

Principal : Dr. Manju Lalwani Pathak

Ref. No: CHM (A) AC/02/2026-27

Date: 27<sup>th</sup> June, 2026

**CIRCULAR**

The immediate attention of all concerned is invited to this Office Circular No. CHM (A) AC 11/2026 dated 19<sup>th</sup> June, 2026 regarding Choice Based and Credit Based Syllabus (CBCS), of Smt. CHM College (Autonomous), under the guidelines of University of Mumbai, as per Academic Framework of NEP 2020, for all subjects of T.Y.B.Sc in Data Science SEM-V and SEM-VI.

This is in continuation with curriculum approved by Academic Council for all the subjects of F.Y.B.Sc in Data Science (SEM-I), S.Y.B.Sc in Data Science (SEM-III) and F.Y.B.Sc in Data Science (SEM-II) & S.Y.B.Sc in Data Science (SEM – IV) vide Circular Reference Numbers CHM (A) AC/C/01/2025 dated 18th June, 2025, CHM (A) AC/C/01A/2025 dated 21st July 2025 and CHM (A) AC/C/02/2025 dated 20th November, 2025 respectively.

It is hereby communicated that the recommendations of the curriculum designed by the Ad-hoc Board of studies in Data Science coordinated by the Dean, Faculty of Applied Sciences in the meeting of Academic Council held on 20<sup>th</sup> June, 2026 have been approved.

In accordance, therewith, the syllabus as per the CBCS, has been brought into force with effect from the Academic Year 2026-27 for T.Y.B.Sc in Data Science, in continuation with syllabus of F.Y.B.Sc in Data Science and S.Y.B.Sc in Data Science of 2025-2026 (updated), and accordingly the same is attached for reference and is available on the College's website [www.chmcollege.in](http://www.chmcollege.in)

Ulhasnagar – 421003

27<sup>th</sup> June 2026



**Dr. Manju Lalwani Pathak**

Principal & Chairperson, Academic Council

Copy forwarded for information to:

1. The Office of Chairperson, Academic Council
2. The Dean, Faculty of Applied Sciences
3. The Chairperson, Ad-hoc Board of Studies
4. The Controller of Examination
5. The Registrar

## **PREAMBLE**

The Bachelor of Science in Data Science is an interdisciplinary program designed to prepare students for a data-driven world. It provides a strong foundation in mathematics, statistics, and programming enabling students to analyze and interpret data effectively. The curriculum includes core machine learning techniques, big data technologies, and real-world applications through capstone projects and internships. Ethical data use and privacy are emphasized, alongside the societal impact of data science. Students build communication skills, particularly in data visualization and explaining insights to non-technical audiences. The program aims to develop analytical, computational, and problem-solving abilities, as well as adaptability to emerging tools and trends. Graduates will be proficient in data analysis, machine learning, and big data tools, with strong ethical awareness, collaboration skills, and leadership potential—ready to contribute across diverse sectors such as healthcare, finance, and marketing.

## **PROGRAMME OUTCOMES (POs)**

**Upon completion of Bachelor of Science in Data Science, learner will be able to :**

### **PO1: Disciplinary Knowledge**

Apply fundamental and advanced knowledge of statistics, mathematics, programming, databases, machine learning, artificial intelligence, and data science techniques to solve real-world problems.

### **PO2: Critical Thinking and Analytical Reasoning**

Critically evaluate data, information, assumptions, and evidence to make informed and objective decisions in diverse contexts.

### **PO3: Problem Solving and Scientific Skills**

Identify, analyze, and address complex and unfamiliar data-driven problems using innovative, logical, and systematic approaches.

### **PO4: Digital Literacy**

Utilize modern computing tools, programming platforms, data technologies, and information systems for learning, analysis, and innovation.

### **PO5: Research Competence**

Formulate relevant research questions, design investigations, conduct data-driven studies, and adhere to ethical and intellectual property standards.

