

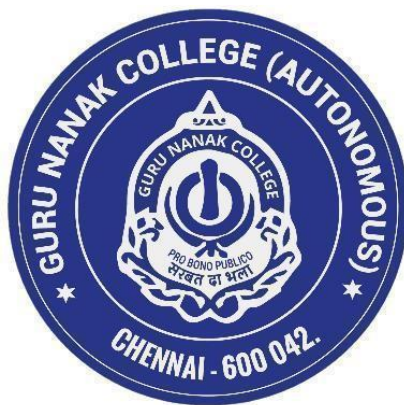
GURU NANAK COLLEGE (AUTONOMOUS)

A Sikh Minority Institution | Unit of Guru Nanak Educational Society (Regd.)

Affiliated to University of Madras | Approved by AICTE

Accredited at A++ Grade by NAAC (CGPA 3.68/4)

Guru Nanak Salai, Velachery, Chennai - 600042



SCHOOL OF INFORMATION TECHNOLOGY

Bachelor of Science – B.Sc. Data Analytics

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the UG batch of 2026-29 and thereafter)

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LOCF - LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

PREAMBLE

1. ABOUT THE PROGRAMME

The B.Sc. Data Analytics programme is a comprehensive three-year undergraduate degree designed to equip students with the knowledge, skills, and analytical mindset required to thrive in the data-driven economy. The programme introduces students to foundational concepts of data analysis, the evolving role of the Data Analyst, and the tools, technologies, and methodologies central to the discipline — progressing from core fundamentals through to advanced applications across six semesters.

Data Analytics ranks among the most sought-after professions of the decade, and this programme requires no prior background in computer science or programming. The curriculum spans Programming for Analytics, Relational Databases and SQL, Data Structures and Algorithms, Data Wrangling, Statistical Modelling, Machine Learning, Big Data Analytics, and Text Analytics, ensuring graduates are proficient across the breadth of modern data science practice.

The programme is integrated with SAS India Pvt. Limited, offering students hands-on, industry-aligned training through the SAS Cloud environment using real-world datasets and professional tools. Students who complete the SAS-integrated modules are eligible to earn internationally recognized digital badges and certifications, validating their proficiency for the global job market.

Allied courses in Mathematics for Analytics, Statistics, and Time Series Analysis build the quantitative foundation essential for rigorous analysis. Students gain proficiency in Python, R, SQL, NoSQL databases, and platforms for data visualization, predictive modelling, and machine learning. Big Data technologies including Hadoop, Hive, and Spark prepare students for large-scale, real-world data environments.

Beyond technical competencies, the programme emphasizes holistic development. Elective offerings in Cloud Computing, Business Analytics, Prompt Engineering, Ethics in Data Science, and Computer Networks allow students to tailor their learning to emerging industry needs. Ability enhancement courses in Communication Skills, Quantitative Aptitude, Data Visualization Tools, and Interview Skills ensure graduates are workplace-ready. Mandatory internship exposure and a final-year project bridge academic learning with professional practice, while components on Value Education, Environmental Studies, and Indian Knowledge Systems foster civic responsibility and cultural awareness.

On successful completion, graduates will be equipped to distinguish between the roles of Data Analyst, Data Scientist, and Data Engineer, and will possess the technical fluency to contribute meaningfully across industries. With 142 credits spread over six semesters, this programme prepares students for both advanced study and immediate employment in one of the most dynamic fields in contemporary professional life.

2. VISION

Develop competent and ethical data analytics professionals with strong analytical, computational, and research skills for data-driven decision-making and societal impact.

3. MISSION

- Provide outcome-based education with strong foundations in data analytics, statistics, and computational techniques aligned with industry and research needs.
- Equip students with modern tools, problem-solving ability, critical thinking, and teamwork skills for effective data-driven solution development.
- Foster innovation, research aptitude, ethical practices, and lifelong learning to enhance employability and address interdisciplinary challenges.

4. PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Technical and Professional Excellence: Graduates will demonstrate strong foundations in computer science, software engineering, data management, and emerging technologies, enabling them to excel in industry, academia, and research.

PEO2: Innovation and Problem-Solving: Graduates will apply analytical thinking, creativity, and modern IT tools to design, develop, and implement solutions for complex technological and societal challenges.

PEO3: Ethics and Responsible Computing: Graduates will uphold ethical standards, practice responsible computing, and contribute to sustainable development by leveraging technology for societal benefit.

PEO4: Leadership and Collaboration: Graduates will exhibit effective communication, teamwork, and leadership skills, preparing them to manage diverse projects and collaborate across multidisciplinary environments.

PEO5: Adaptability and Lifelong Learning: Graduates will engage in continuous professional development, research, and upskilling to remain adaptable in dynamic global IT environments and contribute to innovation and knowledge creation

5. PROGRAMME OUTCOMES

PO1: Knowledge: Apply comprehensive knowledge of foundational and advanced concepts in data analytics, and use appropriate tools and techniques to develop effective data-driven applications.

PO: Problem Solving: Apply analytical, mathematical, and computational methods to analyze and solve complex problems effectively

PO3: Critical Thinking: Apply critical thinking to evaluate data, interpret results, and support informed decision-making

PO4: Individual and Team Work: Function effectively as an individual and team member, exhibiting responsibility, collaboration, and leadership

PO5: Communication and Lifelong Learning: Communicate effectively and apply continuous learning to adapt to emerging technologies and professional advancements

6. PROGRAMME SPECIFIC OUTCOMES

The following points are the expected outcomes of the three-year B.Sc. Data Analytics Programme of Guru Nanak College:

PSO1: Specialized Knowledge: Analyze and apply data analytics, statistical, machine learning, and big data techniques to design and develop domain-specific solutions

PSO2: Experiential and Modern Tools Usage: Apply and evaluate modern tools such as Python, R, SAS, and visualization platforms to design and develop data-driven solutions

PSO3: Investigation and Research: Analyze and evaluate complex datasets to derive valid conclusions using appropriate research methods

PSO4: Employability and Ethics: Apply technical, analytical, and communication skills to solve industry problems with professional competence and ethical responsibility, adhering to data privacy, integrity, and professional standards.

PSO5: Interdisciplinary and Multidisciplinary: Apply interdisciplinary knowledge to solve complex problems across diverse domains.

7. PEO – PO MAPPING

	PEO 1	PEO2	PEO3	PEO4	PEO5
PO 1	3	3	2	1	2
PO 2	2	3	3	2	2
PO 3	2	2	2	2	1
PO 4	1	2	2	3	3
PO 5	2	2	2	1	3

8. PEO – PSO MAPPING

	PSO 1	PSO2	PSO3	PSO4	PSO5
PEO 1	3	3	2	2	1
PEO 2	3	2	3	2	2
PEO 3	1	1	2	3	2
PEO 4	1	1	2	3	3
PEO 5	2	3	3	2	2

9. CHOICE BASED CREDIT SYSTEM (CBCS)

The College follows the CBCS with Grades under the Semester pattern. Each course is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted. This is done after a thorough analysis of the content of each course by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job oriented Elective, Multidisciplinary skill-based courses as part of the curriculum. Students can earn extra credits by opting for Massive Open Online Courses (MOOCs) and Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience

Eligibility For Admission

Candidates for admission to the first year of B.Sc. Data Analytics programme shall be required to have passed the higher secondary examinations with Mathematics or Computer Science or Computer Applications or Informatics Practices or Business Studies (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

Duration of the Course

The UG programme is of three years duration with six semesters and the PG programme is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students appear for the final End Semester Exam.

Course of Study

The main course of study for the Bachelor's Degree shall consist of the following:

Foundation Courses

PART - I: Tamil/ Hindi /Sanskrit/French

PART - II: English

Core Courses

PART - III: Consisting of (a) Core Courses (*Including Project*) (b) Allied Courses (c) Elective Courses related to the main subject of study.

PART – IV: Those who have not studied Tamil up to XII standard and have taken a non- Tamil language under Part – I, shall opt for Basic Tamil in the first two semesters.

Those who have studied Tamil up to XII standard, and taken a non -Tamil language under Part – I, shall opt for Advanced Tamil in the first two semesters.

Others, who do not come under either of the clauses mentioned above, can choose a Non-Major Elective (NME) in the first two semesters.

ABILITY ENHANCEMENT SKILLS (I, II, III & IV Semesters)

Value Education (I Semester)

Self-Study (Compulsory) Course (III Semester)

Indian Knowledge System (Domain Specific) – (IV Semester)

Summer Internship (After IV Semester)

Environmental Studies (V Semester)

PART - V: Compulsory Extension Services

A Student shall be awarded one credit for compulsory extension service. A student must enroll in NSS / NCC /Sports & Games/ Citizen Consumer Club / Enviro Club or any other service organization in the College and should put in compulsory minimum attendance of 40 hours, which shall be duly certified by the Principal of the College. If a student lacks 40 hours compulsory minimum attendance in the extension services in any Semester, s/he shall have to compensate the same, during the subsequent Semesters.

10. COURSE STRUCTURE

The B.Sc Data Analytics consists of 20 Core courses with 4 credits each, 4 Allied courses with 4 credits each, 3 Elective courses with 4 credits each, 4 Ability Enhancement Skill courses with two credits each, 2 Non-Major Elective courses with two credits each, 2 Life Skill courses (Value Education and EVS) with two credits each, 1 Self-study course with 2 credits and a domain specific IKS course with one credit. Internship is a compulsory component with 2 credits and Project is a compulsory core course with 4 credits for all the UG & PG programmes. Extension activity is a compulsory component with 1 credit.

Consolidated Credit Structure for all the 3 years

Course component		No. of Courses	Credits
Part I	Language	2	6
Part II	English	2	6
Part III	Core	20	80
	Allied	4	16
	Elective	3	12
Part IV	NME	2	4
	Ability Enhancement Skills	4	8
	EVS	1	2
	Value Education	1	2
	Internship	1	2
	Self-study course	1	2
	IKS	1	1
Part V	Extension activity	1	1
Total		43	142

B.SC. DATA ANALYTICS
CREDIT DISTRIBUTION FOR EACH SEMESTER

Semester I		Subjects	Credit	Hours per week	Marks		Total
Course Component					Internal	External	
Part I	Language	Language – I	3	6	50	50	100
Part II	English	English – I	3	4	50	50	100
Part III	Core I	Fundamentals of Data Analytics	4	5	50	50	100
	Core II	Practical-I: Programming for Analytics - I	4	4	50	50	100
	Allied I	Mathematics for Analytics	4	5	50	50	100
Part IV	NME I	Basic Tamil I/Advanced Tamil I/ Design Using Generative AI and Open Source Tools	2	2	50	50	100
	Life Skills I	Value Education	2	2	50	50	100
	Ability Enhancement skills I	Communication skills and Personality Development skills	2	2	50	50	100
	Total			24	30		
Semester II		Subjects	Credit	Hrs/ Week	Marks		Total
Course Component					Internal	External	
Part I	Language	Language – II	3	6	50	50	100
Part II	English	English – II	3	4	50	50	100
Part III	Core III	Data Analysis using Excel	4	6	50	50	100
	Core IV	Practical -II - Programming for Analytics - II	4	4	50	50	100
	Allied II	Statistics – I	4	6	50	50	100
Part IV	NME II	Basic Tamil II/Advanced Tamil II/ Multimedia Lab using GIMP	2	2	50	50	100
	Ability Enhancement skills II	Foundations of quantitative aptitude	2	2	50	50	100
	Total			22	30		

Semester III		Subjects	Credit	Hrs/ Week	Marks		Total
Course Component				Internal	External		
Part III	Core V	Fundamentals of Data Structures and Algorithms	4	6	50	50	100
	Core VI	Relational Databases and SQL	4	6	50	50	100
	Core VII	Data Wrangling	4	6	50	50	100
	Core VIII	Practical - III – Big Data Management and Visualization	4	4	50	50	100
	Allied III	Statistics – II	4	6	50	50	100
Part IV	Ability Enhancement skills III	Data Visualization	2	2	50	50	100
	Self-study course (Compulsory for all) Students can choose any one from the two given	1. Indian Heritage and Knowledge System/ 2. Contemporary World and Sustainable Development	2	Nil	Nil	100	100
	Total		24	30			
Semester IV		Subjects	Credit	Hrs/ Week	Marks		Total
Course Component					Internal	External	
Part III	Core IX	Data Analytics using R Programming	4	5	50	50	100
	Core X	Data Mining	4	6	50	50	100
	Core XI	NoSQL Databases	4	6	50	50	100
	Core XII	Practical - IV – Applied Statistical Modelling	4	4	50	50	100
	Allied IV	Time Series Analysis and Forecasting	4	6	50	50	100
Part IV	Indian Knowledge System	Indian Knowledge System With Artificial Intelligence	1	1	50	50	100
	Ability Enhancement skills IV	Resume Writing and Interview Skills	2	2	50	50	100
	Total		23	30			

Semester V			Credit	Hrs/ Week	Marks		Total
Course Component					Internal	External	
Part - III	Core XIII	Python for Data Exploration and Analysis	4	6	50	50	100
	Core XIV	Artificial Intelligence	4	6	50	50	100
	Core XV	Practical - V – Applied Machine Learning and Forecasting	4	5	50	50	100
	Elective I- IDE	Generative AI and Prompt Engineering / Cloud Computing/ Business Analytics	4	5	50	50	100
	Elective II	Practical -VI: Platform Engineering/ Ethics in Data Science/ Computer Networks	4	6	50	50	100
	Life Skills II	Environment Studies	2	2	50	50	100
	Internship	Internship	2	Nil	Nil	Nil	Nil
	Total		24	30			
Semester VI			Credit	Hrs/ Week	Marks		Total
Course Component					Internal	External	
Part - III	Core XVI	Machine Learning for Data Analytics	4	5	50	50	100
	Core XVII	Big Data Analytics	4	6	50	50	100
	Core XVIII	Text Analytics	4	5	50	50	100
	Core XIX	Practical - VII– Applied Text Analytics and Visualization Pitfalls	4	4	50	50	100
	Core XX	Project	4	4	50	50	100
	Elective III	Deep Learning/ Marketing Analytics/Financial Analytics	4	6	50	50	100
	Part V	Extension activity	Participation in NSS/NCC/Enviro club etc.	1	Nil	Nil	Nil
Total			25	30			
Total Credits			142				

11. EXAMINATION

Continuous Internal Assessment(CIA) will be for 50 percent and End Semester Examination(ESE) will be for 50 percent. The CIA marks for the two credit courses (NME, EVS, Value Education and Ability Enhancement skill courses) and one credit course on Indian Knowledge System coming under Part IV, shall be awarded based on the nature of the course or at the course instructor's discretion (Assignment/project/presentation). The mode of examination for IKS will be conducted through CIA with 5 out of 10 questions carrying 20 marks each.

Continuous Internal Assessment (CIA)

Every semester will have a mid-semester examination which will be conducted on completion of 45 working days in each semester. A Model exam for three hours duration will be conducted on completion of 85 working days in each semester. Internship credits will be given in semester V after verification of documents by the respective Heads.

The schedule for these tests is as follows:

CIA	Schedule	Syllabus Coverage
Mid Semester Examination	After 45 working days of the Semester	50%
Model Examination	After 85 working days of the Semester	100%

The components for the CIA (Theory & Practical's) are as follows:

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment			5
Workbook / record book / notebook			5
Class activity 1			5
Class activity 2			5

Class activity 3			5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50
The Mode of Evaluation for class activity can be based on the following parameters (these are suggestions, the faculty can add more if needed) 1) Quiz with MCQ 2) Case-Study analysis 3) Debate 4) Seminar/ Presentation 5) Peer/Self-Assessment 6) Role play 7) Scrap book 8) Monograph 9) Puzzle 10) Group Discussion 11) Group activity 12) Surprise class tests			

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking. CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty.

The marks for attendance will be awarded as per the following:

Percentage of General Attendance	Marks Awarded
90-100	5
75-89	4
60-74	3
<60	0

END SEMESTER EXAMINATIONS (ESE)

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG programmes will be held for all courses in November/December and April/May. Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practical's will be notified by the Controller of Examinations in consultation with the Dean (Academics)

Examination – CIA & ESE (Mode of Evaluation and Assessment)

METHODS OF EVALUATION		
Internal Evaluation	Mid Sem Exam (10)	50 Marks
	Model Exam (10)	
	Assignment (10)	
	Class activity (15)	
	Attendance (5)	
External Evaluation	End Semester Examination	50 Marks
Total		100 Marks

Method of assessment

Remembering (K1)	• The lowest level of questions requires students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook. • Suggested Keywords: Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why
Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. • The questions go beyond simple recall and require students to combined at altogether • Suggested Keywords: Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate

Application (K3)	- Students have to solve problems by using / applying a concept learned in the classroom. - Students must use their knowledge to determine a exact response. - Suggested Keywords: Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize
Analyze (K4)	- Analyzing the question is one that asks the students to breakdown something into its component parts. - Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. - Suggested Keywords: Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme
Evaluate (K5)	Evaluation requires an individual to make judgment on something. - Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. - Students are engaged in decision-making and problem–solving. - Evaluation questions do not have single right answers. - Suggested Keywords: Agree, Appraise, Assess, Award, Choose, compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value
Create (K6)	- The questions of this category challenge students to get engaged in creative and original thinking. - Developing original ideas and problem solving skills - Suggested Keywords: Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory

SEMESTER I

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – I
COURSE NAME: FUNDAMENTALS OF DATA ANALYTICS	COURSE CODE: 26UBDA301
SEMESTER: I	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with foundational knowledge of data analytics along with essential Python programming skills for data analysis

COURSE OUTCOMES:

1. Explain the fundamental concepts, types, and applications of data analytics.
2. Describe Python programming fundamentals including variables, data types, and control structures.
3. Illustrate the concepts of functions and strings in Python.
4. Analyze and justify the use of Python data structures for efficient data organization and problem-solving.
5. Explain file handling and exception handling mechanisms in Python.

UNIT I

(15 HOURS)

Data Analytics: Introduction to Data Analytics, evolution, history and need for Data Analytics, Differences between Data Analysis and Analytics, Different Types of Data Analytics, Importance of Data Analytics, Data Analytics Applications in Various Fields, Tools used in Data Analytics, Overview of the data analytics process (Data Requirements Specification, Data Collection, Data Processing, Data Cleaning, Data Analysis and Communication). Data Scientist vs. Data Engineer vs. Data Analyst- What is Python, Why Python for Data Analysis?

UNIT II

(15 HOURS)

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Control Flow Statements, The if Decision Control Flow Statement, The if...else Decision Control Flow Statement, The if...elif...else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements.

UNIT III

(15 HOURS)

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. **Strings:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

UNIT IV

(15 HOURS)

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement. **Dictionaries,** Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement. **Tuples,** Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function.

UNIT V**(15 HOURS)**

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, errors and exceptions, handling exceptions, modules, packages.

PRESCRIBED BOOKS:

1. Prof. Dipanjan Kumar Dey , “Fundamentals of Data Analytics”, Sankalp Publications, 2022.
2. Gowrishankar S, Veena A, “Introduction to Python Programming”, 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

REFERENCE BOOKS:

1. Mark Lutz, “Learning Python Powerful Object Oriented Programming”, O’reilly Media 2018, 5th Edition.
2. Timothy A. Budd, “Exploring Python”, Tata McGraw Hill Education Private Limited 2011, 1st Edition.
3. Allen Downey, Jeffrey Elkner, Chris Meyers, “How to think like a computer scientist: learning with Python”, 2012

E-LEARNING RESOURCES:

1. <https://www.w3school.com/python/>
2. <https://www.programiz.com/python-programming>
3. <https://www.kaggle.com/learn/python>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	2	2	3
CO 2	3	3	2	2	2
CO 3	2	2	3	3	2
CO 4	3	3	3	3	2
CO 5	2	2	2	2	3
Avg.	2.6	2.4	2.4	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	2	2
CO 2	2	3	2	3	2
CO 3	3	3	3	3	3
CO 4	3	2	3	2	3
CO 5	2	2	2	3	2
Avg.	2.6	2.4	2.6	2.6	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs & PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the fundamental concepts, types, and applications of data analytics.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Describe Python programming fundamentals including variables, data types, and control structures.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate the concepts of functions and strings in Python	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze and justify the use of Python data structures for efficient data organization and problem-solving.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Explain file handling and exception handling mechanisms in Python.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	5	5
Workbook/record book/ notebook	Handwritten notes	5	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	5	5
Class activity 3	Puzzle	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – II
COURSE NAME: PRACTICAL-I: PROGRAMMING FOR ANALYTICS – I	COURSE CODE: 26UBDA302P
SEMESTER: I	MARKS:100
CREDITS: 4	TOTAL HOURS:60
PRACTICAL	

COURSE OBJECTIVE:

To understand how to write SAS programs to access, explore, prepare, and analyze data.

COURSE OUTCOME:

1. Demonstrate data access and import operations using SAS and Microsoft Excel.
2. Examine datasets for accuracy and completeness using appropriate techniques.
3. Perform data analysis and generate reports using SAS procedures.
4. Explain the purpose and structure of SAS user-defined formats and informats for data presentation.
5. Implement restructuring of tables for analytical purposes

Exercises:

- Access SAS, Microsoft Excel, and text data.
- Explore and validate data.
- Prepare data by sub-setting rows and computing new columns.
- Analyze and report on data.
- Create an accumulating column and process data in groups.
- Manipulate data with functions.
- Convert column type.
- Create custom formats.
- Concatenate and merge tables.
- Process repetitive code.
- Restructure tables.

