ChatfieldC."The Analysis of Time Series – An Introduction",Chapman&Hall,2004.
3. CroxtonF.E.,Cowden D.J. and Kelin S.(1973):Applied General Statistics, Prentice Hall of India.
4. GoonA. 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, NewDelhi.
6. GuptaV.K.& Kapoor S.C. Fundamentals of Applied Statistics.-Sultan & Chand
7. HoelP.G.(1971):Introduction to Mathematical Statistics, Asia Publishing House.
8. Kendall M.G. "Time Series", Charles Griffin,1978.
9. Snedecor G.W. and Cochoran W.G. "Statistical Methods",Lowa State University Press.
10. Srivastav D.S: A Textbook of Demography.
11. Waiker and Lev.: Elementary Statistical Methods.

Course Code: **Subject III DSC IV**

Course Title **:DISCRETE PROBABILITY DISTRIBUTIONS**

Credits**: 02** Teaching Scheme**: Practical's– 2Lectures/Week** Total Marks**: 50**

Course Outcomes: The students will acquire knowledge of

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

Unit1: (15hrs.)

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 Hyper geometric to binomial distribution (Statement only), numerical problems.

Unit2: Some standard discrete probability distributions on countable infinite sample space : **(15hrs)**

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., Gray bill F.A.: Introduction to theory of Statistics. 5.BoesD.C.Tata, Mc Graw Hill, New Delhi.(Third Edition)

Course Code: **Subject III Practical II**

Course Title: **Statistical Practical II**

Credits**: 02** Teaching Scheme**: Practical's– 2Lectures/Week** Total Marks**: 50**

Prerequisites: Knowledge of the topics in the theory papers.

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 grow thrates,
iii. Compute and interpret price, quantity and value index numbers,
iv. Understand the applications of discrete probability distributions.

List of Practicals:

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 Hyper geometric distribution.
7. Applications of Poisson distribution.
8. Applications of Geometric and Negative Binomial distributions.
9. Case study equivalent to 2 Practicals.

Notes:

a) Students must complete all experiments using MS-EXCEL.
b) Case study – In case study, students are expected analyze real datasets (primary or secondary) using statistical techniques / tools which they have learnt.
c) MS - EXCEL should be used at the time of practical examination for calculation.
d) Student must complete the entire practical to the satisfaction of the teacher concerned.
e) Student must produce laboratory journal along with completion certificate signed by Head of the Department, at the time of practical examination.

Laboratory Requirements: Laboratory should be well equipped with at least 20 computers along with necessary software's at least two printers, sufficient back up facility (UPS/ Inverter/ Generator).

Nature of Practical Question Paper:

a) In the practical question paper there shall be four questions each of 16 marks, a student has to attempt any two questions.
b) Computations should be completed experiments using MS-EXCEL and should be demonstrated to examiner. Aim of the experiment, Formulae, Results etc. should be written on practical answer paper.
c) 8 marks are reserved for case study, 5 marks are reserved for the journal and 5 marks for the oral examination.
d) Practical examination is of four hours duration which includes viva (oral) examination and on line demonstration.