### **PO6: Communication Skills**

Communicate effectively through written reports, oral presentations, scientific publications, visual media, and interpersonal interactions with diverse audiences.

### **PO7: Environmental Sustainability and Community Engagement**

Demonstrate empathy, appreciate cultural diversity, engage in community service, and promote environmental sustainability.

### **PO8: Ethics and Professional Values**

Demonstrate ethical and responsible practices in data science by ensuring data privacy, security, integrity, fairness, and professional standards in data analysis and decision-making.

### **PO9: Leadership and Teamwork**

Work collaboratively in diverse teams, demonstrate leadership qualities, and contribute effectively to achieving common goals.

### **PO10: Lifelong Education**

Engage in self-directed lifelong education for continuous personal and professional development.

### **PO11: Employability and Entrepreneurship**

Apply data science knowledge and analytical skills to develop data-driven solutions and support career growth and entrepreneurial initiatives.



**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar  
(Autonomous)  
Affiliated to the University of Mumbai**

**Bachelor of Science  
(Data Science)  
(Self-Financing Course)**

**Semester – I**

**Choice Based and Credit Based syllabus  
as per NEP 2020 with effect from the Academic  
Year 2025-2026**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Title: Python Programming**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Python Programming

**Course Code: CHMDSI1**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Python programming is widely valued for its simplicity, versatility, and readability, making it a cornerstone in today's tech industry. Its adaptability spans sectors like web development, data science, automation, IoT and blockchain. With powerful libraries such as Django, NumPy and Pandas, Python supports efficient development and problem-solving. Its user-friendliness and interdisciplinary relevance make it a popular choice in academic courses and professional settings alike. The demand for Python skills continues to grow, leading to strong job prospects in roles such as web developers, data analysts, and machine learning engineers.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>  <b>CO(A) 1.</b> To understand the concept of data types and other basic elements in Python. <b>CO(A) 2.</b> To learn control statements and operators in Python. <b>CO(A) 3.</b> To understand the concept of lists, tuples and dictionaries in Python. <b>CO(A) 4.</b> To apply Python programming concepts including functions, string operations, and built-in modules for managing date, time, and calendar. <b>CO(A) 5.</b> To learn file handling in Python.	

8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Use variables with different data types and input output functions.</p> <p><b>CO 2:</b> Ability to use control statements and operators in programming.</p> <p><b>CO 3:</b> Acquire knowledge of lists, tuples and dictionaries.</p> <p><b>CO 4:</b> Use Python functions, string operations and date-time handling.</p> <p><b>CO 5:</b> Perform file handling tasks proficiently.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Python Language:</b> Overview, Features of Python, Execution of a Python Program, Python Interpreter, Comparison of Python with C and Java.</li> <li>• <b>Data Types, Variables and Other Basic Elements:</b> Comments, Docstrings, Data types- Numeric, Compound, Boolean, Dictionary, Sets, Mapping, Basic Elements of Python, Variables.</li> <li>• <b>Input and Output Operations:</b> Input Function, Output Statements, Command Line Arguments</li> <li>• <b>Control Statements:</b> Control Statements- Loop Statement, The else Suite, break Statement, continue Statement, pass Statement, assert Statement, return Statement.</li> <li>• <b>Functions:</b> Defining &amp; Calling a Function, Returning Results, Returning Multiple Values, Built in Functions, Parameters and Arguments, Recursive Functions, Anonymous or Lambda Functions.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Operators:</b> Arithmetic operator, Assignment operators, Unary minus operator, Relational operators, Logical operators, Bitwise operators, Membership operators, Identity operators, Precedence of Operators, Associativity of Operators.</li> <li>• <b>Date and Time in Python:</b> Date and Time, Date and Time Now, Combining Date and Time, Formatting Dates and Times, Finding Durations using “timedelta”, Comparing Two Dates, Sorting Dates, Stopping Execution Temporarily, Knowing the Time taken by a Program, Working with Calendar Module.</li> <li>• <b>Strings:</b> Creating Strings, Functions of Strings, Working with Strings, Length of a String, Indexing &amp; Slicing, Repeating&amp; Concatenation of Strings, Checking Membership,</li> </ul>

Comparing Strings, Removing Spaces, Finding Substrings, Counting Substrings, Strings are Immutable, Splitting and Joining Strings, Changing Case, Checking Starting and Ending of a String, Sorting & Searching in the Strings, Formatting the Strings, Working with Characters.