PRESCRIBED BOOKS:

1. SAS Programming Essentials, SAS Institute, Cary.
2. SAS Data Manipulation Techniques, SAS Institute, Cary.

REFERENCE BOOKS:

1. Step-by-Step Programming with Base SAS, SAS Institute, Cary.
2. The Little SAS Book: A Primer, Sixth Edition, SAS Institute, Cary.

SAS Internal Reference

LAB1; C1 – PG1V2, C2 – PG2V2; Exam Weightage – 50:50.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	2	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	2	2
CO 4	2	2	3	3	2
CO 5	3	3	2	3	3
Avg.	2.8	2.6	2.4	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	2
CO 2	2	3	3	2	2
CO 3	3	3	3	2	3
CO 4	2	3	2	3	2
CO 5	3	3	2	3	3
Avg.	2.6	3	2.4	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	Pos & PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Demonstrate data access and import operations using SAS and Microsoft Excel.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO2	Examine datasets for accuracy and completeness using appropriate techniques	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO3	Perform data analysis and generate reports using SAS procedures	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO4	Explain the purpose and structure of SAS user-defined formats and unformats for data presentation	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO5	Implement restructuring of tables for analytical purpose	PO1 to PO5 PSO1 to PSO5	K1 to K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise,	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH: 2026 – 2029
PART: III	COURSE COMPONENT: ALLIED - I
COURSE NAME: MATHEMATICS FOR ANALYTICS	COURSE CODE: 26UBDA3A1
SEMESTER: I	MARKS:100
CREDITS: 4	TOTAL HOURS: 75
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

On completion of the course the students will be able to understand and apply the principles of mathematics

COURSE OUTCOMES:

- 1.Implement the basic concepts of matrices and their applications.
- 2.Demonstrate the types of Determinant and its Application.
- 3.Develop knowledge of special types of sets like null sets, subsets, disjoint sets, and universal sets, along with proper set notation and conditions for equality of sets.
- 4.Analysis the concepts of coordinate points and lines.
- 5.Evaluate the First order and second order differentiation, maxima and minima of two variables.

UNIT I (15 Hours)

Matrices: Kind of matrices, Symmetric matrix, Skew symmetric matrix, Hermitian matrix, Skew Hermitian matrix, Orthogonal matrix, Unitary matrix, Rank of the matrix, Transpose echelon form, Homogeneous equations, Eigen value and Eigen vectors .

UNIT II (15 Hours)

Determinants: Introduction, determinant of matrix of order 2×2 and 3×3 , minors and cofactors, inverse of a matrix, applications of matrix and determinants.

UNIT III (15 Hours)

Set Theory: Finite and infinite sets, Examples of finite sets, example of infinite sets, description of sets, the tabulation method, set builder method, Null set, Sub-set, notation, equality of sets, number of subsets of a set, disjoint sets, universal sets, set operations, union of sets, intersection of sets, difference of sets, complement of sets, Venn diagram, law of sets De Morgan laws, number of elements in a set, cartesian product.

UNIT IV (15 Hours)

Co-ordinate Geometry: Distance between two points, the co-ordinates of the points which divide the line joining two points internally and externally in a given ratio, straight line, conditions for parallel and perpendicular lines, perpendicular distance from (x,y) on the line $ax+by+c=0$.

UNIT V (15 Hours)

Differentiation: First order and second order differentiation, Partial differentiation, maxima and minima of two variables.

PRESCRIBED BOOK:

1. Business Mathematics - P.R.Vittal.

REFERENCE BOOKS:

1. Allied mathematics – P. Durai pandian, Dr.S.Udayabaskaran , S.Chand and company limited, Reprint 2018.

E-LEARNING RESOURCES:

1. <https://nptel.ac.in/courses/111108157>
2. <https://nptel.ac.in/courses/111104416>
3. <https://openlearninglibrary.mit.edu/courses/course-v1:MITx+18.01.1x+2T2019/about>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C		20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS FOR THEORY

UNITS	SECTION A		SECTION B		SECTION C	
	THEORY	PROBLEM	THEORY	PROBLEM	THEORY	PROBLEM
I	1	1	-	1	-	1
II	1	1	-	1	-	1
III	1	1	-	1	-	1
IV	1	1	-	1	-	1
V	1	2	-	1	-	1
Any Unit	-	2		2	-	1
TOTAL	5	7		7	-	6
	SECTION A - 12		SECTION B - 7		SECTION C - 6	

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	2	2	2
CO 2	3	3	2	2	2
CO 3	3	2	3	2	3
CO 4	3	3	3	2	2
CO 5	3	3	3	2	3
Avg.	3	2.8	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	3	3
CO 2	3	3	3	3	2
CO 3	3	3	3	2	3
CO 4	3	2	3	2	2
CO 5	3	2	3	2	3
Avg.	3	2.4	3	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Implement the basic concepts of matrices and its applications.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Demonstrate the types of Determinant and its Application.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Develop knowledge of special types of sets like null sets, subsets, disjoint sets, and universal sets, along with proper set notation and conditions for equality of sets.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analysis the concepts of coordinate points and lines.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate the First order and second order differentiation, maxima and minima of two variables	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1=Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Workbook/record book/ notebook	Handwritten Class Notes	5	5
Assignment	Any topic related to the course	10	5
Class activity 1	Develop the Problem solving skill (Time Completion -3 Marks, Total number of question solved - 7Marks)	10	5
Class activity 2	Quiz with MCQ	10	5
Class activity 3	Surprise Class Test	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH: 2026 – 2029
PART: IV	COURSE COMPONENT: NON-MAJOR ELECTIVE - I
COURSE NAME: DESIGN USING GENERATIVE AI AND OPEN SOURCE TOOLS	COURSE CODE: 26UNME4A104
SEMESTER: I	MARKS:100
CREDITS: 2	TOTAL HOURS:30
PRACTICAL	

COURSE OBJECTIVE:

Generative AI tools help in creating new content or data, such as images, videos, music and text without human intervention. This course helps to maximize the productivity and boost creativity effortlessly with free and open AI generative tools.

COURSE OUTCOMES:

1. Generate and edit multimedia content using AI-based tools for image processing and enhancement.
2. Design digital posters and social media creatives using AI design platforms.
3. Develop and edit video content incorporating text, images, and speech using AI-powered tools.
4. Construct customized logos with appropriate design elements and slogans using logo design tools.
5. Produce visual assets and presentations using AI tools for graphic design and automated slide generation.

LAB EXERCISES:

(6 Hours)

1. IMG2GO

- Art Generator: prompting – transform text to AI gen images
- Work with photo editor: crop and resize images
- Watermark images, convert image to documents, Convert videos to animated gif

2. DESIGNAI

(6 Hours)

- Create posters, Resize, Design cards, face book posts and Instagram posts, download and share designs

3. KAPWING AND AI STUDIOS

(6 Hours)

- Create videos from text – images, URLs
- Edit Videos Online.
- Text to Speech features – Choose languages.

4. LOGOMAKER

(6 Hours)

- Make a Logo – Add Slogans – Customize Designing – download zip files of various logo designs.

5. FREEPIK AND SLIDEGPT

(6 Hours)

- AI generated Images, Vectors, Icons, Editing and downloading Images
- Slides GPT: create decks, convert text requests into finished slideshows, download presentations.

E-RESOURCES

Web links

1. <https://www.img2go.com/ai-creator-studio>
2. <https://www.img2go.com/convert-video-to-gif>
3. <https://designs.ai/designmaker/start/search?Category=5d503d6cf8ead94a97909b23&query=Poster>
4. <https://www.kapwing.com/>
5. <https://v3.aistudios.com/dashboard>
6. <https://logo.com/>
1. <https://www.freepik.com/ai/images>
2. <https://www.freepik.com/photo-editor/new-artboard>
3. <https://slidesgpt.com/>

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	2	3	3	3	3
CO 2	2	3	3	3	3
CO 3	3	2	3	3	3
CO 4	3	2	3	3	3
CO 5	2	2	3	3	3
AVG	2.4	2.4	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	2	3	2	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	2	3	2	3	3
CO 5	2	3	2	3	3
AVG	2.4	3	2.4	3	3

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Generate and edit multimedia content using AI-based tools for image processing and enhancement	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO2	Design digital posters and social media creatives using AI design platforms	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO3	Develop and edit video content incorporating text, images, and speech using AI-powered tools.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO4	Construct customized logos with appropriate design elements and slogans using logo design tools.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO5	Produce visual assets and presentations using AI tools for graphic design and automated slide	PO1 to PO5 PSO1 to PSO5	K1 to K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination involving design tasks for 90 minutes	50	10
Model Examination	Practical examination involving content generation, logo creation for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten Lab programs	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Practical Exercise	10	5
Class activity 3	Presentation	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: ALL UG	BATCH: 2026 - 2029
PART: IV	COURSE COMPONENT: Value Education
COURSE NAME: Value Education	COURSE CODE: 26UVED401
SEMESTER: IV	MARKS:100
CREDITS: 2	TOTAL HOURS: 30
THEORY	

COURSE OBJECTIVE

To inculcate human values, ethical principles, social responsibility, and awareness of responsible technology use for holistic personal and societal development.

COURSE OUTCOMES:

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

1. Recall core value systems and their relevance to real-life situations and ethical decision-making in personal and social contexts.
2. Describe the role of culture and civilization in shaping individual and collective identities.
3. List salient values for life such as forgiveness, sacrifice, self-esteem, teamwork, and creative thinking.
4. Describe the role of human rights, social values, and ethical use of Artificial Intelligence in addressing contemporary social issues.
5. Recall the teachings of Guru Nanak Dev Ji and describe their connection to values and sustainable living.

UNIT I: EDUCATION AND VALUES

Definition, Concept, Classification, Theory, Criteria and Sources of values Aims and objectives of value education Role and Need for value education in the contemporary society, Role of education in transformation of values in society Role of parents, teachers, society, peer group and mass media in fostering values

UNIT II: VALUE EDUCATION AND PERSONAL DEVELOPMENT

Human Values: Truthfulness, Sacrifice, Sincerity, Self-Control, Altruism, Scientific Vision, relevancy of human values to good life. Character Formation towards Positive Personality Modern challenges of adolescents: emotions and behavior Self-analysis and introspection: sensitization towards gender equality, differently abled, Respect for - age, experience, maturity, family members, neighbors, strangers, etc.

UNIT III: HUMAN RIGHTS AND MARGINALIZED PEOPLE

Concept of Human Rights – Principles of human rights – human rights and Indian constitution – Rights of Women and children – violence against women – Rights of marginalized People – like women, children, minorities, transgender, differently abled etc.

Social Issues and Communal Harmony Social issues – causes and magnitude - alcoholism, drug addiction, poverty, unemployment – communal harmony –concept –religion and its place in public domain –secular civil society

UNIT IV: VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT

Constitutional Values: (Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity)

Social Values: (Pity and Probity, Self-Control, Universal Brotherhood).

Professional Values: (Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith).

Religious and Moral Values: (Tolerance, Wisdom, character).

Aesthetic Values: (Love and Appreciation of literature, fine arts)

Environmental Ethical Values, National Integration and international understanding.

Need for Humanistic values for espousing peace in society.

Conflict of cross-cultural influences, cross-border education.

Emerging Technologies and Human Values: (Ethical and responsible use of Artificial Intelligence, digital citizenship, privacy, academic integrity and technology for social good).

UNIT V:

Guru Nanak Devji's Teachings

Relevance of Guru Nanak Devji's teachings' relevance to Modern Society

The Guru Granth Sahib

The five Ks, Values and beliefs

Rights and freedom (Right of equality, Right to Education, Right to Justice, Rights of women, Freedom of religion, Freedom of culture, Freedom of assembly, Freedom of speech), Empowerment of women, Concept of Langar, Eminent Sikh personalities

REFERENCE BOOKS:

1. Dr. Abdul Kalam. My Journey-Transforming Dreams into Actions. Rupa Publications, 2013.
2. Steven R Covey, 8th Habit of Effective People (From Effectiveness to Greatness), Free Press, New York, 2005.
3. Prem Singh, G.J. (2004). 'Towards Value Based Education', University News. Vol. 42 (45): P.11-12.
4. V.R. Krishna Iyer. Dialectics & Dynamics of Human Rights in India (Tagore Law Lectures) The Yesterday, Today and Tomorrow, Eastern Law House (1999, Reprint 2018)
5. <http://www.ncert.nic.in/rightside/links/pdf/framework/english/nf2005.pdf>
6. Saptarsi Goswami, Amit Kumar Das and Amlan Chakrabarti, AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI), Pearson India Education Services Pvt. Ltd., First Edition, 2024. ISBN: 978-9361590832.

QUESTION PAPER PATTERN: MCQ

SOFT SKILLS: COMMON TO ALL	BATCH: 2026- 2029
PART: IV	COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS I
COURSE NAME: COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT SKILLS	COURSE CODE: 26USKL401
SEMESTER: I	MARKS:100
CREDITS: 2	TOTAL HOURS: 30
THEORY	

COURSE OBJECTIVE:

To build communication skills for personal and professional development.

COURSE OUTCOMES:

1. Demonstrate the ability to actively listen to others, understand diverse perspectives, and paraphrase key points accurately, enhancing their comprehension skills in various personal and professional contexts.
2. Articulate thoughts, ideas, and information clearly and concisely, using appropriate language and structure to convey messages effectively in both written and verbal communication
3. Develop confidence in expressing opinions, asserting boundaries, and advocating for themselves and others, leading to enhanced self-assurance and effectiveness in interpersonal and group communication.
4. Demonstrate their communication style and approach based on the audience, context, and purpose of communication, fostering flexibility and versatility in interacting with diverse individuals and groups.
5. Acquire techniques for resolving conflicts, managing disagreements, and negotiating mutually beneficial outcomes through effective communication strategies, promoting constructive problem-solving and collaboration in personal and professional settings.

UNIT I Types of Communication (6 Hours)

Verbal Communication - Nonverbal Communication - Visual Communication - Written Communication - Interpersonal Communication - Group Communication - Mass Communication - Digital Communication- Barriers – Language- Cultural- Psychological- Semantic- Technological Barriers

UNIT II Etiquette & Ethical Practices in Communication (6 Hours)

Active Listening - Respectful Language - Clarity and Conciseness – Truthfulness-Professionalism- Tone -Timeliness - Constructive Feedback - Confidentiality - Cultural Sensitivity - - Emotional Intelligence-Social Intelligence- Social Etiquettes-Accountability

UNIT III Self Actualization (6 Hours)

SWOC Analysis- Self Regulation-Self Evaluation, Self-Monitoring, Self- Criticism, Self-Motivation, Self-awareness and Reflection:

UNIT IV III Leadership and Teamwork (6 Hours)

Leadership Skills: Leadership styles- Goal-setting and decision-making- Motivation and influence- Team Dynamics: Team building activities- Conflict resolution- Collaborative problem-solving

UNIT V Stress and Time Management**(6 Hours)**

Definition of Stress, Types of Stress, Symptoms of Stress, Stress coping ability, Stress Inoculation Training, Time Management and Work-Life Balance: Self-discipline Goal-setting

RECOMMENDED TEXTBOOKS

1. Goleman, Daniel (2006) *Emotional Intelligence*, Bantam Books
2. Linden, Wolfgang (2004) *Stress Management- From Basic Science to Better Practice-* University of British Columbia, Vancouver, Canada.
3. Hasson, Gill (2012) *Brilliant Communication Skills*. Great Britain: Pearson Education.
4. Monippally, Matthukutty, M. *Business Communication Strategies*. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2001.
5. Raman, Meenakshi & Sangeetha Sharma (2011) *Communication Skills*, Oxford University Press.

REFERENCE BOOKS

1. N.Krishnaswamy *Current English for College* (1st Edition) - Trinity Press
2. Wood, Julia T (2015) *Interpersonal Communication: Everyday Encounters* 8th Edition, Cengage Learning.

E-LEARNING RESOURCES

1. <http://www.albion.com/netiquette/corerules.html>
2. <http://www.englishdaily626.com/c-errors.php>
3. <https://www.helpguide.org/articles/relationships-communication/nonverbal-communication.htm>
4. <https://www.communicationtheory.org/verbal-vs-non-verbal-communication-with-examples/>
5. <https://letstalkscience.ca/educational-resources/backgrounders/digital-citizenship-ethics>
6. <https://www.switchboard.app/learn/article/teamwork-leadership-skills>

**GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	10
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	20
C	Answer any two (Internal (Choice))	14-15	10	20
	Internal & Viva Voce		50	50

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL	7		
SECTION A – 7		SECTION B – 6	SECTION C - 4

SEMESTER II

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – III
COURSE NAME: DATA ANALYSIS USING EXCEL	COURSE CODE: 26UBDA303
SEMESTER: II	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with the skills to effectively use Excel for data analysis, including functions, formulas, charts, PivotTables, and automation.

COURSE OUTCOME:

1. Explain the fundamentals of Excel, workbook structure, worksheet operations, and data handling tools
2. Describe the use of formulas, cell referencing, and logical functions for data processing.
3. Explain text, lookup, and PivotTable functionalities for organizing and analyzing data.
4. Analyze statistical functions in Excel to interpret data trends and relationships.
5. Explain chart types, data visualization techniques, and the concept of macros in Excel.

UNIT I:

(15 HOURS)

Getting Started with Excel: Worksheets and Workbooks- Navigation with Keyword- Tabs and Ribbons - File Menu - Quick Access Toolbar -Excel options - Create a new workbook- Understanding Worksheet Basics. **Data Tools:** Sort, Filter, Remove Duplicates, Data Grouping-Conditional Formatting-Data Validation.

UNIT II:

(15 HOURS)

Perform Operations with Formulas and Functions: relative and absolute addressing, Referencing Cells Outside the Worksheet & Workbook-Logical functions: if, nested if, if combined with AND / OR, IFS, Switch, Summarizing functions: COUNT, COUNTA, COUNTBLANK, COUNTIF, COUNTIFS, SUM, PRODUCT, SUMIF, SUMPRODUCT.

UNIT III:

(15 HOURS)

Text Functions: Text, find, len, trim, concatenate/concat, Lookup and Reference functions-Vlookup, Hlookup, Date and Time functions - Math functions – int, Round, rand, randbetween, ceil, floor. Analyzing Data Using PivotTables and PivotCharts: Creating and Using PivotTables,Performing Pivot Table Calculations,Building Pivot Chart.

UNIT IV:

(15 HOURS)

Analyzing Data Using Statistics: Calculating average, calculating a conditional average, calculating an average based on multiple conditions, calculating the median, mode, finding the rank, Calculating the nth highest value, Calculating the nth smallest value, calculating the variance, standard deviation, finding the correlation.

UNIT V:

(15 HOURS)

Basic Excel charts & Graphs: Excel chart formatting & Customization., Excel Bar & Columns Charts, Excel Histograms & Pareto Charts, Line Charts & Trendlines, Excel Pie Charts, Scatter Plots, Excel Box & Whisker Charts, Excel Heat Maps with Conditional Formatting, Macros in Excel: VBA

Quick View - Enabling Developer Tab - Create Macro -Record Macro.

PRESCRIBED BOOKS:

1. Paul McFedries, “Excel data Analysis For Dummies”.
2. Nigam, M. (2019), ”Advanced analytics with Excel, (2nd Ed.)”, BPB Publications

REFERENCE BOOKS:

1. Michael Alexander, Richard Kusleika, and John Walkenbach, ”Excel 2019 Bible”

E-LEARNING RESOURCES:

1. <https://www.techtarget.com/searchenterprisedesktop/definition/Excel>
2. <https://www.w3schools.com/EXCEL/index.php>
3. <https://support.microsoft.com/en-us/office/excel-video-training-9bc05390-e94c-46af-a5b3d7c22f6990bb>
4. <https://www.techtarget.com/searchenterprisedesktop/definition/Excel>

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	2	2	3
CO 2	3	3	2	2	2
CO 3	3	2	3	3	2
CO 4	3	3	3	3	2
CO 5	3	2	3	2	3
Avg.	3	2.4	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	3	3
CO 2	3	2	3	2	2
CO 3	3	3	3	3	3
CO 4	2	3	3	3	3
CO 5	3	3	2	3	3
Avg.	2.8	2.8	2.6	2.8	2.8

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the fundamentals of Excel, workbook structure, worksheet operations, and data handling tools	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Describe the use of formulas, cell referencing, and logical functions for data processing.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Explain text, lookup, and PivotTable functionalities for organizing and analyzing data.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze statistical functions in Excel to interpret data trends and relationships.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Explain chart types, data visualization techniques, and the concept of macros in Excel.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes maintained throughout the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Peer/Self-Assessment	10	5
Class activity 3	Group activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – IV
COURSE NAME: PRACTICAL-II: PROGRAMMING FOR ANALYTICS – II	COURSE CODE: 26UBDA304P
SEMESTER: II	MARKS:100
CREDITS: 4	TOTAL HOURS:60
PRACTICAL	

COURSE OBJECTIVE:

To understand the SAS macro facility to design, write, and debug macro programs, with an emphasis on understanding how programs that contain macro code are processed.

COURSE OUTCOME:

1. Apply SAS macro variables and functions to perform text substitution and automate code generation
2. Develop SAS programs using conditional and iterative macro techniques for dynamic code execution.
3. Develop data-driven SAS programs to query, subset, and manipulate datasets effectively.
4. Analyze and summarize data using SAS procedures for reporting and presentation.
5. Integrate and manage data by combining tables, creating views, and accessing external DBMS data using SAS

EXERCISES:

- Perform text substitution in SAS code.
- Use macro variables and macro functions.
- Automate and customize the production of SAS code.
- Conditionally or iteratively construct SAS code.
- Write self-modifying, data-driven programs.
- Query and subset data.
- Summarize and present data.
- Combine tables using joins and set operators.
- Create and modify tables and views.
- Create data-driven macro variables using a query.
- Access DBMS data with SAS/ACCESS technology.

PRESCRIBED BOOKS:

1. SAS Macro Language Essentials, SAS Institute, Cary.
2. SAS SQL Essentials, SAS Institute, Cary.

REFERENCE BOOKS:

1. SAS Macro Programming Made Easy, Third Edition, SAS Institute, Cary.
2. Carpenter's Complete Guide to the SAS Macro Language, Third Edition, SAS Institute, Cary.
3. PROC SQL: Beyond the Basics Using SAS®, Third Edition, SAS Institute, Cary.

SAS INTERNAL REFERENCE

LAB2; C1 – MC1V2, C2 – SQ1M6; Exam Weightage – 50:50

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	2	2	2
CO 2	3	3	2	2	2
CO 3	3	3	3	4	3
CO 4	3	3	3	2	3
CO 5	3	3	3	3	3
Avg.	3	3	2.6	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	2	2
CO 2	3	3	2	2	2
CO 3	3	3	3	3	2
CO 4	3	3	3	3	3
CO 5	3	3	3	2	3
AVG	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply SAS macro variables and functions to perform text substitution and automate code generation	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Develop SAS programs using conditional and iterative macro techniques for dynamic code execution.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Develop data-driven SAS programs to query, subset, and manipulate datasets effectively.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze and summarize data using SAS procedures for reporting and presentation.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Integrate and manage data by combining tables, creating views, and accessing external DBMS data using SAS	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise,	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH: 2026 - 2029
PART: III	COURSE COMPONENT: ALLIED - II
COURSE NAME: STATISTICS - I	COURSE CODE: 26UBDA3A2
SEMESTER: II	MARKS:100
CREDITS: 4	TOTAL HOURS: 75
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To understand about data and use various statistical techniques to measure the compare the relation between data points.

COURSE OUTCOMES:

1. Apply the basics of statistical data, meaning of correlation and regression and probability.
2. Demonstrate the concept measures of central tendency and dispersion.
3. Apply the concepts of data in various types of averages and deviations and probability models.
4. Analyze the concepts of Pearson's coefficient of skewness, Bowley's coefficient of Skewness
5. Evaluate Principle of least squares, Fitting of straight line, parabola, exponential and power curve.

UNIT I (15 Hours)

Introduction to Statistics: Definition, Characteristics, Graphical Representation of data: Bar charts, Pie diagrams, Histograms, Frequency polygon, Ogives.

UNIT II (15 Hours)

Measures of Central Tendency: Mean, Median, Mode - graphical location of median, quartiles, deciles, percentiles–relation among arithmetic mean, geometric mean and harmonic mean.

UNIT III (15 Hours)

Measures of Dispersion: Range, Mean deviation, Quartile deviation, Standard deviation - Coefficient of variation, Inter quartile deviation, Mean Absolute deviation.

UNIT IV (15 Hours)

Skewness and Kurtosis: Pearson's coefficient of skewness, Bowley's coefficient of Skewness, Moments, Relation between moments about mean in terms of moments about point, Pearson's coefficients coefficient of skewness based upon moments.

UNIT V (15 Hours)

Curve fitting: Principle of least squares, Fitting of straight line, parabola, exponential and power curve.

PRESCRIBED BOOK:

1. Statistical methods and numerical methods by P.R.Vittal

REFERENCE BOOK:

1. New Mathematical statistics - Sanjay Arora & Bansilal (2002), Meerat Publications, New Delhi
2. Fundamentals of Mathematical Statistics - Gupta,S.C. and Kapoor, V.K.(2000): 10/e, Sultan Chand & Sons
3. Basic Statistics - 3/Agarwal .B.L (1996): e ,New Age International(P) Ltd

E-LEARNING RESOURCES:

1. <https://nptel.ac.in/courses/109104182>
2. <https://www.mit.edu/search/?q=statistics+#gsc.tab=0&gsc.q=statistics%20&gsc.page=1>

GUIDELINES TO THE QUESTION PAPER**SETTERS QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13 - 19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20 - 25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS FOR THEORY

UNITS	SECTION A		SECTION B		SECTION C	
THEORY	THEORY	PROBLEM	THEORY	PROBLEM	THEORY	PROBLEM
I	1	1	-	1	-	1
II	1	1	-	1	-	1
III	1	1	-	1	-	1
IV	1	1	-	1	-	1
V		2	-	1	-	1
Any Unit	-	2		2	-	1
TOTAL	4	8		7	-	6
	SECTION A - 12		SECTION B - 7		SECTION C - 6	

PO-CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	2	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Avg.	3	3	2.8	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	3	3
CO 2	2	2	3	2	2
CO 3	2	3	2	3	2
CO 4	3	3	3	2	3
CO 5	2	2	2	2	2
Ave.	2.4	2.6	2.4	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply the basics of statistical data, meaning of correlation and regression and probability.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Demonstrate the concept measures of central tendency and dispersion.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Apply the concepts of data in various types of averages and deviations and probability models.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze the concepts of Pearson's coefficient of skewness, Bowley's coefficient of Skewness	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate Principle of least squares, Fitting of straight line, parabola, exponential and power curve	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Workbook/record book/ notebook	Handwritten Class Notes	5	5
Assignment	Any topic related to the course	10	5
Class activity 1	Develop the Problem solving skill (Time Completion -3 Marks, Total number of question solved - 7Marks)	10	5
Class activity 2	Quiz with MCQ	10	5
Class activity 3	Surprise Class Test	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: IV	COURSE COMPONENT: NON-MAJOR ELECTIVE-II
COURSE NAME: MULTIMEDIA LAB USING GIMP	COURSE CODE: 26UNME4B104
SEMESTER: II	MARKS:100
CREDITS: 2	TOTAL HOURS:30
PRACTICAL	

COURSE OBJECTIVE:

To enable the students to know the fundamental tool of image editing software and make them to apply in real world business.

COURSE OUTCOME:

1. Apply graphic design techniques to create and edit digital images using image editing tools
2. Develop visual effects such as text manipulation, image transformation, and photo enhancement.
3. Design and produce digital artifacts including web pages and visiting cards with appropriate layout and graphics
4. Construct animations to simulate real-world movements using multimedia tools.
5. Integrate multiple multimedia elements to develop creative visual compositions and presentations.

Lab Exercises:

1. Create Sun Flower
2. Animate Plane flying in the Clouds
3. Create Plastic Surgery for the Nose
4. Create See-through text.
5. Create a Web Page
6. Convert Black and White Photo to Colour Photo
7. Design a visiting card containing at least one Graphic and text information.
8. Create an animation to represent the growing Moon.
9. Create an animation to indicate a ball Bouncing on steps
10. Simulate movement of a cloud
11. Display the background given (filename: Tulip.jpg) through your name

PO-CO MAPPING

	PO 1	PO2	PO 3	PO 4	PO 5
CO 1	2	2	3	3	3
CO 2	2	3	3	3	3
CO 3	2	3	3	3	3
CO 4	3	2	3	3	3
CO 5	3	2	3	3	3
Avg.	2.4	2.4	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	2	3	3
CO 2	2	3	2	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	2	3	2	3	3
Avg.	2.4	3	2.4	3	3

PO=PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply graphic design techniques to create and edit digital images using image editing tools	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Develop visual effects such as text manipulation, image transformation, and photo enhancement.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Design and produce digital artifacts including web pages and visiting cards with appropriate layout and graphics	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Create animations to simulate real-world movements using multimedia tools.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Integrate multiple multimedia elements to develop creative visual compositions and presentations.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination for 90 minutes	50	10
Model Examination	Practical examination for 180 minutes	100	10
Assignment	Written assignment based on experimental concepts	10	5
Workbook/record book/ notebook	record of experiments with observations and results	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Practical Exercise	10	5
Class activity 3	Presentation	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: ALL UG	BATCH: 2026 – 2029
PART: IV	COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS II
COURSE NAME: FOUNDATIONS OF QUANTITATIVE APTITUDE	COURSE CODE: 26USKL402
SEMESTER: II	MARKS:100
CREDITS: 2	TOTAL HOURS: 30
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

Develop learners' problem-solving skills and critical thinking abilities in the context of recruitment aptitude tests.

COURSE OUTCOME:

CO1: Apply the concepts of number systems, divisibility rules, and number series to solve numerical problems.

CO2: Compute HCF and LCM of numbers using prime factorization method.

CO3: Apply percentage concepts to solve problems involving profit, loss, cost price, and selling price.

CO4: Compare simple interest and compound interest to solve financial problems.

CO5: Interpret data from tables and graphs to draw meaningful conclusions.

UNIT I: Number system and Number series (6 HOURS)

Numbers: Numbers and their classification, test for divisibility of numbers, General properties of divisibility, division and remainder, remainder rules.

Number Series: Number series, three steps to solve a problem on series, two-line number series, sum rules on natural numbers.

UNIT II: HCF and LCM of Numbers (6 HOURS)

Factors, Multiples, Principal of Prime factorization, Highest Common Factor (HCF) and Least Common Multiple (LCM), Product of two numbers, Difference between HCF and LCM.

UNIT III: Percentage, Profit and Loss (6 HOURS)

Percentage: Introduction, fraction to rate percent, rate percent to fraction, rate percent of a number, express a given quantity as a percentage of another given quantity, convert a percentage into decimals and convert a decimal into percentage.

Profit and Loss: Gain/Loss and % gain and % loss, relation among Cost price, Sale price, Gain/Loss and % gain and % loss.

UNIT IV: Simple Interest and Compound Interest (6 HOURS)

Simple Interest: Definition, effect of change of P , R and T on Simple Interest, amount.

Compound Interest: Introduction, conversion period, basic formula, to find the Principal/Rate/Time, Difference between Simple Interest and Compound Interest.

UNIT V: Data interpretation (6 HOURS)

Tabulation, Bar Graphs, Pie Charts, Line Graphs, average.

PRESCRIBED BOOK:

1. Quantitative Aptitude by R.S. Agarwal

REFERENCE BOOKS:

1. Quantitative Aptitude by Abhijit Guha, Fourth Edition.
2. Quantitative Aptitude by Ramandeep Singh.

E - LEARNING RESOURCES:

1. <https://byjus.com/maths/numeralsystem/#:~:text=crore%20is%207.International%20Numeral%20System,8%20%E2%80%93%20Ones>
2. <https://byjus.com/maths/hcf-and-lcm/>
3. <https://byjus.com/maths/profit-loss-percentage/>
4. <https://www.vedantu.com/jee-main/maths-difference-between-simple-interest-and-compound-interest>
5. <https://sites.utexas.edu/sos/guided/descriptive/descriptivec/frequency/>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Multiple Choice Questions: Answer 20 out of 20 questions (each question carries one mark)	1 – 20	20	20
B	Answer any 5 out of 7 questions (each question carries 6 marks)	21 – 27	6	30
TOTAL MARKS				50

BREAK UP OF QUESTIONS FOR PROBLEMS

UNITS	SECTION A	SECTION B
I	4	1
II	4	1
III	4	1
IV	4	1
V	4	1
Any Unit	-	2
TOTAL	20	7

SEMESTER III

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – V
COURSE NAME: FUNDAMENTALS OF DATA STRUCTURES AND ALGORITHMS	COURSE CODE: 26UBDA305
SEMESTER: III	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.

COURSE OUTCOMES:

1. Describe the fundamental concepts, classifications, and real-world applications of data structures
2. Illustrate the structure and operations of arrays and linked lists with suitable examples.
3. Explain stacks and queues with their operations and uses.
4. Analyze tree structures and apply traversal methods to solve hierarchical data problems.
5. Evaluate sorting, searching, and graph techniques to determine their efficiency and suitability for given problems.

UNIT-I : (15 Hours)

INTRODUCTION TO DATA STRUCTURE: Definition, Data Types, Abstract Data Types (ADT), classification of data structure - primitive & non-primitive data structures, Linear and Non-linear data structures. **ARRAYS:** Definition, one dimensional array, two dimensional arrays, Applications, pointers. **LINKED LIST:** Definition, linked list ADT, single linked list, double linked list, circular linked list, comparison of linked list with Arrays.

UNIT-II: (15 Hours)

STACKS: Definition, Stack as an ADT & Operations on stack, Applications of stack, Representation of stack. **QUEUES:** Definition, Queue as an ADT & Operations on Queue, Application of Queues, Representation of Queues, Various Queue Structures: circular Queue, Dequeue.

UNIT-III: (15 Hours)

TREES: Definition, Basic Tree Terminology. **Binary Tree** – Definition, Properties of Binary Trees, Types of Binary Trees, Representation of Binary Tree, Binary Tree Traversals. **Binary Search Tree (BST)** – Definition, Operations on a Binary Search Tree, Examples of BST.

UNIT-IV: (15 Hours)

SORTING: Definition, Sorting methods - Bubble Sort, Selection Sort, Quick Sort, Insertion Sort, Merge Sort. **SEARCHING:** Definition, searching methods - Linear or Sequential Search, Binary Search.

UNIT-V: (15 Hours)

GRAPHS: Definition, Basic Graph Terminology, Representation of Graphs, Graph Traversal – DFS and BFS. Topological sort, Shortest Path problem, Minimum Spanning Tree.

PRESCRIBED BOOKS:

1. Classic Data Structures”, by DEBASIS SAMANTHA 2nd EDITION, PHI publications, 2009
2. “Data Structures and Algorithms”, by NARASIMHA KARUMANCHI, CAREERMONK Publications, 2017

REFERENCE BOOKS:

1. Data structures: A Pseudo code Approach with C, 2nd Edition, R.F.Gilberg And B.A.Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung, Pearson

E-LEARNING RESOURCES:

1. <https://www.simplilearn.com/tutorials/data-structure-tutorial>
2. <https://www.geeksforgeeks.org/data-structures/>
3. <https://www.simplilearn.com/tutorials/data-structure-tutorial/graphs-and-advanced-topics>
4. <https://www.simplilearn.com/tutorials/data-structure-tutorial/stacks-and-queues>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	3	1	1
IV	3	1	1
V	2	1	1
TOTAL	12	7	6
SECTION A – 12		SECTION B - 7	SECTION C - 6

PO-CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	3
CO 2	3	3	2	2	2
CO 3	3	2	3	2	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Avg.	3	2.8	2.6	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	2	3	2
CO 3	3	2	3	3	2
CO 4	3	2	3	2	3
CO 5	3	3	3	2	3
Avg.	3	2.6	2.8	2.4	2.6

PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe the fundamental concepts, classifications, and real-world applications of data structures	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Illustrate the structure and operations of arrays and linked lists with suitable examples.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Explain stacks and queues with their operations and uses.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze tree structures and apply traversal methods to solve hierarchical data problems.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate sorting, searching, and graph techniques to determine their efficiency and suitability for given problems.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Surprise class tests	10	5
Class activity 3	Seminar/ Presentation	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – VI
COURSE NAME: RELATIONAL DATABASES AND SQL	COURSE CODE: 26UBDA306
SEMESTER: III	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To provide foundational knowledge and practical skills in database design, SQL querying, normalization, and database management for effective data handling and analysis

COURSE OUTCOMES:

1. Explain fundamental concepts, architecture, and data models of DBMS.
2. Describe data modeling concepts, ER diagrams, relational algebra, and normalization techniques.
3. Explain SQL commands for defining, manipulating, and querying data.
4. Analyze data constraints, SQL operators, and functions for data processing.
5. Analyze database security, transactions, and advanced SQL queries for data management.

UNIT I (15 HOURS)

Introduction: Basic concepts of DBMS, Advantages of a DBMS over file-processing systems, Data abstraction, Database Languages, Data Models: Introduction to Hierarchical, Network, ER, and Object Relational Model, Data Independence, Components of a DBMS and overall structure of a DBMS, Multi-User DBMS Architecture, Client Server architecture (1, 2, 3, n-Tier).

UNIT II (15 HOURS)

Data Modeling: Basic Concepts and terminology: entity, attributes, schema, subschema, cardinality, degree, tuple, attributes, E-R diagrams: Components of E-R Model, conventions, understanding Relational Algebra, Codd's rules, Normalization: 1st, 2nd, 3rd, 4th, 5th Normal forms.

UNIT III (15 HOURS)

Interactive SQL: SQL commands; Data Definition Language Commands; Data Manipulation Language Commands; Data types, Insertion of data into the tables; Viewing of data from the tables; Conditional viewing of data; Deletion operations; Updating the contents of the table; Modifying the structure of the table; Renaming table; Destroying tables

UNIT IV (15 HOURS)

Data Constraints: Types of Data Constraints; Column Level Constraints; Table Level Constraints; Null value concepts; The UNIQUE Constraint; The PRIMARY Constraint; The FOREIGN key Constraint; The CHECK Constraint; Viewing the User Constraint.

SQL Operators and Functions: Arithmetic operators, Logical operators, Range searching, Pattern matching; Using DUAL, SYSDATE; SQL Functions: Group, Scalar, Aggregate, Numeric, String and Date Functions.

UNIT V**(15 HOURS)**

Database Security and Privileges: Grant Command, Revoke Command, Application Privileges Management, COMMIT and ROLLBACK.

Grouping data from tables in SQL: GroupBy, Having clause, Subqueries, Collating Information: Equi Joins, Cartesian Joins, Outer Joins, Self Joins; SET Operators: Union, Intersect, Minus; Nested Queries.

PRESCRIBED BOOKS:

1. Database System Concepts, Sixth Edition, Abraham Silberschatz , Henry F. Korth, S. Sudarshan, Mc Graw Hill.
2. Fundamentals Of Database Systems, Seventh Edition, Ramez Elmasri & Shamkant B. Navathe, Pearson

REFERENCE BOOKS:

1. Raghuram Krishnan, Johnnes Gehrke,(2011), “Database Management System”, (3rd Edn.),Mc Graw Hill
2. C.J.Date, A.Kannan and S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

E-LEARNING RESOURCES:

1. <https://www.geeksforgeeks.org/dbms/>
2. <https://www.guru99.com/dbms-tutorial.html>
3. <https://www.javatpoint.com/dbms-tutorial>
4. <https://byjus.com/govt-exams/database-management-system-dbms/>
5. <https://beginnersbook.com/2015/04/dbms-tutorial/>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	2
CO 2	3	3	2	2	2
CO 3	3	2	3	3	2
CO 4	3	3	3	3	3
CO 5	3	3	3	2	3
Avg.	3	2.8	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	2
CO 2	3	3	2	2	2
CO 3	3	3	3	3	2
CO 4	3	3	2	3	3
CO 5	3	3	3	3	3
Avg.	3	3	2.6	2.6	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	To introduce the fundamental concepts, architecture, and advantages of database management systems over traditional file systems.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Learn about the role of RDBMS in managing data and supporting applications.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Create Entity-Relationship (ER) diagrams to represent database structures and relationships	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Write and execute SQL queries to perform data manipulation tasks	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	To understand and implement database security, user privileges, joins, subqueries, and transaction control in SQL.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes	10	5
Class activity 1	Database Query Evaluation	10	5
Class activity 2	SQL Query Writing Exercises	10	5
Class activity 3	ER Diagram Development	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – VII
COURSE NAME: DATA WRANGLING	COURSE CODE: 26UBDA307
SEMESTER: III	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with essential data wrangling, analysis, and visualization skills for data-driven decision making. This course enables learners to transform raw datasets into interactive visualizations and dashboards, fostering deeper quantitative reasoning for predictive analytics.

COURSE OUTCOME:

1. Describe the concepts of data wrangling, data formats, and their role in analytical workflows.
2. Illustrate data extraction techniques from structured and unstructured sources such as Excel, PDFs, and databases.
3. Examine data cleaning techniques to identify and resolve inconsistencies in real-world datasets.
4. Analyze datasets using exploratory and visualization methods to derive meaningful insights.
5. Evaluate web scraping techniques and assess their applicability for automated data collection.

UNIT I:

(15 HOURS)

INTRODUCTION TO DATA WRANGLING: What Is Data Wrangling? - Importance of Data Wrangling -How is Data Wrangling performed? - Tasks of Data Wrangling-Data Wrangling Tools- Introduction to Python-Python Basics-Data Meant to Be Read by Machines-CSV Data-JSON Data-XML Data.

UNIT II:

(15 HOURS)

WORKING WITH EXCEL FILES AND PDFS: Installing Python Packages-Parsing Excel Files-Parsing Excel Files -Getting Started with Parsing-PDFs and Problem Solving in Python-Programmatic Approaches to PDF Parsing-Converting PDF to Text-Parsing PDFs Using pdf miner-Acquiring and Storing Data-Databases: A Brief Introduction- Relational Databases: MySQL and PostgreSQL-Non-Relational Databases: NoSQL- When to Use a Simple File-Alternative Data Storage.

UNIT III:

(15 HOURS)

DATA CLEANUP: Why Clean Data? Data Clean up Basics-Identifying Values for Data Clean-up-Formatting Data-Finding Outliers and Bad Data-Finding Duplicates-Fuzzy Matching-RegEx Matching-Normalizing and Standardizing the Data-Saving the Data- Determining suitable Data Clean-up Scripting the Clean-up Testing with New Data.