- **Lists and Tuples:** Lists, List Functions and Methods, List Operations, Tuples.
- **Dictionaries:** Creating a Dictionary, Operators in Dictionary, Dictionary Methods, Using for Loop with Dictionaries, Operations on Dictionaries, Ordered Dictionaries.
- **File Handling:** Introduction to files, Types of Files, Opening and Closing of files, Reading from and writing to files, Working with CSV files.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI vs Human Approach: Comparative Study of Python Problem Solving, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**REFERENCES:**

1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1st edition (2018)
2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1st edition (2016)
3. Let Us Python, Yashwant Kanetkar, BPB publication , 1st edition (2019)
4. Programming in Python3, Mark Summerfield, Pearson Education, 2<sup>nd</sup> edition (2018)
5. Learning Python, LutzM, O'Reilly- Shroff, 5<sup>th</sup> edition, 2013
6. Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009
7. Star Python, Star Certification, Star Certification, 1st, 2018
8. <https://docs.python.org/3/tutorial/index.html>
9. <https://www.freecodecamp.org/learn/scientific-computing-with-python/>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Title: Descriptive Statistics**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Descriptive Statistics

**Course Code: CHMDSI2**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Descriptive Statistics is a foundational tool in data analysis, helping transform complex data into clear, actionable insights through measures like mean, median, and data visualizations. It plays a vital role across various sectors aiding informed decision-making. Its visual and analytical appeal makes it engaging for students and serves as a bridge to more advanced topics like inferential statistics and machine learning. With the growing importance of data in industry, professionals skilled in Descriptive Statistics are in high demand for roles such as data analysts, business analysts, and statistical consultants.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To introduce the fundamental concepts and applications of statistics for organizing and interpreting data. <b>CO(A) 2.</b> To enable students to compute and interpret key measures of central tendency and dispersion in both grouped and ungrouped datasets. <b>CO(A) 3.</b> To develop students' ability to analyze relationships between variables using correlation and regression methods. <b>CO(A) 4.</b> To provide students with the tools to visualize and summarize data effectively using various graphical techniques.	

	<b>CO(A) 5.</b> To introduce the concepts of skewness and kurtosis for understanding data.
<b>8</b>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Explain the basic concepts of statistics, different data types, and appropriate methods of data classification and presentation.</p> <p><b>CO 2:</b> Compute and interpret various measures of central tendency and dispersion.</p> <p><b>CO 3:</b> Construct and interpret graphical representations such as histograms, pie charts, and box plots for univariate data.</p> <p><b>CO 4:</b> Analyze and interpret the strength and direction of relationships between variables using correlation techniques.</p> <p><b>CO 5:</b> Able to understand forecasting techniques and to find cause and effect relationship between variable through regression analysis.</p>
<b>9</b>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction of Statistics:</b> Meaning of Statistics, Importance of Statistics, Types of Characteristics, Types of data: Quantitative and Qualitative data, Discrete and Continuous Data, Population and Sample, Different types of Scales: Nominal, Ordinal, Interval and ratio. Univariate frequency distribution of discrete and continuous variables and Cumulative frequency distribution. Data Presentation: Frequency Distribution, Histogram, Pie Graph, Box Plot.</li> <li>• <b>Measures of Central Tendencies:</b> Concept of Central Tendency, characteristics of good measures of Central Tendency, Mathematical Averages: Arithmetic Mean, Introduction to Geometric Mean and Harmonic Mean, Positional Averages: Median, Mode , Partition values: Quartiles, Deciles and Percentiles -examples of ungrouped and grouped data, Practical Problems based on Missing Frequency &amp; Word Problems.</li> <li>• <b>Measures of Dispersion:</b> Concept of Dispersion, Requirements of good measures of Dispersion, Absolute and Relative measures of Dispersion, Introduction to various means of dispersion, Standard Deviation, Combined Standard Deviation-examples of ungrouped and grouped data, Coefficient of Variation.</li> </ul>