UNIT IV:

(15 HOURS)

DATA EXPLORATION AND ANALYSIS: Exploring Data-Importing Data-Exploring Table Functions-Joining Numerous Datasets-Identifying Correlations-Identifying Outliers- Creating Groupings-Analysing Data-Separating and Focusing the Data Presenting Data-Visualizing the Data-Charts-Time-Related Data-Maps- Interactives -Words- Images, Video, and Illustrations-Presentation Tools-Publishing the Data-Open Source

UNIT V:**(15 HOURS)**

WEB SCRAPING: What to Scrape and How-Analyzing a Web Page-Network/Timeline-Interacting with JavaScript-In-Depth Analysis of a Page- Getting Pages-Reading a Web Page-Reading a Web Page with LXML-XPath-Advanced Web Scraping -Browser-Based Parsing-Screen Reading with Selenium-Screen Reading with Ghost.PySpidering the Web-Building a Spider with Scrapy-Crawling Whole Websites with Scrapy.

PRESCRIBED BOOKS:

1. Principles of Data Wrangling: Practical Techniques for Data Preparation
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython

REFERENCE BOOKS:

1. Data Wrangling with Python: Creating actionable data from raw sources
2. Data Wrangling with Python: Tips and Tools to Make Your Life Easier

E-LEARNING RESOURCES:

1. www.simplilearn.com
2. W2 www.analyticsvidhya.com
3. W3 www.trifacta.com

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBER S	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	2	2	2	3	3
CO 3	3	2	3	2	2
CO 4	2	3	3	3	2
CO 5	3	3	3	2	3
Avg.	2.6	2.6	2.8	2.6	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe the concepts of data wrangling, data formats, and their role in analytical workflows.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Illustrate data extraction techniques from structured and unstructured sources such as Excel, PDFs, and databases.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Examine data cleaning techniques to identify and resolve inconsistencies in real-world datasets.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze datasets using exploratory and visualization methods to derive meaningful insights.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate web scraping techniques and assess their applicability for automated data collection.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Surprise class tests	10	5
Class activity 3	Seminar/ Presentation	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – VIII
COURSE NAME: PRACTICAL-III: BIG DATA MANAGEMENT AND VISUALIZATION	COURSE CODE: 26UBDA308P
SEMESTER: III	MARKS:100
CREDITS: 4	TOTAL HOURS:60
PRACTICAL	

COURSE OBJECTIVE:

To understand the data preparation capabilities of SAS Data Preparation in SAS Viya.

COURSE OUTCOME:

1. Perform data access, import, and preparation using SAS Viya tools.
2. Transform and manage data using SAS Data Studio for analytical tasks.
3. Analyze datasets and derive insights using SAS Visual Analytics.
4. Design and develop interactive reports and dashboards using SAS Visual Analytics.
5. Apply advanced analytics techniques such as forecasting, mapping, and text analysis using SAS Viya.

EXERCISES:

- Accessing, Importing, and Loading Data using SAS Viya
- Preparing data for analytics using SAS Viya tools
- Preparing Data in SAS Data Studio
- Analyzing Data in SAS Visual Analytics
- Designing Reports with SAS Visual Analytics
- Restructuring Data for Geographic Mapping in SAS Data Studio
- Restructuring Data for Forecasting in SAS Data Studio
- Performing Path Analysis in SAS Viya
- Performing Text Analytics in SAS Viya
- Exploring advanced options in SAS Viya

Course Materials

SAS Company Manual

Reference Text

SAS Internal Reference

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	2	3	3	3
CO 2	3	2	3	2	3
CO 3	2	3	3	3	3
CO 4	3	3	2	3	2
CO 5	3	3	3	2	2
AVG	2.6	2.6	2.8	2.6	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	3	3	3
CO 2	3	2	3	2	3
CO 3	2	3	3	3	3
CO 4	3	3	2	3	2
CO 5	3	3	3	2	2
AVG	2.6	2.6	2.8	2.6	2.6

PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Perform data access, import, and preparation using SAS Viya tools.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5
CO2	Transform and manage data using SAS Data Studio for analytical tasks.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5
CO3	Analyze datasets and derive insights using SAS Visual Analytics.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5
CO4	Design and develop interactive reports and dashboards using SAS Visual Analytics.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6
CO5	Apply advanced analytics techniques such as forecasting, mapping, and text analysis using SAS Viya.	PSO1, PSO2, PSO3, PSO4, PSO5	K1, K2, K3, K4, K5, K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Practical Exercise	10	5
Class activity 3	Presentation	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc. DATA ANALYTICS	BATCH: 2026 – 2029
PART: III	COURSE COMPONENT: ALLIED III
COURSE NAME: STATISTICS - II	COURSE CODE: 26UBDA3A3
SEMESTER: III	MARKS:100
CREDITS: 4	TOTAL HOURS: 75
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To understand and use mathematical knowledge in optimal use of resources.

COURSE OUTCOMES:

1. Explain fundamentals of R, its environment, and basic operations
2. Describe R data types, variables, operators, and control structures.
3. Explain functions and data structures in R for data manipulation.
4. Analyze data handling techniques using data frames and file operations in R.
5. Analyze statistical measures and visualization techniques in R.

UNIT I

(15 Hours)

Random Variables and Expectation: Discrete Random Variables, Continuous Random Variables, Definition of Mathematical Expectation. Chapter 9,9.1,9.2, Chapter 10,10.1,10.2

UNIT II

(15 Hours)

Probability: Basic Probability, The Concept of Probability, The Axioms of Probability, Independent events, Addition theorem, Multiplication theorem, Conditional Probability, Bayes' Theorem.

UNIT III

(15 Hours)

Probability Distributions: Binomial Distribution, Poisson distribution, Normal Distribution

UNIT IV

(15 Hours)

Correlation: Meaning, Applications, types of degree of correlation, Scatter diagram, Karl Pearson's Coefficient of Correlation Rank Correlation. **Regression:** Meaning, uses, Difference correlation and regression, linear regression equations.

UNIT V

(15 Hours)

Tests of Hypothesis: Meaning, types, standard hypothesis, null and alternative hypothesis, simple and composite hypothesis, Type I and Type II error, testing of hypothesis: t -test, F-test, Chi square.

PRESCRIBED BOOK:

1. Statistical methods and numerical methods by P.R.Vittal.

REFERENCE BOOKS:

1. New Mathematical statistics - Sanjay Arora & Bansilal (2002), Meerat Publications, New Delhi
2. Fundamentals of Mathematical Statistics - Gupta,S.C. and Kapoor, V.K.(2000): 10/e, Sultan Chand & Sons
3. Basic Statistics - 3/Agarwal .B.L (1996): e ,New Age International(P) Ltd

E-LEARNING RESOURCES:

1. <https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/>
2. <https://mathforums.com/advanced-probability-statistics/>
3. <https://ocw.mit.edu/courses/14-30-introduction-to-statistical-method-in-economics-spring-2006/>
4. <https://www.digimat.in/nptel/courses/video/110107114/L01.html>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1 - 12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13 - 19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20 - 25	10	40
	TOTAL MARKS			100

BREAK UP OF QUESTIONS FOR THEORY

UNITS	SECTION A		SECTION B		SECTION C	
	THEORY	PROBLEM	THEORY	PROBLEM	THEORY	PROBLEM
I	1	1	-	1	-	1
II	1	1	-	1	-	1
III	1	1	-	1	-	1
IV		2		1	-	1
V	1	1	-	1	-	1
Any Unit	-	2	-	2	-	1
TOTAL	4	8		7	-	6
	SECTION A –12		SECTION B - 7		SECTION C – 6	

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	2	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	2.8	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	3	2	3
CO 2	3	2	3	2	2
CO 3	3	3	3	2	3
CO 4	3	3	3	3	2
CO 5	3	2	3	3	3
Ave.	3	2.4	3	2.4	2.6

PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain fundamentals of R, its environment, and basic operations	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Describe R data types, variables, operators, and control structures.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Explain functions and data structures in R for data manipulation.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze data handling techniques using data frames and file operations in R.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Analyze statistical measures and visualization techniques in R.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Workbook/record book/ notebook	Handwritten Class Notes	10	5
Assignment	Any topic related to the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Seminar/Presentation (Content -5 Marks, Presentation – 5 Marks)	10	5
Class activity 3	Surprise Class Test	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: DATA ANALYTICS	BATCH: 2026-2029
PART: IV	COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS III
COURSE NAME: DATA VISUALIZATION	COURSE CODE: 26USKL406
SEMESTER: III	MARKS: 100
CREDITS: 2	TOTAL HOURS: 30
PRACTICAL	

COURSE OBJECTIVE:

To improve the Data Visualization skills of the Students using Tableau and Power BI

COURSE OUTCOMES:

1. Perform data connection and preparation using Tableau and Power BI tools.
2. Create various charts and geographical visualizations for data representation.
3. Develop calculated fields and manipulate data using built-in functions.
4. Design interactive dashboards by integrating multiple visualizations.
5. Evaluate dashboards using data storytelling principles for effective communication.

UNIT I (6 HOURS)

Tableau Foundations: The cycle of analytics, Connecting to Data, Measures & Dimensions, Discrete and Continuous Fields.

UNIT II (6 HOURS)

Working with Data in Tableau: Connecting to data on a file, Connecting to data on a server, Connecting to data in the cloud, Joining Tables.

UNIT III (6 HOURS)

CHARTS: Bar Chart, Line Chart, Pie Chart, Histogram, Scatter Plot. **Geographical Visualization:** Filled maps, Symbol Maps, Density Maps Using Show Me.

UNIT IV (6 HOURS)

Calculated field – Formatting and Dashboard Interface: Working with String Functions, Basic Arithmetic Calculations, Building the Dashboard, Combining multiple visualizations into a dashboard.

UNIT V (6 HOURS)

Power BI for Data Visualization and Dashboard Creation: Introduction to Power BI: Interface, data connection, roles. - Creating Basic Visualizations: Bar charts, line charts, scatter plots. - Building Interactive Dashboards: Design principles, combining visualizations. - Effective Data Storytelling using Power BI.

PRESCRIBED BOOKS:

1. Joshua N.Milligan, “Learning Tableau 2019”, 3rd Edition, Packt.
2. Ryan Sleeper, “Power BI for Data Science”
3. Daniel Murray, “Data Visualization with Power BI”

E-LEARNING RESOURCES:

1. <https://www.tutorialspoint.com/tableau/index.htm>
2. <https://www.tpointtech.com/tableau>
3. <https://www.udemy.com/course/tableau-tutorial-for-beginners/?srsltid=AfmBOooBPcyhxExrhMbFV4a1xmxEh4azDaPsHCRMCIBmBo7VUPRZJo>
4. <https://www.ccslearningacademy.com/power-bi-dashboard/>
5. <https://mammoth.io/blog/how-to-create-a-power-bi-dashboard/>
6. <https://blog.coupler.io/power-bi-tutorial/>

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	3	3
CO 2	3	2	3	3	3
CO 3	3	2	3	3	3
CO 4	3	2	3	3	3
CO 5	3	3	3	3	3
Avg.	3	2.4	2.8	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	2	2
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Avg.	3	3	3	2.8	2.6

PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the basic concepts of Tableau and power BI.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO2	Demonstrate and Discuss working with Data in Tableau.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO3	Demonstrate and Explain drawing different charts using Tableau and Power BI.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO4	Discuss and Demonstrate Geographical Visualization.	PO1 to PO5 PSO1 to PSO5	K1 to K6
CO5	Demonstrate and Explain working with String Functions, Arithmetic Calculations.	PO1 to PO5 PSO1 to PSO5	K1 to K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Surprise Practical test	10	5
Class activity 3	Peer Assessment / Self-Assessment	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: COMMON TO ALL	BATCH: 2026-2029
PART: III	COURSE COMPONENT: SELF-STUDY COURSE
COURSE NAME: INDIAN HERITAGE AND KNOWLEDGE SYSTEM	COURSE CODE: 26USSP401
SEMESTER: III	MARKS:100
CREDITS: 2	TOTAL HOURS:
THEORY	

COURSE DESCRIPTION

Delving into Indian Heritage, this course focuses on South Indian cultures and ancient knowledge like Yoga, Ayurveda, and Siddha, shaping the Nation's identity.

COURSE OBJECTIVES:

Analyzing Indian heritage's impact on national identity, South India's culture, and holistic traditions like Yoga, Ayurveda, Siddha, Jyotish, and Natya Shastra.

COURSE OUTCOMES:

1. Recall the key features of Indian heritage and its role in shaping cultural identity.
2. Identify the artistic, architectural, and literary achievements of South India and other regions.
3. List traditional practices preserved through folklore across India. (K1)
4. Recall the principles of ancient Indian sciences related to physical, mental, and spiritual well-being.
5. Describe the connections between spiritual, medicinal, and artistic elements in Indian heritage.

UNIT I: Introduction to Indian Heritage

- **Concept of Heritage:** Definition, the importance of studying heritage, and its diverse forms.
- **Cultural Landscape of India:** Overview of major cultural zones in India, with a focus on South India.

Key Concepts: Cultural heritage, diversity, tangible heritage (e.g., monuments), intangible heritage (e.g., traditions, practices).

UNIT II: Cultural Tapestry of South India

- **Literature:** The classical Tamil literature of Sangam poetry, the epic Kannada works like the "Kuvempu Ramayana," the Telugu compositions of Annamacharya, and the poetic Malayalam works of Kerala's rich literary tradition.
- **Painting:** The intricate gold leaf work of Tanjore painting, the intricate patterns of Mysore painting, hand-painting or block-printing of Kalamkari.
- **Theatre:** The ancient art form of Koothu and the elaborate dance-dramas of Bhagavata Mela in Tamil Nadu, and the colourful folk theatre of Yakshagana in Karnataka.

- **UNESCO Indian Heritage Sites:** Great Living Chola Temples artistry, Hampi-Virupaksha Temple and the Vijaya Vittala Temple, Mahabalipuram- a treasure trove of Pallava art, Mysore Palace-Indo-Saracenic architecture, Periyar National Park- Western Ghats, Kanchipuram-City of Thousand Temples

UNIT III: Tamil Nadu Folklores

- **Origins and Significance:** Historical background of Tamil Nadu folklore and its cultural significance.
 - **Folk Dances:** Exploration of traditional Tamil folk dances like Karakattam, Kolattam, and Kummi.
 - **Folk Music:** Overview of folk music traditions in Tamil Nadu, including Parai Attam and Villu Paatu.
 - **Rituals and Festivals:** Understanding the role of folklore in Tamil Nadu's rituals and festivals- Pongal and Jallikattu.
- Key Concepts:** Karakattam, Kolattam, Parai Attam, Villu Paatu, Tamil folk tales, cultural rituals.

UNIT IV: Unveiling the Knowledge Systems

- **Cultural Landscape of India:** Overview of major cultural zones in India, with a focus on South India.
 - **Yoga:** Exploring the various aspects of Yoga - its philosophy, Eight Limbs, practices (e.g., Asanas, Pranayama), and benefits for physical and mental well-being.
 - **Ayurveda:** Understanding the core principles of Ayurveda - its focus on holistic health, diagnosis, and treatment methods.
- Key Concepts:** Yoga philosophy, Asanas, Pranayama, Tridosha theory (Ayurveda), Doshas (Vata, Pitta, Kapha), Panchakarma, herbal medicine, Ayurvedic lifestyle.

UNIT V: Siddha Tradition and Other Knowledge Systems

- **Siddha Tradition:** Origins, philosophy, medicinal practices, and spiritual aspects.
 - **Other Important Knowledge Systems:** Jyotish Shastra (Indian astrology), Natya Shastra (Treatise on performing arts).
- Key Concepts:** Siddha literature, alchemy, and spirituality in Siddha tradition. Pancha Boothas (Siddha), herbal remedies, Planetary influences, elements of classical Indian dance and music, and aesthetics in Natya Shastra.

Question Paper Pattern : MCQ

PROGRAMME: COMMON TO ALL	BATCH: 2026-2029
PART: IV	COURSE COMPONENT: SELF-STUDY
COURSE NAME: CONTEMPORARY WORLD AND SUSTAINABLE DEVELOPMENT	COURSE CODE: 26USSP402
SEMESTER: III	MARKS:100
CREDITS: 2	TOTAL HOURS: SELF-STUDY
THEORY	

COURSE OVERVIEW:

Delving into global dynamics, this course highlights Asia and India's pivotal role in achieving global sustainability objectives.

COURSE OBJECTIVES:

Exploring global challenges, Asian politics, conflict resolution, sustainability, and India's SDG efforts, with a focus on Tamil Nadu.

COURSE OUTCOMES:

1. Identify the key actors and institutions that shape the contemporary world order.
2. Describe the political, economic, and security challenges in major Asian regions.
3. Recall the causes and human impact of recent wars and conflicts.
4. Describe the principles of sustainable development and their relevance at local, national, and global levels.
5. Identify India's contributions to the SDGs through Tamil Nadu's programs.

UNIT I: Global Governance and Institutions

- **State & Non-State Actors:** Definition, types (nation-states, failed states), functions.
Key Actors: International states, Intergovernmental organizations (IGOs), nongovernmental organizations (NGOs), multinational corporations (MNCs).
- **United Nations (UN):** Structure, key organs (General Assembly, Security Council), functions, WB, & others.
Key Concepts: United Nations General Assembly, United Nations Security Council.
- **Regional Organizations:** European Union (EU), African Union (AU), North Atlantic Treaty Organization (NATO)
Key Concepts: European Union Commission, African Union Commission, North Atlantic Treaty Organization.
- **International Law and Treaties:** Significance, role in addressing global challenges.
Key Concepts: International Court of Justice, International Criminal Court, Geneva Conventions.

UNIT II: Contemporary Asia

Major Geographical Regions

- **Middle East:** Characterized by rich oil reserves, Complex political dynamics, and ongoing conflicts.
Key countries: Iran, Iraq, Israel, Saudi Arabia, Syria, Turkey
- **Southeast Asia:** Rapid economic growth, Challenges- maritime security and environmental degradation.
Key countries: Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam
- **Far East:** Major economic powerhouses and Potential flashpoints.
Key countries: China, Japan, North Korea, South Korea
- **Rise of China:** Political-South China Sea, Territorial disputes and Competition for Resources. Economic- China's Belt and Road Initiative (BRI)
- **Major Economic Centers:** **Singapore-** Global financial hub, **Hong Kong-** Special Administrative Region of China, **United Arab Emirates (UAE)-** Diversified economy driven by oil and gas, tourism, and trade.

Regional Organizations:

- Association of Southeast Asian Nations (ASEAN)
- South Asian Association for Regional Cooperation (SAARC)
- Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)
- Asia-Pacific Economic Cooperation (APEC)
- Shanghai Cooperation Organization (SCO)

UNIT III: Recent Wars of the World

- **Syrian Civil War (2011-present):** Bashar al-Assad regime, Syrian opposition groups, ISIS.
Key Concepts: Origins of the conflict, humanitarian crisis, foreign intervention, refugee crisis.
- **Yemeni Civil War (2015-present):** Houthi rebels, Yemeni government, Saudi-led coalition.
Key Concepts: Proxy war dynamics, humanitarian crisis, role of Iran and Saudi Arabia, UN peace efforts.
- **Ukraine Conflict (2014-present):** Ukrainian government, Russian-backed separatists, Russia.
Key Concepts: Annexation of Crimea, Donbas region conflict, Minsk agreements, NATO-Russia tensions.
- **Ethiopia Civil War (2020-present):** Ethiopian government, Tigray People's Liberation Front (TPLF), Eritrean forces.
Key Concepts: Tigray conflict, humanitarian crisis, regional implications, efforts for ceasefire and peace talks.
- **Nagorno-Karabakh War (2020):** Armenia, Azerbaijan, Russia.
Key Concepts: Conflict over Nagorno-Karabakh region, ceasefire agreement, role of Turkey, peace negotiations.
- **Myanmar Civil War (2021-present):** Myanmar military (Tatmadaw), ethnic armed groups, and Civilian resistance.
Key Concepts: Coup aftermath, Rohingya crisis, ethnic conflicts, ASEAN mediation efforts.

UNIT IV: Sustainable Development Goals

- **Definition of Sustainable Development:** Balancing economic, social, and environmental needs.
Key Concepts: United Nations Development Programme (UNDP), World Wildlife Fund (WWF), Sustainable Development Solutions Network (SDSN).
- **UN Sustainable Development Goals (SDGs):** Overview, targets.
Key Concepts: United Nations, national governments, NGOs, private sector.
- **Challenges and Opportunities:** Achieving sustainability, global cooperation.
Key Concepts: United Nations, national governments, civil society organizations, multinational corporations.

UNIT V: India's Role in Achieving Sustainable Development Goals (SDGs) with Tamil Nadu Initiatives

Addressing Basic Needs:

- **Goal 1: No Poverty**
 - National Rural Employment Guarantee Act (NREGA)
 - Kalaigiar Kanchi Thalaiyalar Scheme
 - Ungal Thozhil Udhayanam (UTOY)
- **Goal 2: Zero Hunger**
 - National Food Security Act (NFSA)
 - Nutritious Noon Meal Programme
 - Annadhanam Scheme
 - Amma Unavagam
- **Goal 3: Good Health and Well-being**
 - National Health Mission (NHM)
 - Health Insurance of Tamil Nadu
 - Chief Minister's Comprehensive Health Insurance Scheme
 - Maruthuva Mitri
 - Amma Mini Clinics

Ensuring Essential Services:

- **Goal 4: Quality Education**
 - Sarva Shiksha Abhiyan (SSA)
 - Rashtriya Madhyamik Shiksha Abhiyan (RMSA)
 - Namakkal District Library Scheme
 - Pudhumai Penn Scheme under Higher Education Assurance Scheme (HEAS)
 - Free Coaching for Competitive Exams
- **Goal 6: Clean Water and Sanitation**
 - Swachh Bharat Mission (Clean India Mission)
 - National Rural Drinking Water Programme (NRDWP)
 - Jal Jeevan Mission Tamil Nadu
 - Namakku Naathey Scheme
 - Kudimaramathu Scheme
- **Goal 7: Affordable and Clean Energy**
 - National Solar Mission
 - Tamil Nadu Solar Energy Policy
 - Green House Scheme

Building Sustainable Communities:

- **Goal 11: Sustainable Cities and Communities**
 - Smart Cities Mission
 - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
 - Adi Dravidar Housing Scheme
- **Goal 13: Climate Action**
 - National Action Plan on Climate Change (NAPCC)
 - International Solar Alliance
 - Tamil Nadu Wind Energy Policy 2019
- **Goal 17: Partnerships for the Goals**
 - Development Assistance Programmes (DAPs)
 - International Development Cooperation (IDC)

Question Paper Pattern: MCQ

SEMESTER IV

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – IX
COURSE NAME: DATA ANALYTICS USING R PROGRAMMING	COURSE CODE: 26UBDA309
SEMESTER: IV	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with the foundational knowledge and skills to effectively use R programming for data manipulation, analysis, and visualization.

COURSE OUTCOMES:

1. Explain the fundamentals of R programming, its environment, and basic input/output operations
2. Apply R data types, operators, control structures, and loops to solve computational problems.
3. Develop functions and manipulate strings, vectors, lists, matrices, arrays, and factors
4. Analyze and manage data using data frames and external files (CSV, Excel) in R
5. Analyze and visualize data using descriptive statistics and graphical techniques in R.

UNIT I

(15 HOURS)

Introduction to R: What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed. packages(), package Description(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and –inf.

UNIT II

(15 HOURS)

R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – **R - Variables:** Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - **R Operators:** Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - **R Decision Making:** if statement, if – else statement, if – else if statement, switch statement – **R Loops:** repeat loop, while loop, for loop - Loop control statement: break statement, next statement.

UNIT III

(15 HOURS)

R-Function: Function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values-- **R-Strings** – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - **R Vectors** – Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting - **R List** - Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - **R Matrices:** Accessing Elements of a Matrix, Matrix Computations: Addition,

subtraction, Multiplication and Division. **R Arrays:** Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements. **R Factors** –creating factors, generating factor levels gl().

UNIT IV

(15 HOURS)

Data Frames: Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame. **Expand Data Frame:** Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast(). **Loading and handling Data in R:** Getting and Setting the Working Directory – getwd(), setwd(), dir(). **R-CSV Files** - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – R -Excel File – Reading the Excel file.

UNIT V

(15 HOURS)

Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode - Standard Deviation – Correlation - Spotting Problems in Data with Visualization: visually Checking Distributions for a single Variable - **R – Pie Charts:** Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart – **R Histograms** – Density Plot - **R – Bar Charts:** Bar Chart Labels, Title and Colors.

PRESCRIBED BOOKS:

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017, ISBN : 978-93-5260-455-5.

REFERENCE BOOKS:

1. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260- 524-8.
2. Tutorials Point (I) simply easy learning, Online Tutorial Library (2018), R Programming, Retrieved from https://www.tutorialspoint.com/r/r_tutorial.pdf.
3. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8

E-LEARNING RESOURCES:

1. <https://www.datacamp.com/courses/free-introduction-to-r>
2. <https://www.khanacademy.org/math/statistics-probability>

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	2	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	3	2
CO 4	3	3	3	2	2
CO 5	3	3	3	3	3
Avg.	3	2.8	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	3	2
CO 4	3	2	3	3	2
CO 5	3	3	3	2	3
Avg.	3	2.8	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain the fundamentals of R programming, its environment, and basic input/output operations	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Apply R data types, operators, control structures, and loops to solve computational problems.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Develop functions and manipulate strings, vectors, lists, matrices, arrays, and factors	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze and manage data using data frames and external files (CSV, Excel) in R	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Analyze and visualize data using descriptive statistics and graphical techniques in R.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Mini Project	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – X
COURSE NAME: DATA MINING	COURSE CODE: 26UBDA310
SEMESTER: IV	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To provide a comprehensive understanding of data mining concepts, techniques, and applications including classification, clustering, association rules, and emerging trends.

COURSE OUTCOMES:

1. Describe data mining concepts, data types, and preprocessing techniques.
2. Classify classification techniques including regression, Bayesian, and decision trees.
3. Illustrate association rule mining and Apriori algorithm.
4. Analyze clustering techniques and outlier detection methods.
5. Evaluate data mining applications and emerging trends.

UNIT I (15 Hours)

Introduction: Introduction to Data Mining: Origins of Data Mining - Data Mining Tasks - Data: Attributes and Measurement - Types of Data sets - Data Mining Issues - Data Quality - Data Preprocessing - Measures of Similarity and Distance Measures - Proximity measures.

UNIT II (15 Hours)

Classification: Introduction – Statistical Based Algorithms: Regression – Bayesian Classifications – Distance Based Algorithms: K Nearest Neighbors - Decision Tree Based Algorithms

UNIT III (15 Hours)

Associations: Association Rules - Introduction - Large Itemsets – Apriori Algorithm – Sampling algorithm – Advanced Association Rule Techniques: Generalized Association Rule – Multi Level Association Rules – Quantitative Association Rules

UNIT IV (15 Hours)

Clustering: Similarity and Distance Measures – Outliers – Hierarchical Algorithms : Agglomerative – Divisive Clustering – K means Clustering – Nearest Neighbor Algorithm.

UNIT V (15 Hours)

Applications and Trends : Web Mining – Web Content Mining – Structure and Usage Mining – Spatial Mining – Time Series and Sequence Mining – Temporal Association Rules.

PRESCRIBED BOOKS:

1. Vipin Kumar, Pang-Ning Tan Michael Steinbach (2006), "Introduction to Data Mining", Addison Wesley.
2. Margaret H. Dunham, (2003), "Data Mining : Introductory and Advanced Topics", (1st Edn.), Pearson Education

REFERENCE BOOKS:

1. Arun.K.Pujari, (2013)"Data Mining Techniques", (3rd Edn.), University Press (India) Limited
2. Jiawei Han and Micheline Kamber, (2006), "Data Mining Concepts and Techniques", (2nd Edn.), Morgan Kaufmann Publication.

E-LEARNING RESOURCES:

1. https://www.vssut.ac.in/lecture_notes/lecture1428550844.pdf
2. <https://www.spiceworks.com/tech/big-data/articles/what-is-data-mining>
3. <https://web.pdx.edu/~nauna/week7b-neuralnetwork.pdf>
4. <https://slideplayer.com/slide/5069586>
5. <https://www.srividyaengg.ac.in/coursematerial/CSE/104661.pdf>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	3	2	3
CO 3	3	2	3	2	2
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Avg.	3	2.8	3	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.4

PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe data mining concepts, data types, and preprocessing techniques.	PSO1, PSO2, PSO3, PSO4, PSO5	K1 to K5
CO2	Classify classification techniques including regression, Bayesian, and decision trees.	PSO1, PSO2, PSO3, PSO4, PSO5	K1 to K5
CO3	Illustrate association rule mining and Apriori algorithm.	PSO1, PSO2, PSO3, PSO4, PSO5	K1 to K5
CO4	Analyze clustering techniques and outlier detection methods.	PSO1, PSO2, PSO3, PSO4, PSO5	K1 to K5
CO5	Evaluate data mining applications and emerging trends.	PSO1, PSO2, PSO3, PSO4, PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Seminar	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XI
COURSE NAME: NoSQL DATABASES	COURSE CODE: 26UBDA311
SEMESTER: IV	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To provide students with comprehensive knowledge of NoSQL database types, data modeling techniques, storage architectures, and indexing strategies to effectively design and manage modern data-driven applications.

COURSE OUTCOMES:

1. Summarize NoSQL concepts, characteristics, and types of non-relational databases.
2. Classify CRUD operations and interaction with NoSQL data stores.
3. Illustrate NoSQL storage architectures and data models.
4. Analyze querying techniques and data handling in various NoSQL databases.
5. Evaluate indexing and data organization methods in NoSQL systems for efficient data retrieval.

UNIT - I: (15 HOURS)

Introduction to NoSQL: Definition And Introduction, Sorted Ordered Column-Oriented Stores, Key/Value Stores, Document Databases, Graph Databases, Examining Two Simple Examples, Location Preferences Store, Car Make And Model Database, Working With Language Bindings.

UNIT - II: (15 HOURS)

Interacting with NoSQL: If NoSql Then What, Language Bindings For NoSQL Data Stores, Performing Crud Operations, Creating Records, Accessing Data, Updating And Deleting Data.

UNIT - III: (15 HOURS)

NoSQL Storage Architecture: Working With Column-Oriented Databases, Hbase Distributed Storage Architecture, Document Store Internals, Understanding Key/Value Stores In Memcached And Redis, Eventually Consistent Non-Relational Databases.

UNIT - IV: (15 HOURS)

NoSQL Stores: Similarities Between Sql And MongoDB Query Features, Accessing Data From Column Oriented Databases Like Hbase, Querying Redis Data Stores, Changing Document Databases, Schema Evolution In Column-Oriented Databases, Hbase Data Import And Export, Data Evolution In Key/Value Stores.

UNIT - V: (15 HOURS)

Indexing and Ordering Data Sets : Essential Concepts Behind A Database Index, Indexing And Ordering In MongoDB, Creating and Using Indexes In MongoDB, Indexing And Ordering In Couchdb, Indexing In Apache Cassandra.

PRESCRIBED BOOKS:

1. Shashank Tiwari, *Professional NoSQL*, Wrox Press, Wiley, 2011, ISBN: 978-0-470-94224-6
2. Pramod Sadalage and Martin Fowler, *NoSQL Distilled*, Addison-Wesley Professional, 2012.

REFERENCE BOOKS:

1. Dan McCreary and Ann Kelly, *Making Sense of NoSQL*, Manning Publications, 2013.
2. Gaurav Vaish, *Getting Started with NoSQL*, Packt Publishing, 2013.

E-LEARNING RESOURCES:

1. <https://www.scylladb.com/learn/nosql/nosql-database-resources/>
2. <https://www.acte.in/nosql-database-learning-guide>
3. <https://www.mongodb.com/resources/basics/databases/nosql-explained>

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
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C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
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Avg.	3	2.8	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	2	2	3
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.6	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Summarize NoSQL concepts, characteristics, and types of non-relational databases.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Classify CRUD operations and interaction with NoSQL data stores.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate NoSQL storage architectures and data models.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze querying techniques and data handling in various NoSQL databases.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate indexing and data organization methods in NoSQL systems for efficient data retrieval.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
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Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Seminar	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XII
COURSE NAME: PRACTICAL - IV – APPLIED STATISTICAL MODELLING	COURSE CODE: 26UBDA312P
SEMESTER: IV	MARKS:100
CREDITS: 4	TOTAL HOURS:60
PRACTICAL	

COURSE OBJECTIVE:

To understand the statistical background for machine learning using SAS Viya.

COURSE OUTCOME:

1. Perform statistical analysis and explore datasets using SAS Viya tools.
2. Develop explanatory and predictive models using linear and logistic regression techniques.
3. Apply clustering and segmentation techniques to group input variables.
4. Construct and analyze decision tree models for data-driven insights.
5. Evaluate and compare machine learning models and generate score code for deployment.

EXERCISES:

- Exploring Statistics and Machine Learning
- Explanatory Modeling Using Linear Regression in SAS Viya
- Predictive Modeling Using Logistic Regression in SAS Viya
- Exploring Statistical Foundations of Machine Learning
- Perform statistical analysis of data of any size
- Create segments, or clusters, of input variables
- Perform decision tree modelling
- Perform stratified model fitting
- Compare models
- Generate score code

Course Materials Required

SAS Company manual

Reference Text

SAS Internal Reference

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	3	2	3
CO 3	3	3	3	2	2
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Avg.	3	3	3	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	3
CO 3	3	3	3	2	2
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Avg.	3	3	3	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO1	Perform statistical analysis and explore datasets using SAS Viya tools.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Develop explanatory and predictive models using linear and logistic regression techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Apply clustering and segmentation techniques to group input variables.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Construct and analyze decision tree models for data-driven insights.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate and compare machine learning models and generate score code for deployment.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Practical Exercise	10	5
Class activity 3	Debugging tasks	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc. (DATA ANALYTICS)	BATCH:2026-2029
PART: III	COURSE COMPONENT: ALLIED IV
COURSE NAME: TIME SERIES ANALYSIS AND FORECASTING	COURSE CODE: 26UBDA3A4
SEMESTER: IV	MARKS:100
CREDITS: 4	TOTAL HOURS: 90
THEORY AND PROBLEMS	

COURSE OBJECTIVE:

To equip students with various forecasting techniques and knowledge on modern statistical methods for analyzing time series data.

COURSE OUTCOMES:

1. Implement the fundamental ideas of component of time series.
2. Apply the concept Measurement of trend: Free hand or Graphic method, Method of Semi-average.
3. Analysis the Measuring trend by logarithms.
4. Create measurement of irregular variation Calculation of correlation in Time series.
5. Evaluate Some simple time series models, Models with trend and seasonality and a General approach to time series modelling.

UNIT I (15 Hours)

Time Series and its Components: Introduction, Utility of time series analysis, Components of time series-Secular trend, seasonal variations, cyclical variations, irregular variations - Preliminary adjustments before analyzing time series.

UNIT II (15 Hours)

Measurement of trend: Free hand or Graphic method, Method of Semi- average, Method of Moving average, Method of Least squares.

UNIT III (15 Hours)

Measuring trend by logarithms: Exponential trends - Growth curves Shifting the trend origin - Conversion of Annual Trend Values to Monthly Values - Method of Seasonal Variation - Method of Simple Averages - Ratio to Trend.

UNIT IV (15 Hours)

Link relative method: Measurement of Cyclical Variations Residual Method Reference cycle analysis or the National Bureau Method - Measurement of irregular variation Calculation of correlation in Time series.

UNIT V (15 Hours)

Time series models: Introduction, Examples of time series, Objectives of time series analysis, Some simple time series models-Definition, Models with trend and seasonality- A General approach to time series modelling.

PRESCRIBED BOOK:

1. S.P. Gupta (2008) Statistical methods, Sultan Chand & Sons.
2. Peter. J. Brockwell & Richard. A. Davis, Introduction to Time Series and Forecasting, Second Edition, Springer

REFERENCE BOOKS:

1. Rami Krispin(2019). Hands-on Time Series Analysis with R, Packt publishing Ltd.

E-LEARNING RESOURCES:

1. <https://towardsdatascience.com/the-complete-guide-to-time-series-analysis-and-forecasting-70d476bfe775>
2. <https://www.altexsoft.com/blog/business/time-series-analysis-and-forecasting-novel-business-perspectives/>
3. <https://www.infoworld.com/article/3622246/an-introduction-to-time-series-forecasting.html>
4. https://www.sigmaxl.com/ARIMAForecast.shtml?gclid=EAIaIQobChMI0tPwxOfy-AIVQ5NmAh3Tqwo1EAMYASAAEgKLavD_BwE
5. <https://naarm.org.in/VirtualLearning/vlc/echapters/anntimeseries.pdf>

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	1	1
II	2	1	1
III	2	1	1
IV	2	1	1
V	2	1	1
Any Unit	2	2	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	2	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	2	3
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.6	2.8

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	2	3	2	3
CO 3	3	3	3	2	2
CO 4	3	2	3	3	2
CO 5	3	3	3	3	3
Avg.	3	2.6	3	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs & PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	To understand the various components of time series	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	To examine the different measurement techniques used in time series analysis.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	To study the simple time series models and its applications.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	To acquire knowledge on stationary models with auto correlation functions for estimating trends	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	To investigate time series models for forecasting time	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	10	5
Workbook / record book / notebook	Maintenance of class notebook	10	
Class activity 1	Develop the Problem solving skill (Time Completion -3 Marks, Total number of question solved - 7Marks)	10	5
Class activity 2	Quiz with MCQ	10	5
Class activity 3	Surprise Class Test	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: COMMON TO B.C.A, B.Sc (CS), B.Sc (IT), B.Sc (DA) , BSC CS with AI	BATCH: 2026 - 2029
PART: IV	COURSE COMPONENT: INDIAN KNOWLEDGE SYSTEM
COURSE NAME:INDIAN KNOWLEDGE SYSTEM WITH ARTIFICIAL INTELLIGENCE	COURSE CODE: 26UIKS409
SEMESTER: IV	MARKS:100
CREDITS: 1	TOTAL HOURS: 15
THEORY	

COURSE OBJECTIVE:

Provide a concise understanding of Indian Knowledge Systems and AI, focusing on foundations, ethics, and interdisciplinary applications.

COURSE OUTCOMES:

1. Explain Indian Knowledge Systems and their relevance to modern technology.
2. Analyze AI concepts and compare them with Indian logical frameworks.
3. Evaluate the integration of IKS and AI in real-world applications.

UNIT I Introduction to Indian Traditional Knowledge (5 Hours)

Concept, scope, and significance of Indian Traditional Knowledge (ITK) Concept and scope of Indian Knowledge Systems - Sources of IKS: Vedas, Upanishads, Puranas, Manuscripts, inscriptions, oral traditions - Major knowledge domains in IKS : Ayurveda, Yoga, Siddha, Mathematics, Astronomy, Architecture, Linguistics - Indian scientific and logical traditions: Nyaya, Vaisheshika, Sankhya - Relevance of IKS in the modern digital and technological era.

UNIT II Artificial Intelligence – Concepts and Indian Perspectives (5 Hours)

Introduction to Artificial Intelligence: Definition, history, and applications - Core AI concepts: Machine Learning, Deep Learning, Natural Language Processing (NLP) - Data, knowledge representation, and reasoning - Indian logical frameworks and cognition: Comparison of Indian logic with modern AI reasoning - Ethical AI and Indian philosophical perspectives: Dharma, ethics, and responsible AI.

UNIT III Integration of IKS and AI Applications (5 Hours)

Digitization of Indian Knowledge using AI: Manuscript digitization, OCR for Indian scripts, Knowledge extraction. AI applications in traditional knowledge systems: AI in Ayurveda diagnosis and drug discovery, AI in Yoga and wellness analytics, AI in agriculture and traditional farming knowledge. Knowledge databases and digital repositories: Traditional Knowledge Digital Library (TKDL) – role and importance. Challenges and future scope of IKS with AI: Preservation, authenticity, bias, and ethics, Research and innovation opportunities.

RECOMMENDED TEXTBOOKS

1. Kapoor, Kapil, Indian Knowledge Systems, D.K. Printworld, 2017.
2. Russell, Stuart and Norvig, Peter, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, New Delhi, 2021.
3. Chatterjee, Satischandra and Datta, Dhirendramohan, An Introduction to Indian Philosophy, University of Calcutta Press, Kolkata, 2016.

REFERENCE BOOKS

1. Plofker, Kim, Mathematics in India, Princeton University Press, Princeton, 2009.
2. Vagbhata, Ashtanga Hridayam (Selected English Translations), Chaukhambha Publications, Varanasi, 2014.
3. Bishop, Christopher M., Pattern Recognition and Machine Learning, Springer, New York, 2006.
4. Brachman, Ronald J. and Levesque, Hector J., Knowledge Representation and Reasoning, Morgan Kaufmann Publishers, San Francisco, 2004.
5. CSIR, Government of India, Traditional Knowledge Digital Library (TKDL): Documentation and Reports, Council of Scientific and Industrial Research, New Delhi, 2018.

E-LEARNING RESOURCES

1. <https://iks.aicte-india.org/>
2. https://www.youtube.com/@IKS_Media_MoE
3. <https://www.classcentral.com/course/swayam-indian-knowledge-system-292677>
4. <https://www.ignca.gov.in/>
5. <https://artsandculture.google.com/partner?hl=en>

SOFT SKILLS: COMMON TO ALL	BATCH: 2026 - 2029
PART: IV	COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS IV
COURSE NAME: RESUME WRITING AND INTERVIEW SKILLS	COURSE CODE: 26USKL405
SEMESTER: II	MARKS:100
CREDITS: 2	TOTAL HOURS: 30
THEORY	

COURSE OBJECTIVE:

To equip the students to acquire the relevant skills for better employability.

COURSE OUTCOMES:

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

1. Prepare professional resumes, CVs, biodata and covering letters suitable for job applications.
2. Apprise the fundamental concepts, purpose and characteristics of job interviews.
3. Identify various types of interviews and their expectations in recruitment processes.
4. Apply interview techniques and strategies to effectively handle different stages of the interview process.
5. Demonstrate employability skills such as communication, personality development, time management, and presentation skills for career readiness.

UNIT I: Preparing Biodata / CV / Resume (6 Hours)

Essential characteristics of a job application – Difference between Biodata, CV, Resume – Covering letter – Tips to draft an application

UNIT II: Introduction to Interview Skills (6 Hours)

Definition – Meaning – Concept of interview – Purpose – Objectives of interview – Characteristic features of job interviews

UNIT III: Types of Interview (6 Hours)

Traditional one-to-one job interview – Panel interview – Behavioural interview – Group interview – Phone interview – Preliminary interview – Patterned interview – Depth interview – Stress interview – Exit interview – Interview through tele and video conferencing

UNIT IV: Interviews – Techniques and Strategies (6 Hours)

Preparing for the interview process – Before the interview – During the interview – After the interview – Tips to ace an interview – Commonly asked interview questions – Do's and Don'ts – Reasons for rejection.