**UNIT II:**

- Concept of Correlation, types and interpretation, Scatter Diagram, Product Moment Correlation Coefficient, and its properties.
- Spearman's Rank Correlation (with and without ties).
- Concept of Linear Regression, Principle of Least Square, Fitting a straight line by method of least square.
- Relation between Correlation and Regression Coefficients (Only Statement), Practical Applications of Correlation and Regression.
- Raw and Central Moments, Relation between Raw and Central moments, Concept of Skewness and Kurtosis.

**10****Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Based Comparative Study of Datasets Using Statistical Measures and AI-Generated Insights, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**REFERENCES:**

1. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentce Hall of India, NewDelhi.
2. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, NewDelhi.
3. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi.
4. Schaum's Outline Of Theory And Problems Of Beginning Statistics, Larry J. Stephens, Schaum's Outline Series Mcgraw-Hill
5. Gupta, S.C. and Kapoor, V.K. (1987): Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi
6. Goon AM, Gupta MK, Das Gupta B: Fundamentals of Statistics, Vol-I, the World Press Pt. Ltd, Kolkata
7. Shah R.J: Descriptive Statistics: Seth Publication, Eight Edition
8. Spiegel M.R: Theory and Problems of Statistics, Schaum's Publishing Series, Tata McGraw-Hill, First Edition
9. Basic Statistics: Agarwal B.L: New Age International Ltd
10. <https://onlinestatbook.com/2/>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Title: Major Practical 1**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Major Practical 1

**Course Code: CHMDSI3**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	Basic Python programming practical modules provide foundational knowledge essential for implementing Python code across a wide range of applications. These modules enable learners to understand and effectively work with various data types, utilize control structures such as conditionals and loops, and apply logical flow in program execution. Additionally, they offer hands-on experience in handling strings and arrays, which are crucial for data manipulation and processing tasks. The modules also emphasize the use of functions, promoting code reusability, modularity, and clarity. Through practical exercises and examples, learners gain the skills necessary to build efficient and structured Python programs suitable for solving real-world problems.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> CO(A) 1. To implement various data types. CO(A) 2. To implement different functions. CO(A) 3. To implement lists, tuples and strings. CO(A) 4. To plot graphs and charts. CO(A) 5. To develop ability to analyze statistical data.	

8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Use all data types in different ways.</p> <p><b>CO 2:</b> Acquire knowledge to implement user defined, built in and lambda functions.</p> <p><b>CO 3:</b> Make a use of arrays and strings in python programming.</p> <p><b>CO 4:</b> Understand data analysis through programming.</p> <p><b>CO 5:</b> Study the relationship between variables using techniques of correlation and regression.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Python Fundamentals</b> <ol style="list-style-type: none"> <li>a. Implement the use of various data types such as integer, float, string, boolean, list, tuple, and dictionary in Python.</li> <li>b. Perform type checking for different variables and values using the type() function.</li> <li>c. Implement basic input and output operations using input() and print() functions.</li> <li>d. Develop user interaction by accepting and displaying messages entered by the user.</li> </ol> </li> <li>• <b>Basic Arithmetic and Mathematical Applications</b> <ol style="list-style-type: none"> <li>a. Implement temperature conversion from Celsius to Fahrenheit.</li> <li>b. Perform distance conversion from kilometers to miles.</li> <li>c. Develop a simple calculator to perform arithmetic operations.</li> <li>d. Implement the solution of quadratic equations using mathematical formulas in Python.</li> <li>e. Perform addition of two user-defined numbers.</li> <li>f. Implement calculation of the area of a triangle using the standard mathematical formula.</li> </ol> </li> <li>• <b>Iterative and Looping Constructs</b> <ol style="list-style-type: none"> <li>a. Implement Armstrong number verification using a while loop.</li> <li>b. Perform generation and display of the first <math>n</math> natural numbers using iterative statements.</li> <li>c. Implement looping constructs along with break and continue statements.</li> <li>d. Develop factorial calculation of a given number using loops.</li> </ol> </li> </ul>

- **Conditional Statements and Functions**
  - a. Implement even and odd number verification using conditional statements.
  - b. Develop functions using keyword arguments and default arguments.
  - c. Perform mail merge operations for generating customized messages.
  - d. Implement determination of the largest among three numbers using decision-making statements.
  
- **Number Systems and Utility Programs**
  - a. Implement calculation of the Highest Common Factor (HCF) or Greatest Common Divisor (GCD) of two numbers.
  - b. Perform conversion of decimal numbers into binary, octal, and hexadecimal number systems.
  - c. Implement determination of the size or resolution of an image file.
  - d. Perform leap year verification for a given year.
  - e. Implement swapping of two variables with and without using a temporary variable.
  
- **Functions and Lambda Expressions**
  - a. Implement the use of built-in Python functions.
  - b. Develop mathematical computations using lambda functions.
  - c. Implement factorial computation using recursive functions and verify the result using `math.factorial()`.
  - d. Perform list transformation using lambda expressions with the `map()` function.
  
- **Lists, Tuples, and Date-Time Operations**
  - a. Perform duplicate removal, descending order sorting, and display operations on a list of integers.
  - b. Implement student record management using list operations such as add, remove, count, and display.
  - c. Develop nested tuple operations for storing employee and department details.
  - d. Implement display of the current date and time in formatted style.
  - e. Perform calculation of the number of days between two dates using the `timedelta` module.

f. Implement display of the current month calendar and execution time measurement using the time module.

- **String Operations**

- a. Implement string immutability and multiline string operations in Python.
- b. Perform comparison operations between two strings.
- c. Implement string concatenation operations.
- d. Perform determination of the ASCII value of a given character.

- **Advanced String Manipulation**

- a. Implement removal of punctuation marks from a given string.
- b. Perform palindrome verification for a given string.
- c. Implement counting of vowels in a string.
- d. Perform sorting of words in alphabetical order using string operations.

- **File Handling and Miscellaneous Applications**

- a. Implement random shuffling of a deck of cards.
- b. Perform file creation, opening, and reading operations in Python.
- c. Implement reading and display of specific lines from a file.
- d. Develop function-based operations to calculate the average of numbers in a list.

## **UNIT II:**

- **Introduction to Excel**

- a. Implement data analysis operations using Excel Data Tools.
- b. Perform formula creation and functional operations using Formula Tools and Insert Function Library.
- c. Implement Add-Ins and Analysis ToolPak features for data analysis operations.
- d. Develop spreadsheet operations using formulas, functions, cell references, sorting, filtering, and advanced filtering techniques.

- **Data Entry and Manipulation**

- a. Implement tools for accurate data entry using Quick Access Toolbar customization

and Form Tool.

- b. Perform data transposition operations for arranging data in array format.
- c. Develop data conversion operations using Logical IF, VLOOKUP, Pivot Table, and Pivot Chart techniques.
- d. Implement conversion of non-Excel data into text format using Text-to-Columns operations.

- **Data Validation**

- a. Implement validation rules by specifying a valid range of values for a cell.
- b. Perform data validation using predefined lists of valid values for a cell.
- c. Develop custom validation rules based on formulas for specific cells.