UNIT V: Leveraging Employability Skills (6 Hours)

Personality Development – Organizational skills – Time Management – Stress Management – Effective Communication Skills – Reasoning Ability – Verbal Ability – Group Discussion – Technical skills – Presentation skills

RECOMMENDED TEXTBOOKS

1. Monipally, Matthukutty M. (2017) *Business Communication: From Principles to Practice*
2. Peter, Francis. (2012) *Soft Skills and Professional Communication*. New Delhi: Tata McGraw Hill.

REFERENCE BOOKS

1. Higgins, Jessica JD (2018) *10 Skills for Effective Business Communication: Practical Strategies from the World's Greatest Leaders*
2. Nicholas, Sonji (2023) *Interviewing: Preparation, Types, Techniques, and Questions*, Pressbooks
3. Storey, James (2016) *The Art of The Interview: The Perfect Answers to Every Interview Question*

E-LEARNING RESOURCES

1. <https://careermobilityoffice.cs.ny.gov/cmo/documents/Resume%20&%20Interviewing%20Handout.pdf>
2. <https://edu.gcfglobal.org/en/interviewingskills/interview-etiquette/1/>
3. <https://findjobhub.com/en/types-of-interviews>
4. <https://egyankosh.ac.in/bitstream/123456789/23411/1/Unit-2.pdf>
5. https://bharatskills.gov.in/pdf/E_Books/CTS/ES/English/ES_Part_1_62%20hour_English.pdf
6. https://bharatskills.gov.in/pdf/E_Books/CTS/ES/English/ES_Part2_58hour_English.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	10
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	20
C	Answer any two (Internal (Choice))	14-15	10	20
	Internal & Viva Voce		50	50

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL			
SECTION A – 7		SECTION B – 6	SECTION C - 4

SEMESTER V

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE –XIII
COURSE NAME: PYTHON FOR DATA EXPLORATION AND ANALYSIS	COURSE CODE: 26UBDA313
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To develop skills in data analysis using Python for data manipulation, cleaning, visualization, and exploration.

COURSE OUTCOMES:

1. Describe data analysis concepts and the role of Python libraries in data processing workflows.
2. Explain NumPy and Pandas data structures and their operations for data manipulation.
3. Illustrate data loading, cleaning, and transformation techniques using Python concepts.
4. Analyze data wrangling methods including merging, reshaping, and aggregation operations.
5. Evaluate grouped data operations and interpret the insights derived from aggregated datasets.

UNIT I:

(15 HOURS)

Introduction to Data Analysis: Kinds of Data, Essential Python Libraries: NumPy, Pandas, Matplotlib, IPython and Jupyter, SciPy, scikit-learn, statsmodels.

NumPy Basics: The NumPy ndarray: Creating ndarrays, Data types for ndarrays, Arithmetic with NumPy Arrays, Basic indexing, slicing, Boolean indexing, Fancy indexing, transposing arrays and swapping axes, Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays.

UNIT II:

(15 HOURS)

Getting Started With Pandas: Introduction to pandas Data Structures: Series, Data frame, Index Objects.

Essential Functionality: Reindexing, Dropping Entries from an Axis, Indexing, Selection, Filtering, Integer Indexes, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels, Summarizing and Computing Descriptive Statistics

UNIT III:

(15 HOURS)

Data Loading, Storage, and File Formats: Reading and Writing Data in Text Format: csv files, json files.

Data Cleaning and Preparation: Handling Missing Data: filtering out missing data, filling in missing data; Data Transformation: Removing duplicates, transforming data using a function or mapping, replacing values, renaming axis indexes, String Manipulation: string object methods.

UNIT IV: (15 HOURS)

Data Wrangling: Join, Combine, and Reshape, Hierarchical Indexing, Combining and Merging Datasets, Reshaping with hierarchical indexing.

Data Aggregation and Group Operations: GroupBy Mechanics, Iterating over groups, selecting a column or subset of columns, Data Aggregation.

UNIT V: (15 HOURS)

Visualization and Matplotlib: Basic functions of matplotlib-Simple Line Plot, Scatter Plot-Density and Contour Plots- Histograms, Binning and Density – Customizing Plot Legends, Colour Bars-Three-Dimensional Plotting in Matplotlib.

PRESCRIBED BOOKS:

1. Wes McKinney “Python for Data Analysis” O’reilly Publications Second edition
2. Jake VanderPlas, J. (2016). Python Data Science Handbook: Essential Tools for Working with Data. Second edition, O’reilly (SPD).

REFERENCE BOOKS:

1. Michael Milton, A Brain Friendly Guide: Head First Data Analysis, Shroff Publications and Distributors.
2. Bharti Motwani, Data Analytics using Python, Wiley publisher.
3. Anil Maheshwari, Data Analytics, McGraw Hill Education.

E-LEARNING RESOURCES:

1. <https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.DataFrame.mode.html>
2. <https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.crosstab.html>
3. <https://www.datacamp.com/community/tutorials/wordcloud-python>
4. <https://www.tutorialspoint.com/create-word-cloud-using-python>
5. <https://www.geeksforgeeks.org/generating-word-cloud-python/>
6. <https://www.geeksforgeeks.org/contingency-table-in-python/>
7. <https://www.tutorialspoint.com/contingency-table-in-python>

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	2
CO 2	3	3	2	3	2
CO 3	3	3	3	2	3
CO 4	3	3	3	2	3
CO 5	3	3	3	3	3
Avg.	3	3	2.6	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	2	2
CO 4	3	2	3	3	2
CO 5	3	3	3	3	3
Avg.	3	2.8	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Identify key Python libraries used in data analysis.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain the use of NumPy and pandas for data handling.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Apply data cleaning and manipulation techniques using pandas.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze datasets using grouping, aggregation, and reshaping methods.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Create visualizations and reports using Python tools.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment.	10	5
Workbook/record book/ notebook	Maintenance of course notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	10	5
Class activity 3	Surprise test activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XIV
COURSE NAME: ARTIFICIAL INTELLIGENCE	COURSE CODE: 26UBDA314
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

Provide a concise understanding of Indian Knowledge Systems and AI, focusing on foundations, ethics, and interdisciplinary applications.

COURSE OUTCOMES:

1. Describe AI concepts, problem characteristics, and search techniques.
2. Explain heuristic search methods and constraint-based problem solving.
3. Illustrate knowledge representation using logic and predicates.
4. Analyze rule-based systems and reasoning methods in AI.
5. Evaluate uncertainty handling using probabilistic and statistical reasoning techniques.

UNIT I

(15 Hours)

Problems and Search: What is Artificial Intelligence, The AI Problems, and Underlying Assumption, what is an AI Technique. Problems, Problems Spaces, and Search: Defining the problem as a state space search, production systems, problems characteristics, issues in the design of search programs.

UNIT II

(15 Hours)

Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

UNIT III

(15 Hours)

Knowledge Representation Issues: Representations and Mapping, Approaches to Knowledge Representation, The frame problem. Using Predicate Logic: Representing simple facts in logic, Representing Is a relationships, predicates, Resolution.

UNIT IV

(15 Hours)

Representing Knowledge using Rules: Procedural Vs Declarative knowledge, Logic Programming, Forward Vs Backward Reasoning, Matching, Control Knowledge.

UNIT V

(15 Hours)

Symbolic Reasoning under Uncertainty: Introduction to Non-monotonic Reasoning, Logics for Non-monotonic Reasoning, Implementation issues, Augmenting a Problem solver, implementation: DFS, BFS.

Statistical Reasoning: Probability and Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Networks, Dempster-Shafer Theory.

PRESCRIBED BOOKS:

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed.,2009

REFERENCE BOOKS:

Russell, S., & Norvig, P. Artificial intelligence: a modern approach. Third Edition. Pearson new International edition. 2014.

E-LEARNING RESOURCES:

1. NPTEL & MOOC courses titled Artificial Intelligence and Expert Systems
2. <https://nptel.ac.in/courses/106106140/>
3. <https://nptel.ac.in/courses/106106126/>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	3	3	2
CO 3	3	2	3	3	2
CO 4	3	3	3	2	3
CO 5	3	3	3	2	3
Avg.	3	2.8	3	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe AI concepts, problem characteristics, and search techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain heuristic search methods and constraint-based problem solving.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate knowledge representation using logic and predicates.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze rule-based systems and reasoning methods in AI.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate uncertainty handling using probabilistic and statistical reasoning techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment	10	5
Workbook / record book / notebook	Maintenance of class notes	10	5
Class activity 1	Surprise class test.	10	5
Class activity 2	Group discussion	10	5
Class activity 3	Quiz with MCQ	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XV
COURSE NAME: PRACTICAL – V - APPLIED MACHINE LEARNING AND FORECASTING	COURSE CODE: 26UBDA315P
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:60
PRACTICAL	

COURSE OBJECTIVE:

To understand the theoretical foundation for techniques associated with supervised machine learning models.

COURSE OUTCOME:

1. Describe AI concepts, problem characteristics, and search techniques.
 2. Explain heuristic search methods and constraint-based problem solving.
 3. Illustrate knowledge representation using logic and predicates.
 4. Analyze rule-based systems and reasoning methods in AI.
- Evaluate uncertainty handling using probabilistic and statistical reasoning techniques.

EXERCISES:

1. Data Preparation using SAS Model Studio
2. Decision Trees and Ensembles of Trees in SAS Model Studio
3. Neural Networks in SAS Model Studio
4. Additional Topics in SAS Model Studio
5. Data Visualization using SAS Model Studio
6. Pipeline Essentials in SAS Model Studio
7. Hierarchical Forecasting in SAS Model Studio
8. Post-forecasting Functionality in SAS Model Studio
9. Improving Modeling in SAS Model Studio
10. In-Line Code Access in SAS Model Studio

COURSE MATERIALS

SAS Company Manual

REFERENCE TEXT

SAS Internal Reference

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	3	3	2
CO 3	3	3	3	3	3
CO 4	3	2	3	2	2
CO 5	3	3	3	2	3
Avg.	3	2.8	3	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	3
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe AI concepts, problem characteristics, and search techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain heuristic search methods and constraint-based problem solving.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate knowledge representation using logic and predicates.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze rule-based systems and reasoning methods in AI.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate uncertainty handling using probabilistic and statistical reasoning techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination -valuation based on lab performance during practical session for 90 minutes	50	10
Model Examination	Practical examination based on coding skill and lab performance for 180 minutes	100	10
Assignment	Submission of practical programming exercises	10	5
Workbook/record book/ notebook	Maintenance of practical record book	10	5
Class activity 1	Tool-based practical activity	10	5
Class activity 2	Quiz with MCQ	10	5
Class activity 3	Error correction exercise	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – I
COURSE NAME: GENERATIVE AI AND PROMPT ENGINEERING	COURSE CODE: 26UBDA3E1
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To enable students to effectively interact with Large Language Models (LLMs) using prompt engineering techniques and apply AI solutions responsibly in real-world applications.

COURSE OUTCOME:

1. Summarize the concepts, capabilities, and applications of large language models.
2. Explain the fundamentals of prompt engineering and key components of prompts.
3. Apply prompt design techniques for tasks such as summarization, classification, and question answering.
4. Analyze advanced prompting strategies including zero-shot, few-shot, and chain-of-thought techniques.
5. Evaluate LLM parameters and prompt configurations for optimizing outputs in practical scenarios.

UNIT I: (15 Hours)

Introduction to Large Language Models

Evolution of Generative AI – Foundation Models-LLMs - Nature and Capabilities – Applications of LLMs - Different LLM Models and their limitations - Hallucinations and Bias in LLMs – Responsible AI and Ethical Considerations - Real-world applications of LLMs.

UNIT II: (15 Hours)

Foundations of Prompt Engineering

Prompt Engineering – Role in LLM Communication – Basics of Prompts – Elements of Prompts: Instruction, Context, Input Data and Output Indicator – Prompt Templates – Role Prompting – Persona Prompting – Output Formatting Techniques – Best Practices in Prompt Design.

UNIT III: (15 Hours)

Prompt Design Techniques

Basics of Prompt Design – Examples of Prompt Design – Text Summarization Prompts – Information Extraction Prompts – Question Answering Prompts – Text Classification Prompts – Conversation Prompts – Code Generation Prompts – Reasoning Prompts – SQL Query Generation Prompts – Excel Formula Generation Prompts – Data Cleaning Prompts – Data Visualization Prompts – Analytics Report Generation Prompts.

UNIT IV: (15 Hours)

Advanced Prompt Engineering Techniques

Prompt Designing Techniques – Zero-Shot Prompting – Few-Shot Prompting – Chain-of-Thought Prompting – Self-Consistency Prompting – ReAct Prompting – Structured Output Prompting – Tree-of-Thought Prompting (Overview) – General Knowledge Prompts.

UNIT V:**(15 Hours)****Prompt Engineering in Open AI Playground**

LLM Settings: Temperature – Max Length – Stop Sequences – Top-P – Frequency Penalty – Presence Penalty – Best Of – Prompt Evaluation – AI Agents (Introduction) – Retrieval Augmented Generation (RAG) (Introduction) – Vector Databases (Basics) – Text Classification – Code Generation – Creativity – Information Extraction – Mathematics – Question Answering.

Practical Component

List of Exercises (Open Large Language Models through Ollama can be utilized)

1. Explore Open AI Playground
2. Explore Prompt design elements and techniques
3. Explore and implement Text classification Prompts
4. Explore and implement a Few Shot Prompts
5. Explore and implement Text Summarization Prompts
6. Explore and implement General Knowledge Prompts
7. Implement Information Extraction Prompts
8. Implement Question Answering Prompts

PRESCRIBED BOOKS:

1. John. Ibrahim, Art Of Asking Chatgpt For High-Quality Answers: A Complete Guide to Prompt Engineering Techniques, Nzunda Technologies Limited, 2023.

REFERENCE BOOKS:

1. James Phoenix and Mike Taylor, Prompt Engineering for Generative AI, O'Reilly Media, 2024.
2. Jay Alamar and Maarten Grootendorst, Hands-On Large Language Models, O'Reilly Media, 2024.

E-LEARNING RESOURCES

1. <https://www.promptingguide.ai/>
2. https://platform.openai.com/docs/guides/prompt-engineering?utm_source=chatgpt.com
3. https://platform.openai.com/docs?utm_source=chatgpt.com
4. https://platform.openai.com/examples?utm_source=chatgpt.com
5. https://learnprompting.org?utm_source=chatgpt.com
6. https://platform.openai.com/docs/guides/prompt-engineering?utm_source=chatgpt.com
7. https://platform.openai.com/docs/api-reference/chat/create?utm_source=chatgpt.com

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	3	1	2
IV	3	1	1
V	2	1	1
TOTAL	12	7	6
SECTION A – 12		SECTION B – 7	SECTION C - 6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	3	2	3
CO 2	3	2	3	2	2
CO 3	3	3	3	2	3
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Avg.	3	2.6	3	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	3	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.4	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Summarize the concepts, capabilities, and applications of large language models.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain the fundamentals of prompt engineering and key components of prompts.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Apply prompt design techniques for tasks such as summarization, classification, and question answering.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze advanced prompting strategies including zero-shot, few-shot, and chain-of-thought techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate LLM parameters and prompt configurations for optimizing outputs in practical scenarios.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment	10	5
Workbook / record book / notebook	Maintenance of class notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	10	5
Class activity 3	Puzzle	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE- I Interdisciplinary Elective
COURSE NAME: CLOUD COMPUTING	COURSE CODE: 26UBDA3E4
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To provide students with a comprehensive understanding of cloud computing concepts, architectures, services, security, and distributed systems for designing and managing modern cloud-based applications.

COURSE OUTCOME:

1. Summarize cloud computing concepts, characteristics, and deployment models.
2. Explain cloud service models, architectures, and emerging computing trends.
3. Illustrate cloud services and platforms with real-world examples.
4. Analyze risks, security mechanisms, and SOA principles in cloud environments.
5. Evaluate distributed computing models and communication mechanisms in cloud systems.

UNIT I (15 Hours)

Introduction to Cloud Computing: Cloud Computing Basics – History of Cloud Computing – Importance of Cloud Computing in the Current Era – Characteristics of Cloud Computing – What Cloud Computing Really Is? **Move to Cloud Computing:** Pros and Cons of Cloud Computing – Nature of the Cloud – Technologies in Cloud Computing – Migrating into the Cloud. **Types of Cloud:** Public and Private Cloud – Cloud Infrastructure – Cloud Application Architecture.

UNIT II (15 Hours)

Trends in Computing: IT Maturity Analysis – Technology Trends to Watch – **Cloud Service Models:** Cloud Service Models – Cloud Deployment Models – Cloud Computing Services: Pros and Cons. **Cloud Computing Technology:** Cloud Lifecycle Model – Phases of SDLC – Case Study: Oracle Cloud Management - Role of Cloud Modelling and Architecture. **Cloud Computing Logical Architecture:** Examples – Types – Problems – Service Architecture – Cloud Computing Models. **Cloud System Architecture:** Example Reference Diagram – Cloud Computing Deployment Models – Types of Cloud Deployment Model.

UNIT III (15 Hours)

Cloud Computing Elements: The Cloud – Value of Cloud Computing – Cloud Do's and Don'ts – Cloud Computing: Legal Implication – Overview of Amazon Web Services. Web-based Application – Web Services – Infrastructure Services – On demand Computing – Web Application Framework. **Cloud Services:** Cloud Types and Services – Software as a Service – Platform as a Services – Infrastructure as a Service – Other Clouds Services.

UNIT IV (15 Hours)

Risks in Cloud Computing: Introduction – Risk Management – Cloud Impact – Enterprise wide Risk Management – Types of Risks in Cloud Computing. **Data Security in Cloud:** Introduction – Current State – Homo Sapiens and Digital Information – Cloud, Digital Persona and Data Security – Content Level Security. **Cloud Security Services:** Objectives – Confidentiality, Integrity and Availability – Security Authorization Challenges in the Cloud – Secure Cloud Software Requirements – Secure Cloud Software Testing. **SOA Foundations:** Introduction – Defining SOA

Communication – SOA Operation – Defining BPM.

UNIT V

(15 Hours)

Introduction: Definition-Relation to Computer System Components – Motivation – Message Passing systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; **A Model of Distributed Computations:** A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.

PRESCRIBED BOOKS:

1. A.Srinivasan and J.Suresh, “Cloud Computing – A Practical Approach for Learning and Implementation”, Pearson India Publications 2014.
2. Kshemkalyani Ajay D, Mukesh Singhal, “Distributed Computing: Principles, Algorithms and Systems”, Cambridge Press, 2011.

REFERENCE BOOKS:

1. Rajkumar Buyya, James Broberg, Andrzej, “Cloud Computing: Principles and Paradigms”, Wiley India Publications 2011.
2. Arshdeep Bahga and Vijay Madisetti, “Cloud Computing – A Hands on Approach”, Universities Press (India) Pvt Ltd. 2014.

E-LEARNING RESOURCES:

1. <https://nptel.ac.in/courses/106105167/>
2. <https://docs.aws.amazon.com/accounts/latest/reference/welcome-first-time-user.html>

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	3
CO 2	3	2	3	2	2
CO 3	3	2	3	3	3
CO 4	3	3	3	3	2
CO 5	3	3	3	2	3
Avg.	3	2.6	2.8	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	3
CO 2	3	3	3	2	2
CO 3	3	2	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
Avg.	3	2.8	2.6	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Summarize cloud computing concepts, characteristics, and deployment models	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain cloud service models, architectures, and emerging computing trends.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate cloud services and platforms with real-world examples.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze risks, security mechanisms, and SOA principles in cloud environments.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate distributed computing models and communication mechanisms in cloud systems.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment	10	5
Workbook/record book/ notebook	Maintenance of class notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	10	5
Class activity 3	Puzzle	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – I
COURSE NAME: BUSINESS ANALYTICS	COURSE CODE: 26UBDA3E5
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with the skills to analyze data, apply probability and statistical methods, and make informed decisions under uncertainty using quantitative modeling techniques.

COURSE OUTCOMES:

1. Interpret data modelling concepts and types of data used in analysis.
2. Summarize descriptive statistics and data visualization methods.
3. Examine relationships among variables using correlation and probability concepts.
4. Investigate probability distributions and decision-making under uncertainty.
5. Evaluate decision models, sampling methods, and statistical inference techniques.

UNIT I (15 Hours)

Introduction - The Methods-The Software- Modeling and Models: Graphical Models, Algebraic Models, Spreadsheet Models, A Seven-Step Modeling Process. Exploring Data: Describing the Distribution of a Single Variable: Data Sets, Variables, and Observations, Types of Data.

UNIT II (15 Hours)

Descriptive Measures for Categorical and Numerical variables, Charts for Numerical Variables, Time Series Data, Outliers and Missing Values. Finding Relationships among Variables: Relationships among Categorical Variables and a Numerical Variable, Scatterplots.

UNIT III (15 Hours)

Correlation and Covariance, Pivot Tables, Probability and Decision making under Uncertainty: Probability Essentials, Rule of Complements-Addition Rule- Conditional Probability and the Multiplication Rule - Probability Distribution of a Single Random Variable.

UNIT IV (15 Hours)

Conditional Mean and Variance- Normal, Binomial, Poisson, and Exponential Distributions - Decision Making under Uncertainty- Elements of Decision Analysis-Payoff Tables- Possible Decision Criteria - Expected Monetary Value (EMV).

UNIT V (15 Hours)

Decision Trees- The Precision Tree Add-In-Bayes' Rule. Multistage Decision Problems and the Value of Information- Sampling and Sampling Distributions- Sampling Terminology- Methods for Selecting Random Samples- Introduction to Estimation- Confidence Interval Estimation - Hypothesis Testing.