- **Diagrams and Graphs**

- a. Implement Histogram plotting using Python, R, or Excel.
- b. Perform Bar Graph plotting using Python, R, or Excel.
- c. Develop Pie Chart visualization using Python, R, or Excel.
- d. Implement Boxplot and Multiple Boxplot visualization techniques.

- **Measures of Central Tendency**

- a. Implement computation of Mean using Python, R, or Excel.
- b. Perform computation of Median using Python, R, or Excel.
- c. Develop computation of Mode using Python, R, or Excel.

- **Measures of Dispersion**

- a. Implement computation of Range and Interquartile Range using Python, R, or Excel.
- b. Perform computation of Variance using Python, R, or Excel.
- c. Develop computation of Standard Deviation using Python, R, or Excel.
- d. Implement computation of Skewness and Kurtosis using Python, R, or Excel.

- **Correlation**

- a. Implement Positive Correlation analysis using Python, R, or Excel.
- b. Perform Negative Correlation analysis using Python, R, or Excel.
- c. Develop Zero Correlation analysis using Python, R, or Excel.

- **Regression – I**
  - a. Implement Linear Regression techniques for prediction using Python, R, or Excel.
  - b. Develop Polynomial Regression techniques for prediction using Python, R, or Excel.
- **Regression – II**
  - a. Implement Multiple Linear Regression techniques for prediction using Python, R, or Excel.
  - b. Perform Logistic Regression techniques for prediction using Python, R, or Excel.
- **Survey Design and Data Analysis**
  - a. Develop a survey form, collect primary data, and perform data analysis based on the given case study.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	15
Q2	Unit 2	15
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / Evaluation	Marks
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	AI-Assisted Statistical Analysis and Predictive Analytics using Python and Excel.	10
		<b>Total: 20</b>

**REFERENCES:**

1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1st edition (2018)
2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1st edition (2016)
3. Let Us Python, Yashwant Kanetkar, BPB publication , 1st edition (2019)
4. Programming in Python3, Mark Summerfield, Pearson Education, 2<sup>nd</sup> edition (2018)
5. Learning Python, LutzM, O'Reilly- Shroff, 5<sup>th</sup> edition, 2013.
6. Beginning Python, Magnus LieHetland, Apress, 2<sup>nd</sup> edition, 2009
7. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi.
8. Schaum's Outline Of Theory And Problems Of Beginning Statistics, Larry J. Stephens, Schaum's Outline Series Mcgraw-Hill
9. <https://docs.python.org/3/tutorial/index.html>
10. <https://r4ds.hadley.nz/>
11. <https://support.microsoft.com/en-us/excel>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

**Name & Signature of the Ad-hoc BoS Chairperson:** Dr.Shiji Johnson



**Name & Signature of the Dean:** Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Vertical - 2  
Minor Course**

**Not Applicable**

**with effect from  
Academic Year 2025-2026**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Vertical - 3  
Open Elective Course – 2+2 Credits**

**with effect from  
Academic Year 2025-2026**



HSNC Board's

# Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

(Affiliated to the University of Mumbai)

University College Code: 217 | JD Office: T14



Estd. Year  
1965

## Faculty of Interdisciplinary

### Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester - I

Sr. No.	Nomenclature of the Paper
1	Basic Computer Skills for Digital Age
2	Visual Design and Digital Tools : A Foundation For Animation
3	Basic Tools of AI for Economics and Education
4	Communicative English
5	Urbanization and Real Estate: Concepts and Contemporary Scenarios
6	Business of Travel and Tours
7	Managing Family Wealth Through Family Office
8	Web Designing Essentials: HTMLI and CSS Styling Techniques
9	Basics of Nutrition
10	Lessons of Reel Making
11	Performing Arts
12	Data Analysis with Excel
13	Political Communication and Media Skills
14	Stress Management-I
15	Social Media and Communication
16	Mushroom Cultivation: Training and Trading
17	Yoga and Fitness
18	Basic Perfumeries Course (Level-I)
19	Soft Skills for Corporate Readiness
20	Beautician : Strategic Business Planning
21	Current Trends of Fashion Design: Financial Perspective
22	Basics of Accounting-I
23	Digital Marketing
24	Online Trading in Stock Market
25	Event Management Course in Sindhi