PRESCRIBED BOOKS:

1. Business Analytics: Data Analysis and Decision Making, Fifth Edition, S. Christian Albright and Wayne L. Winston Cengage Learning, US.

REFERENCES BOOKS:

1. Business Analysis For Dummies® Published by: John Wiley & Sons, Inc. 111 River Street Hoboken, NJ 07030-5774, www.wiley.com.

E-LEARNING RESOURCES:

1. https://mrcet.com/downloads/digital_notes/AE/III/Business%20Analytics.pdf
2. <https://www.analyticsvidhya.com/blog/2021/06/exploratory-data-analysis-using-data-visualization-techniques/>
3. https://www.southampton.ac.uk/~sks/teach/2018_math1024.pdf
4. <https://egyankosh.ac.in/bitstream/123456789/89090/1/Block-2.pdf>
5. [https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/MACHINE%20LEARNING\(R17A0534\). Pdf](https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/MACHINE%20LEARNING(R17A0534).Pdf)

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

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C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	2	3	2
CO 3	3	3	3	3	2
CO 4	3	3	3	2	3
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
Avg.	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Interpret data modeling concepts and types of data used in analysis.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Summarize descriptive statistics and data visualization methods.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Examine relationships among variables using correlataion and probability concepts.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Investigate probability distributions and decision-making under uncertainty.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate decision models, sampling methods, and statistical inference techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment	10	5
Workbook/record book/ notebook	Maintenance of class notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	10	5
Class activity 3	Puzzle	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

ELECTIVE – II

PROGRAMME: B.C.A, B.Sc (CS), B.Sc (IT), B.Sc (DA) ,BSC CS with AI	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE - II
COURSE NAME: PRACTICAL VI – PLATFORM ENGINEERING	COURSE CODE: 26UBCA3E2P
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75
PRACTICAL	

COURSE OBJECTIVE:

To provide students with the knowledge and practical skills required to administer, secure, virtualize, monitor, and manage modern network, server, and cloud infrastructures in enterprise environments.

COURSE OUTCOMES:

1. Explain networking, server infrastructure, storage systems, and operating system fundamentals for enterprise environments.
2. Apply Windows Server administration techniques for system configuration, storage management, and performance monitoring.
3. Analyze Active Directory services and security mechanisms for efficient domain management.
4. Apply Linux administration and virtualization techniques for managing systems and virtual environments.
5. Analyze cloud services, backup strategies, and infrastructure monitoring tools for effective IT management.

Unit I: Networking and Server Infrastructure (15 Hours)

Introduction to Networking Devices and LAN/WAN - IPv4 and IPv6. Routers and Switches Overview. Datacenter Overview and Server Form Factors - Server Management Portals (IPMI/iLO/iDrac) and Events - Introduction to Storage: NAS, DAS, SAN - RAID Levels and Comparisons (Fibre Channel, iSCSI, FCoE) - Operating Systems Overview (Server & Client) - Domain vs. Workgroup - File Systems: FAT, NTFS, ReFS, EXT3, EXT4 - Installing and Managing OS (Windows Server, Linux) - Firewall Fundamentals (Hardware/Software)

Unit II: Windows Server Administration (15 Hours)

Windows Server Core Installation, Upgrades, Patch Management & Migrations - Storage Spaces, iSNS, DCB, and MPIO - Data Deduplication and Disk Management - High Availability, Fail-over Clustering, iSCSI, NLB - Deployment Images using MDT and WSUS - PowerShell DSC and Monitoring Tools - Performance Monitoring and Event Logs

Unit III: Active Directory & Security (15 Hours)

AD DS, DNS Server Role, Zones, and Transfers - AD DS Replication and Sites - Group Policy Management and Templates - Securing Domain Controllers and Accounts - Audit Authentication and Managed Service Accounts - Certificate Services (CAs, Templates, Revocation, Recovery) - AD FS, AD RMS, and Smart Cards - Backup & Restore of Active Directory

Unit IV: Linux Server Administration and Virtualization (15 Hours)

RHEL / Cent OS Overview, Boot Process and GRUB2 - Filesystem Hierarchy, Shell Environment, Text Editors - User and Group Management, File Permissions, ACLs - RPM, YUM, Dependency Management, Patching , System Logging, Snapshots, Backup/Restore.

Virtualization: Hypervisors, Hyper-V, VMware vSphere/vCenter - Configuring VMs, Networking, Storage, HA/DRS - vMotion, Templates, Resource Pools, dvSwitches

Unit V: Cloud, Backup and Monitoring (15 Hours)

Cloud Computing Fundamentals, Deployment Models - SaaS, PaaS, IaaS and Key Providers (AWS, Azure, GCP) - Cloud Security, Navigation, and Resource Management- AWS EC2, S3, VPC, IAM; Azure VM, Storage, Networking. Backup Technologies: Disk, Tape, VM Backups, Restoration, Deduplication, Troubleshooting. Infra Monitoring Tools Overview : Nagios.

PRESCRIBED BOOKS:

1. Mustafa Toroman , "Hands-On Cloud Administration in Azure" , Packt, 2020.
2. Sara Perrott, "Windows Server 2019 & PowerShell All-in-One For Dummies", Wiley, 2021.
3. Sander van Vugt, "Red Hat RHCSA 8 Cert Guide: EX200", Pearson IT Certification, 2021.
4. Nick Marshall, "Mastering VMware vSphere 7", Wiley, 2021.

LIST OF PROGRAMS :

Windows Server

1. **Windows Server Installation & Configuration**
 - Install Windows Server (Core & GUI).
 - Patching
2. **Install & Configure Active Directory Domain Services (AD DS)**
 - Promote server to DC, join clients to the domain.
 - Enforce password policy, restrict drives, desktop configuration.
3. **Implement Failover Cluster and Network Load Balancing (NLB)**
 - Build a high-availability cluster for file share service.
 - Cluster Troubleshooting – High Availability, Fail-Over
4. **PowerShell Scripting for Automation Tasks**
 - Write scripts for backup, log rotation, monitoring, Patching, Checking stale records

Linux Server

5. Install Linux (RHEL/CentOS) and Set Up Users & ACLs

- Partitioning, user creation, chmod, setfacl, etc.
- Patching
- Configuring Network interfaces – NMTUI/NMCLI
- Server Troubleshooting – Boot, Package, Services, Discover services

6. Service Monitoring and Patch Management using YUM

- Enable repo, install updates, monitor with top, systemctl.

7. Create and Manage VMs in VMware / Hyper-V

- Install hypervisor, create VM, snapshot, clone, Delete

Cloud Computing

8. Launch and Access EC2 Instances on AWS

- Key pair creation, EC2 instance launch, inbound rules, remote access.

9. Configure S3 Bucket and Lifecycle Policies

- Create bucket, enable versioning, lifecycle rule to archive/delete.

10. Create and Manage VPC with Subnets and Security Groups (AWS)

- Design private/public subnets, attach IGW, and route tables.

11. Azure VM Deployment and Storage Blob Configuration

- Create VM, configure VNet, attach a blob container for backup.

12. IAM Role and Policy Creation in AWS

- Create custom IAM roles and attach to EC2 instance for access control.

13. Configure Cloud Backup using AWS/Azure Services

- Snapshot of EC2 instance / Azure VM backup vault.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	3	3
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PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
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CO 2	3	3	2	3	2
CO 3	3	3	3	3	2
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
AVG	3	3	2.4	3	2.4

PO-PSO-CO QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Explain networking, server infrastructure, storage systems, and operating system fundamentals for enterprise environments	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 2	Apply Windows Server administration techniques for system configuration, storage management, and performance monitoring	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 3	Analyze Active Directory services and security mechanisms for efficient domain management	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 4	Apply Linux administration and virtualization techniques for managing systems and virtual environments	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 5	Analyze cloud services, backup strategies, and infrastructure monitoring tools for effective IT management	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination for 90 minutes	50	10
Model Examination	Practical examination for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Practical Exercise	10	5
Class activity 3	Debugging tasks	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – II
COURSE NAME: ETHICS IN DATA SCIENCE	COURSE CODE: 26UBDA3E6
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75

COURSE OBJECTIVE:

To teach how to anonymize various types of data and to ensure the privacy and security of enterprise data.

COURSE OUTCOMES:

1. Describe key ethical principles and identify challenges in responsible data collection and use.
2. Explain legal frameworks and regulations governing data privacy and protection.
3. Examine ethical reasoning in addressing issues of algorithmic bias, fairness, and transparency
4. Analyze real-world case studies involving data misuse, breaches, and ethical failures.
5. Evaluate data governance policies and design ethically responsible analytics systems.

UNIT I

(15 HOURS)

Introduction to Data Science Ethics: The Rise of Data Science (Ethics) – Why Care? – Right and Wrong Data Science – Data Science Ethics Equilibrium – The FAT Flow Framework for Data Science Ethics – Of Oaths and Checklists – Doing Good Data Science – The Five Cs.

UNIT II

(15 HOURS)

Ethics in Data Analytics: Ethics Review; Business Ethics; Elements of Big Data Ethics; Research Ethics; Ethical Guidelines and Codes; Legal Frameworks; Regional (US, Europe, Asia) Differences; Artificial Intelligence (AI); Algorithmic Bias; Analyzing Behavioral Big Data: Methodological, Practical, Ethical, and Moral Issues – The 4R's: Reuse, Repurposing, (Re)Combining, Reanalysis – Ethical Issues in Sports and Healthcare; Wearable Device Data – Ethical Issues in HR and Talent Analytics.

UNIT III

(15 HOURS)

Ethical Data Gathering & Ethical Data Preprocessing: Ethical Data Gathering: Privacy as a Human Right – Regulations – Privacy Mechanisms – Cautionary Tales: Backdoors and Messaging Encryption. Ethical Data Preprocessing: Defining and Measuring Privacy – Cautionary Tales: Re-identification – Defining and Selecting Variables – Cautionary Tale: Pregnancy and Face Recognition – Fair Relabelling – Cautionary Tale: Biased Language.

UNIT IV

(15 HOURS)

Ethical Modeling: Privacy-Preserving Data Mining – Discrimination-Aware Modelling – Cautionary Tale: Predicting Recidivism and Redlining – Comprehensible Models and Explainable AI – Cautionary Tale: Explaining Webpage Classifications – Including Ethical Preferences: Self-Driving Car – Case Studies.

UNIT V**(15 HOURS)**

Ethical Evaluation & Ethical Deployment: Ethical Evaluation: Ethical Measurement – Ethical Interpretation of the Results – Ethical Reporting – Cautionary Tale of Diederik Stapel. Ethical Deployment: Access to the System – Different Treatments for Different Predictions – Cautionary Tales: Censoring Search and Face Recognition – Honesty and Deep Fake – Governance – Unintended Consequences.

PRESCRIBED BOOKS:

1. Data Science Ethics: Concepts, Techniques, and Cautionary Tales, Oxford University Press, USA (24 Jun 2022).
2. Ethics and Data Science by Mike Loukides, Hilary Mason, DJ Patil, released July 2018, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492043881.

REFERENCE BOOKS:

1. Ethics of Data and Analytics: Concepts and Cases by Kirsten Martin, 1st Edition, Copyright 2022.
2. Ethical Practice of Statistics and Data Science by Rochelle Tractenberg, Hardback, Paperback, ebook, pp. 684, Publication date: 25th October 2022.
3. Things About Ethics Everyone in Data Science Should Know by Bill Franks, released August 2020, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492072669.

WEB REFERENCES:

1. <https://mdsr-book.github.io/mdsr2e/ch-ethics.html>
2. https://onlinecourses.nptel.ac.in/noc21_hs55/preview
3. <https://www.geeksforgeeks.org/ethics-in-data-science-and-proper-privacy-and-usage-of-data/>
4. <https://github.com/microsoft/Data-Science-For-Beginners/blob/main/1-Introduction/02-ethics/README.md>
5. <https://www.youtube.com/watch?v=krIVOb23EH8>
6. <https://www.youtube.com/watch?v=xiZRpwznHmE>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	2	3	3	3
CO 2	2	2	3	3	2
CO 3	2	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	2	3	3	3
Avg.	2.4	2.4	3	3	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	3	3	3
CO 2	2	2	3	3	2
CO 3	2	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	2	3	3	3
Avg.	2.4	2.4	3	3	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe key ethical principles and identify challenges in responsible data collection and use.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain legal frameworks and regulations governing data privacy and protection.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Examine ethical reasoning in addressing issues of algorithmic bias, fairness, and transparency	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze real-world case studies involving data misuse, breaches, and ethical failures.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate data governance policies and design ethically responsible analytics systems.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment	10	5
Workbook/record book/ notebook	Maintenance of class notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	10	5
Class activity 3	Puzzle	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – II
COURSE NAME: COMPUTER NETWORKS	COURSE CODE: 26UBDA3E7
SEMESTER: V	MARKS:100
CREDITS: 4	TOTAL HOURS:75

COURSE OBJECTIVE:

To provide students with a strong foundation in computer networking concepts, network protocols, communication models, and network services required for designing and managing modern communication networks.

COURSE OUTCOMES:

1. Describe network fundamentals, models, transmission modes, and physical layer concepts.
2. Explain LAN technologies, data link layer protocols, and error control mechanisms.
3. Illustrate network devices, IP addressing, and network layer protocols
4. Examine transport layer protocols and congestion control techniques.
5. Evaluate application layer protocols and their roles in network communication.

UNIT – I:

(15 HOURS)

Introduction to Network:- Definition, Applications, line configuration, Network topologies, Transmission mode, Types of Networks (LAN, WAN, MAN), Protocols, Network models: The OSI model. TCP/IP Protocol Suite. Physical Layer: Signals -Analog signals, Digital signals, Transmission media - Guided & UnGuided.

UNIT – II:

(15 HOURS)

Network LAN Technologies: Ethernet, Fast Ethernet, Gigabit Ethernet, and Wireless LAN's. Data Link Layer: Error Detection and correction - Types of Errors, Error Detection, Error correction. Data link Protocols -Stop-and-wait ARQ, Go-back-n ARQ, Automatic Repeat Request (ARQ).

UNIT – III:

(15 HOURS)

Network Devices: Modern, Hub, Switch, Router, Repeaters, bridges, Gateway.

Network Layer: Internetwork Protocol (IP), Addressing (Classes, Dotted-decimal notation, Sample Internet), Subnet mask, Network Layer Protocols- ARP, IPv4 and IPv6.

UNIT – IV:

(15 HOURS)

Transport Layer: TCP protocol, UDP protocol, Process-to-Process delivery, Congestion: Congestion control, congestion avoidance, congestion discarding, Quality of Service (QOS).

UNIT – V:

(15 HOURS)

Application Layer: Domain Name System (DNS) - domain name space, distribution of name space, DNS in the Internet, SMTP, SNMP, FTP, POP3, HTTP, WWW.

PRESCRIBED BOOKS:

1. Data Communication and Computer Networks by Behrouz A. Forouzoun, Published by Thomas casson, MC GRAW HILL 2nd Edition.

REFERENCE BOOKS:

1. A S. Tanenbaum, “Computer Networks”, Prentice-Hall of India 2008, 4th Edition.
2. Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition
3. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.
4. F. Halsall, “Data Communications, Computer Networks and Open Systems”, Pearson Education 2008.

E-LEARNING RESOURCES:

1. <https://www.geeksforgeeks.org/basics-computer-networking/>
2. https://en.wikipedia.org/wiki/Computer_network
3. https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm
4. <https://www.javatpoint.com/computer-network-tutorial>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	2
CO 2	3	3	2	2	2
CO 3	3	2	3	2	2
CO 4	3	3	3	3	3
CO 5	3	2	3	3	3
Avg.	3	2.6	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	2
CO 2	3	3	2	2	2
CO 3	3	2	3	2	2
CO 4	3	3	2	3	3
CO 5	3	3	3	3	3
Avg.	3	2.8	2.6	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe network fundamentals, models, transmission modes, and physical layer concepts.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain LAN technologies, data link layer protocols, and error control mechanisms.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate network devices, IP addressing, and network layer protocols.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Examine transport layer protocols and congestion control techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate application layer protocols and their roles in network communication.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Submission of topic-based written assignment	10	5
Workbook/record book/ notebook	Maintenance of class notes	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Presentation	10	5
Class activity 3	Puzzle	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: ALL UG	BATCH: 2024 - 2027
PART: IV	COURSE COMPONENT: LIFE SKILLS II
COURSE NAME: ENVIRONMENTAL STUDIES	COURSE CODE: 26UEVS401
SEMESTER: V	MARKS:100
CREDITS: 2	TOTAL HOURS: 30
THEORY	

COURSE OBJECTIVE:

To make students realize the importance of Environmental Studies.

COURSE OUTCOMES:

1. Define the scope and importance of environmental studies and its relevance to sustainable development.
2. Identify different types of natural resources and classify them as renewable, non-renewable, and potentially renewable.
3. Describe the concept of biodiversity and list major conservation strategies.
4. Identify the causes and types of environmental pollution and recall common prevention measures.
5. List basic disaster management plans for common environmental hazards and recall preparedness measures at community level.

UNIT-1:

The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.

UNIT-2:

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

- a) Forest resources: Use and Over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water dams benefits and problems.
- c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.
- f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. - Role of an individual in conservation of natural resources. - Equitable use of resources for sustainable lifestyles.

UNIT-3:

Ecosystems - Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem.

Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem: -

- a. Forest ecosystem
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT-4:

Biodiversity and its Conservation

- Introduction-Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-5: Environmental Pollution: Definition - Causes, effects and control measures of: -

- a. Air pollution
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

- Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

UNIT-6: Social Issues and the Environment

- From Unsustainable to Sustainable development.
- Urban problems related to energy. - Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

UNIT-7: Human Population and the Environment

- Population growth, variation among nations.
- Population explosion-Family welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of information Technology in Environment and human health.
- Case Studies. UNIT-8: Field Work (Practical).
- Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. SIX MONTHS COMPULSORY CO

UNIT-8: Field Work (Practical).

- Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH: 2026 - 2029
PART: IV	COURSE COMPONENT: INTERNSHIP
COURSE NAME: INTERNSHIP	COURSE CODE: 26UINT401
SEMESTER: V	MARKS:100
CREDITS: 2	TOTAL HOURS: 30
INTERNSHIP	

COURSE OBJECTIVES:

To expose students to real-world data analytics practices and corporate work environments, enabling them to apply theoretical knowledge in practical, professional settings.

COURSE OUTCOMES:

1. Apply academic knowledge to real-world IT problems.
2. Develop domain knowledge, multidisciplinary, and professional skills.
3. Gain industry exposure through practical experience.
4. Practice ethical and sustainable computing approaches.
5. Enhance employability skills.

INTERNSHIP PROGRAM GUIDELINES

- Internships must offer a structured learning experience in the field of data analytics, preferably in roles involving data analysis, visualization, business intelligence, or data management.
- Each internship must be supervised by a qualified professional with experience in data science, analytics, or related fields, providing feedback and necessary tools for effective learning.
- Students must complete 21 working days of internship during summer, second year vacation in a recognized organization related to software, data analytics, or technology.
- Students are required to submit a detailed report and present their internship experience, reflecting on projects handled, tools used (e.g., Excel, SQL, Python, Tableau), and insights gained.

SEMESTER VI

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XVI
COURSE NAME: MACHINE LEARNING FOR DATA ANALYTICS	COURSE CODE: 26UBDA316
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with the fundamental concepts and techniques of machine learning, enabling them to build, evaluate, and apply predictive and data-driven models for real-world problem solving.

COURSE OUTCOMES:

1. Describe the types, applications, and processes of machine learning.
2. Explain data preprocessing, feature engineering, and model evaluation methods
3. Illustrate supervised learning algorithms for classification and regression tasks.
4. Examine clustering and association rule techniques for data analysis.
5. Evaluate neural networks and deep learning models for predictive tasks.

UNIT I (15 Hours)

Introduction to Machine Learning: Introduction-Types of machine learning: Supervised, Unsupervised and reinforcement-Applications of machine learning-Machine learning activities-Basic types of data in machine learning-Exploring structure of Data-Data quality and remediation-Data pre-processing.

UNIT II (15 Hours)

Feature Engineering, Modeling and Evaluation: Introduction to Feature Engineering-Feature transformation-Feature subset selection-Selecting a model-Training a model: Hold out method-K fold cross validation method-Model representation and Interpretability-Evaluating performance of the model-Improving model performance.

UNIT III (15 Hours)

Supervised Learning-Classification, Regression: Introduction to Supervised Learning-Classification Model-Classification learning steps: K-nearest neighbour-Decision trees- Random Forest Model-Support vector machines-**Regression:** Introduction-Simple linear regression, Multiple linear regression, Logistic Regression.

UNIT IV (15 Hours)

Unsupervised Learning-Clustering, Association Rules: Introduction-Supervised Vs Unsupervised Learning-Applications of unsupervised learning-Clustering: Types of Clustering-Partitioning methods-K-Medoids-Hierarchical Clustering-DBSCAN-Finding patterns using association rule: Association rule-Apriori algorithm.

UNIT V (15 Hours)

Neural Networks and Deep Learning: Introduction-Exploring the artificial neuron-Types of activation functions-architectures of neural networks-Learning process in ANN-Backpropagation. Deep Learning: Shortcomings of feature selection-vanilla deep neural network issues-Filters and feature maps-Convolutional layer.

PRESCRIBED BOOKS:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, (2019), "Machine Learning", (1st Edition), Pearson Publishers (Unit I-IV).
2. Nikhil Buduma, (2017), "Fundamentals of Deep learning: Designing Next generation Machine Intelligence algorithm", (1st Edition), O'Reilly Media (Unit V).

REFERENCE BOOKS:

1. Tom M. Mitchell, (1997), "Machine Learning", (1st Edn.), Tata McGraw-Hill.
2. Suresh Samudrala, (2019), "Demystifying Machine Learning, Neural Networks and Deep learning", (1st Edn.), Notion Press.
3. Christopher M. Bishop, (2007), "Pattern Recognition and Machine Learning", (1st Edn.), Springer.

E-LEARNING RESOURCES:

1. <https://www.geeksforgeeks.org/machine-learning>.
2. <https://www.tpointtech.com/machine-learning>.
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview.
4. https://www.sas.com/en_in/insights/analytics/neural-networks.html.
5. <https://www.simplilearn.com/tutorials/machine-learning-tutorial/logistic-regression-in-python>.

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	1-12	3	30
B	Answer any 5 out of 7 Questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 Questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	3	1	2
IV	3	1	1
V	2	1	1
TOTAL	12	7	6
SECTION A – 12		SECTION B – 7	SECTION C - 6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	2	4
CO 5	3	3	3	3	3
Avg.	3	3	3	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	2
CO 3	3	3	3	3	3
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Describe the types, applications, and processes of machine learning.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain data preprocessing, feature engineering, and model evaluation methods	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Illustrate supervised learning algorithms for classification and regression tasks.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Examine clustering and association rule techniques for data analysis.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate neural networks and deep learning models for predictive tasks.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes maintained throughout the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Peer/Self-Assessment	10	5
Class activity 3	Group activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XVII
COURSE NAME: BIG DATA ANALYTICS	COURSE CODE: 26UBDA317
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To provide students with the knowledge and practical skills required to process, store, manage, and analyze large-scale data using Hadoop, MapReduce, and NoSQL technologies.

COURSE OUTCOMES:

1. Interpret big data concepts, Hadoop ecosystem, and distributed computing architecture.
2. Explain MapReduce framework and data processing techniques.
3. Examine Pig and Hive tools for querying and managing large datasets.
4. Examine NoSQL databases such as MongoDB for data handling operations.
5. Evaluate Cassandra database features and query mechanisms for scalable data management.

UNIT I (15 HOURS)

Big data Introduction: Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.

UNIT II (15 HOURS)

Map reduce: Introduction to Map Reduce frame work - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.

UNIT III (15 HOURS)

Pig and Hive: Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - Fundamentals of HBase and ZooKeeper.

UNIT IV (15 HOURS)

Mongo DB: No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export.

UNIT V (15 HOURS)

Cassandra: Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

PRESCRIBED BOOKS:

1. JSeema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.
2. Ramesh Sharda, Dursun Delen, Efraim Turban (2018), Business Intelligence, Pearson Education Services Pvt Ltd

REFERENCE BOOKS:

1. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”, John Wiley & Sons, Inc., 2013.
2. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publications, 2011
3. Kyle Banker, “Mongo DB in Action”, Manning Publications Company, 2012.

E-LEARNING RESOURCES:

1. <https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics>
2. <https://www.coursera.org/articles/big-data-analytics>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Avg.	3	3	2.8	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	2
CO 3	3	3	3	3	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Interpret big data concepts, Hadoop ecosystem, and distributed computing architecture.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain MapReduce framework and data processing techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Examine Pig and Hive tools for querying and managing large datasets.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Examine NoSQL databases such as MongoDB for data handling operations.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate Cassandra database features and query mechanisms for scalable data management.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes maintained throughout the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Group activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE- XVIII
COURSE NAME: TEXT ANALYTICS	COURSE CODE: 26UBDA318
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with knowledge of linguistics, NLP, text analytics, and machine learning techniques for modeling and analyzing textual data.

COURSE OUTCOMES:

1. Describe fundamental concepts of text analytics, language structure, and corpora.
2. Explain text processing techniques including tokenization and normalization.
3. Examine text classification methods and syntactic analysis techniques.
4. Discuss text summarization, similarity, and clustering approaches
5. Evaluate semantic and sentiment analysis techniques for text interpretation.

UNIT I (15 Hours)

Introduction to Text Analytics: Introduction - Natural Language Basics- Language Syntax and Structure – Language Semantics - Text Corpora

UNIT II (15 Hours)

Working with Text - String Operations and Methods - Text Analytics Frameworks - Processing and Understanding Text - Text Tokenization – Text Normalization

UNIT III (15 Hours)

Understanding Text Syntax and Structure – Parts of Speech Tagging – Shallow parsing – Dependency-based parsing – Constituency-based parsing - Text Classification - Feature Extraction – Classification Algorithms: Multinomial Naïve Bayes - Evaluating Classification Models – Building a Multi-Class Classification System-Application and uses

UNIT IV (15 Hours)

Text Summarization: Text Normalization – Feature Extraction – Key phrase Extraction - Text Similarity: Analyzing Term Similarity - Clustering Greatest Movies of All Time: K-Means Clustering

UNIT V (15 Hours)

Semantic and Sentiment Analysis: Semantic Analysis- Exploring WordNet – Analyzing lexical semantic relations – Word sense disambiguation – Named Entity Recognition – Analyzing Semantic Representations – Case Study: Sentiment Analysis of Movie Reviews

PRESCRIBED BOOKS:

1. DipanjanSarkar (2016). Text Analytics with Python: A Practical Real-World Approach toGaining Actionable Insights from your Data (2/e), Apress Media LLC

REFERENCES BOOKS:

1. Steven Bird, Ewan Klein, Edward Loper (2009). Natural Language Processing with Python. O'Reilly Media, Inc.
2. Benjamin Bengfort & Tony Ojeda & Rebecca Bilbro(2018), Applied Text Analysis with Python: Enabling Language-Aware Data Products with Machine Learning, O'Reilly Media, Inc.

E-LEARNING RESOURCES:

1. <https://www.datacamp.com/tutorial/text-analytics-beginners-nltk>
2. <https://www.kapiche.com/blog/text-mining>
3. <https://www.geeksforgeeks.org/data-science/what-is-text-analytics/>

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
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C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	3	2
CO 2	3	2	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	3	2	2
CO 5	3	3	3	2	3
Avg.	3	2.8	2.8	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
Avg.	3	3	2.6	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO1	Describe fundamental concepts of text analytics, language structure, and corpora.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain text processing techniques including tokenization and normalization	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Examine text classification methods and syntactic analysis techniques	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze text summarization, similarity, and clustering approaches	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate semantic and sentiment analysis techniques for text interpretation.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes maintained throughout the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Group activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: CORE – XIX
COURSE NAME: PRACTICAL – VII - APPLIED TEXT ANALYTICS AND VISUALIZATION PITFALLS	COURSE CODE: 26UBDA319P
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:60
PRACTICAL	

COURSE OBJECTIVE:

To explore the five components of Visual Text Analytics: parsing, concept derivation, topic derivation, text categorization, and sentiment analysis.

COURSE OUTCOME:

1. Perform text analytics tasks using SAS Visual Text Analytics tools and nodes.
2. Construct concept and category rules for extracting insights from textual data.
3. Analyze real-world datasets to derive meaningful text-based insights.
4. Examine data visualization techniques to identify misinterpretations and graphical pitfalls
5. Evaluate and improve visual representations by applying appropriate remedies for effective communication.

EXERCISES:

1. Introduction to SAS Visual Text Analytics
2. SAS Visual Text Analytics Demonstrations
3. SAS Visual Text Analytics Nodes
4. Concept and Category Rule Definitions
5. Case Study on ASRS incident reports
6. Case Study on CFPB customer complaint reports
7. Introduction to graphicacy and data representation pitfalls
8. Common Data Misinterpretations and Paradoxes
9. Common Visual Misrepresentations
10. Common Remedies for Pitfalls in Visualization

COURSE MATERIALS

SAS Company Manual

REFERENCE TEXT:

SAS Internal Reference

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	3	3	3	2
CO 4	3	3	3	3	3
CO 5	3	3	3	2	3
Avg.	3	3	3	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	3	3
Avg.	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs & PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Perform text analytics tasks using SAS Visual Text Analytics tools and nodes.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Construct concept and category rules for extracting insights from textual data.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Analyze real-world datasets to derive meaningful text-based insights.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Examine data visualization techniques to identify misinterpretations and graphical pitfalls	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate and improve visual representations by applying appropriate remedies for effective communication.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Practical Exercise	10	5
Class activity 3	Debugging tasks	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc. DATA ANALYTICS	BATCH: 2026-29
PART: III	COURSE COMPONENT: CORE-XX
COURSE NAME: PROJECT	COURSE CODE: 26UBDA320
SEMESTER: VI	MARKS: 100
CREDITS: 3	TOTAL HOURS: 90
PRACTICAL	

Students of B.Sc. Data Analytics must develop a small-scale data-driven or software application using knowledge from the first five semesters. The project should focus on areas like data analysis, machine learning, data visualization, statistical modeling, or big data. The project should be done individually. The aim is to solve real-world problems using analytics and computational methods. This project promotes hands-on learning, teamwork, and practical application of core concepts.

COURSE OBJECTIVE:

To demonstrate the ability to analyze data-driven requirements, identify analytical challenges, and develop effective data-based solutions to address real-world problems using techniques from data analytics and related technologies.

COURSE OUTCOMES:

1. Apply domain specific theories, principles, and methodologies to design and execute meaningful projects.
2. Identify complex problems and develop innovative, practical, and multidisciplinary solutions.
3. Demonstrate the ability to conduct research, analyze data, and interpret findings to support informed decision making.
4. Integrate ethical practices, sustainability, and social responsibility into project work, contributing positively to society.
5. Present and document project outcomes, while cultivating adaptability and continuous learning.

GUIDELINES

- Each student must individually complete a mini project based on data analytics concepts within a 3-month timeframe.
- The project should cover all phases: planning, data collection, analysis, design, model implementation, and reporting.
- Projects must be independently developed, and individual effort is mandatory for internal assessment and eligibility for the final viva voce.
- The focus should be on applying data analytics techniques to solve real-world problems using relevant tools and technologies.

EVALUATION:

- Internal assessment will be based on initial project proposal, two reviews and a comprehensive final report of the project.
- External assessment will be based on the presentation of the project work and Viva Voce.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	2	3
AVG	3	3	3	2.6	2.8

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
AVG	3	3	3	2.8	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO 1	Demonstrate hands-on proficiency in using programming languages, analytics tools, and technologies relevant to data-driven projects.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 2	Apply data science concepts, statistical methods, and machine learning techniques to analyze and solve real-world problems.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 3	Collaborate and organize tasks within a team to effectively manage data workflows and integrate individual components.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 4	Integrate various data sources, platforms, and technologies to develop comprehensive analytics solutions.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO 5	Evaluate and validate data models and software components through systematic testing and debugging to ensure reliability and performance.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyze, K5= Evaluate, K6= Create

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – III
COURSE NAME: DEEP LEARNING	COURSE CODE: 26UBDA3E3
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip students with the fundamentals of neural networks and deep learning, enabling them to design, train, and apply advanced AI models for solving real-world problems in computer vision, natural language processing, and speech analytics.

COURSE OUTCOMES:

1. Explain basic concepts of machine learning and neural networks.
2. Describe multilayer perceptron and backpropagation techniques.
3. Explain TensorFlow, Keras, and convolutional neural networks.
4. Analyze recurrent neural networks and clustering methods.
5. Analyze deep learning applications in vision, NLP, and speech.

UNIT I (15 Hours)

Introduction: Overview of machine learning, linear classifiers, loss functions What Are Neural Networks: History, Artificial and biological neural networks, Artificial intelligence and neural networks Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates.

UNIT II (15 Hours)

Multilayer perceptron The XOR problem, Back-propagation algorithm, Heuristic for improving backpropagation algorithm, Some examples- Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies- Kohonen Self-Organizing Maps: Self-organizing map, the SOM algorithm, Learning vector quantization

UNIT III (15 Hours)

Introduction to TensorFlow: Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, Tensor Board, Modularity, Sharing Variables, Keras- Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, problem and solution of under fitting and overfitting

UNIT IV (15 Hours)

Recurrent Neural Networks : Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, GRU, Encoder Decoder architecturesring Greatest Movies of All Time: K-Means Clustering

UNIT V (15 Hours)

Deep Learning applications: Image segmentation, Object detection, Attention model for computer vision tasks, Natural Language Processing, Speech Recognition, Video Analytics. Tools :TensorFlow, Keras, PyTorch, Caffe, Theano, MXNet. Applications: Object detection withRCNN-YOLO,SSD. Speech recognition with RNN.

PRESCRIBED BOOKS:

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly, 2017.

REFERENCES BOOKS:

1. Bishop, C.M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

E-LEARNING RESOURCES:

1. <https://www.tensorflow.org/tutorials>
2. <https://keras.io/examples/>
3. <https://docs.pytorch.org/tutorials/>
4. s231n.stanford.ed

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
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C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	3
CO 2	3	3	2	2	2
CO 3	3	2	3	2	2
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Avg.	3	2.8	2.6	2.4	2.4

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.4

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain basic concepts of machine learning and neural networks.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Describe multilayer perceptron and backpropagation technique	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Explain TensorFlow, Keras, and convolutional neural networks.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze recurrent neural networks and clustering methods.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Analyze deep learning applications in vision, NLP, and speech.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes maintained throughout the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Group activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – III
COURSE NAME: MARKETING ANALYTICS	COURSE CODE: 26UBDA3E8
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To equip learners with analytical tools and techniques to extract insights from marketing, customer, social media, and web data for effective decision-making.

COURSE OUTCOMES:

1. Identify key concepts and methods in marketing, customer, and social media analytics.
2. Explain techniques like regression, factor analysis, and A/B testing for marketing decisions.
3. Apply tools to analyze customer behavior, campaign performance, and market segmentation.
4. Analyze data using models such as cluster analysis, correlation, and predictive modeling.
5. Evaluate marketing strategies using insights from analytics to optimize ROI and campaign outcomes.

UNIT I (15 Hours)

Marketing Analytics: Introduction to marketing research, Research design setup, Qualitative research, Quantitative research, Concept development, scale development, Exploring Data, Descriptive Statistics. Product analytics- features, attributes, benefits, Price analytics, Promotion analytics, Channel analytics, Multiple Discriminate analysis.

UNIT II (15 Hours)

Customer Analytics: Customer Analytics, Analyzing customer satisfaction, Prospecting and Targeting the Right Customers, Covariance and Correlation analysis, Developing Customers, Retaining Customers, Customer lifetime value case, Factor analysis. Market Segmentation & Cluster Analysis, Scatterplots & Correlation Analysis, Linear Regression, Model Validation & Assessment, Positioning analytics, Cross tabulation.

UNIT III (15 Hours)

Social Media Analytics (SMA): Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.

UNIT IV (15 Hours)

Facebook Analytics: Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction.

UNIT V**(15 Hours)**

Web Analytics and making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing.

PRESCRIBED BOOKS:

1. Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, Chuck Hemann & Ken Burbary, Pearson, ISBN 9780789750303
2. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Eric Siegel, Pearson.
3. Marketing Analytics: Optimize Your Business with Data Science in R, Python, and SQL, Dave Jacobs.
4. Matthew Ganis, Avinash Kohirkar. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media. Pearson 2016.

REFERENCE BOOKS:

1. Jim Sterne. Social Media Metrics: How to Measure and Optimize Your Marketing Investment. Wiley, 2020
2. Marshall Sponder. Social Media Analytics. McGraw Hill Latest edition.

E-LEARNING RESOURCES:

1. <https://analytics.google.com/analytics/academy>
2. <https://www.kaggle.com/learn>
3. <https://skillshop.withgoogle.com/>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

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TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	1	1
III	2	1	1
IV	2	2	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	2	3
CO 2	3	3	2	2	2
CO 3	3	3	3	3	3
CO 4	3	3	3	3	2
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.6

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	2	3	3
CO 5	3	3	3	3	3
Avg.	3	3	2.8	2.4	2.6

PO-PSO-CO-QUESTION PAPER MAPPING

CO No:	COURSE OUTCOME	POs&PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K5)
CO1	Identify key concepts and methods in marketing, customer, and social media analytics.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO2	Explain techniques like regression, factor analysis, and A/B testing used in marketing decisions.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Apply tools to analyze customer behavior, campaign performance, and market segmentation.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze data using models such as cluster analysis, correlation, and predictive modeling.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate marketing strategies using insights from analytics to improve business outcomes.	PO1 to PO5 PSO1 to PSO5	K1 to K5

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	Nature	Maximum Marks	Weightage
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Written assignment on course-related topics	10	5
Workbook/record book/ notebook	Handwritten notes maintained throughout the course	10	5
Class activity 1	Quiz with MCQ	10	5
Class activity 2	Puzzle	10	5
Class activity 3	Group activity	10	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: B.Sc., DATA ANALYTICS	BATCH:2026-2029
PART: III	COURSE COMPONENT: ELECTIVE – III
COURSE NAME: FINANCIAL ANALYTICS	COURSE CODE: 26UBDA3E9
SEMESTER: VI	MARKS:100
CREDITS: 4	TOTAL HOURS:75
THEORY	

COURSE OBJECTIVE:

To provide learners with the skills to analyze financial data, build predictive models, and create visual insights for informed financial decision-making.

COURSE OUTCOMES:

1. Identify key financial documents, metrics, and analytics concepts.
2. Explain techniques used in descriptive, predictive, and forecasting analytics.
3. Apply financial models and tools to analyze risks, returns, and investment performance.
4. Analyze financial data using regression, clustering, and portfolio optimization techniques.
5. Evaluate business performance through dashboards, scorecards, and BI reporting tools.

UNIT I (15 Hours)

Financial Analytics: Introduction: Meaning-Importance of Financial Analytics uses-Features-Documents used in Financial Analytics: Balance Sheet, Income Statement, Cash flow statement-Elements of Financial Health: Liquidity, Leverage, Profitability. Financial Securities: Bond and Stock investments - Housing and Euro crisis - Securities Datasets and Visualization - Plotting multiple series.

UNIT II (15 Hours)

Descriptive Analytics: Data Exploration, Dimension Reduction and Data Clustering Geographical Mapping, Market Basket Analysis. Predictive Analytics, Fraud Detection, Churn Analysis, Crime Mapping, Content Analytics, Sentiment Analysis. Analyzing financial data and implement financial models. Process of Data analytics: obtaining publicly available data, refining such data, implement the models and generate typical output, Prices and individual security returns, Portfolio returns, Risks, Factor Models.

UNIT III (15 Hours)

Forecasting Analytics: Estimating Demand Curves and Optimize Price, Price Bundling, Non Linear Pricing and Price Skimming, Forecasting, Simple Regression and Correlation Multiple Regression to forecast sales. Modeling Trend and Seasonality Ratio to Moving Average Method, Winter's Method.

UNIT IV (15 Hours)

Business Intelligence & Tableau: Definition of BI – A Brief History of BI – The Architecture of BI. The origin and Drivers of BI. Successful BI Implementation – Analytics Overview – Descriptive, Predictive and Perspective Analytics. Business reporting and Visualization – components - A brief history of data visualization – Different types of charts and graphs – The emergence of data visualization and visual analytics – Performance dashboards – Dashboard design – Best practices in dashboard design – Business performance management – Balanced Scorecards – Six sigma as a performance measurement system.

UNIT V**(15 Hours)**

Visualizations: Using Tableau to Summarize Data, Slicing and Dicing Financial Data, Charts to Summarize Marketing Data. Functions to Summarize Data, Pricing Analytics, Risk based pricing, Fraud Detection and Prediction, Recovery Management, Loss Risk Forecasting, Risk Profiling, Portfolio Stress Testing.

PRESCRIBED BOOKS:

1. Analysis of Economic Data, Gary Koop, (4th Edition), Wiley.
2. Statistics and Data Analysis for Financial Engineering: with R examples; David Ruppert, David S. Matteson, Springer

REFERENCE BOOKS:

1. Analyzing Financial Data and Implementing Financial Models Using „R“, Ang Clifford, Springer.
2. Microsoft Excel 2013: Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Publishing

E-LEARNING RESOURCES:

1. <https://www.techtarget.com/searcherp/definition/financial-analytics>
2. <https://www.teradata.com/Glossary/What-is-Finance-Analytics>

GUIDELINES TO THE QUESTION PAPER SETTERS**QUESTION PAPER PATTERN**

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer any 10 out of 12 questions (each in 50 words)	01-12	3	30
B	Answer any 5 out of 7 questions (each in 300 words)	13-19	6	30
C	Answer any 4 out of 6 questions (each in 1200 words)	20-25	10	40
TOTAL MARKS				100

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	3	2	2
II	3	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	12	7	6

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	3	3
CO 2	3	3	2	3	2
CO 3	3	3	3	2	3
CO 4	3	3	3	2	2
CO 5	3	3	3	2	3
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PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	3
CO 2	3	3	3	2	2
CO 3	3	3	3	3	2
CO 4	3	3	2	3	3
CO 5	3	3	3	2	3
Avg.	3	3	2.8	2.4	2.6

PSO-CO-QUESTION PAPER MAPPING

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CO2	Explain techniques used in descriptive, predictive, and forecasting analytics.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO3	Apply financial models and tools to analyze risks, returns, and investment performance.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO4	Analyze financial data using regression, clustering, and portfolio optimization techniques.	PO1 to PO5 PSO1 to PSO5	K1 to K5
CO5	Evaluate business performance through dashboards, scorecards, and BI reporting tools.	PO1 to PO5 PSO1 to PSO5	K1 to K5

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