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Title: Excel for Business**

**Vertical - 4  
Vocational Skill Course (VSC) - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Excel for Business**

**Course Code: CHMDSI5**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	<b>Excel for Business</b> is a course aimed at equipping professionals with the skills to use Microsoft Excel for financial analysis, data management, and informed decision-making. Highly relevant in today's data-driven business environment, it emphasizes real-world applications such as budgeting, forecasting, and risk analysis. The course complements finance, accounting, and business analytics programs by bridging theoretical concepts with hands-on modelling. With Excel proficiency in high demand across industries, this course enhances career prospects in roles like financial analyst, business analyst, and management accountant.
<b>2</b>	<b>Vertical 4</b>	Vocational Skill Course (VSC)
<b>3</b>	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	30 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b>	<b>CO(A) 1.</b> Understand the basics of spreadsheets and financial models, and learn about different types and their uses. <b>CO(A) 2.</b> Learn how to choose the right tools and techniques to build effective financial models. <b>CO(A) 3.</b> Design well-structured, accurate financial models using good layout practices and flowcharts.

	<p><b>CO(A) 4.</b> Use Excel, including advanced functions, to create, manage, and present financial models.</p> <p><b>CO(A) 5.</b> Plan financial modelling projects, manage data requests, and use tools to clearly display model results.</p>
8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Understand spreadsheet basics and the key components of financial models.</p> <p><b>CO 2:</b> Select suitable financial models and tools for different business needs.</p> <p><b>CO 3:</b> Design clear, accurate, and well-organized financial models using best layout and visualization practices.</p> <p><b>CO 4:</b> Use Excel features, including functions, shortcuts, and data handling tools, for financial modelling tasks effectively.</p> <p><b>CO 5:</b> Apply advanced Excel techniques like aggregation, lookup, regression, PivotTables, and formatting to analyze and present financial data.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Financial Modelling:</b> Spreadsheet and a Financial Model, Types and Purposes of Financial Models, Tool Selection, Model Design, Design Issues, The Workbook Anatomy of a Model, Steps to Building a Model, Workbook Layout and Best Practices.</li> <li>• <b>Modular worksheet design:</b> Input, Processing and Output Sheets. Importance of Version Control and Backups.</li> <li>• <b>Using Excel in Financial Modelling:</b> Formulas and Functions in Excel, Handy Excel Shortcuts, Cell Referencing, Named Ranges, Basic Excel Functions (SUM, AVERAGE, COUNT, MAX, MIN — for summarizing business data)., Logical Functions (IF, AND, OR, NOT), Error-Handling Functions (IFERROR, ISERROR, and ISNA).</li> <li>• <b>Functions for Financial Modelling:</b> Aggregation &amp; LOOKUP Functions, Regression Analysis, Choose Function, Working with Dates, Financial Project Evaluation Functions, Loan Calculations.</li> <li>• <b>Tools for Model Display and Financial Modelling:</b> Basic Formatting, Conditional Formatting, Customising the Display Settings, Form Controls, Hiding Sections, Grouping, Array Formulas, Structured Reference Tables, PivotTables, Freezing Panes, Grouping, and Hiding.</li> </ul>

**UNIT II:**

- **Common Uses of Tools in Financial Modelling:** Understanding Nominal and Effective (Real) Rates, Calculating a Cumulative Sum (Running Totals), How to Calculate a Payback Period, Modelling Depreciation Methods, Break-Even Analysis.
- **Stress Testing, Scenarios, and Sensitivity Analysis in Financial Modelling:** What are the Differences Between Scenario, Sensitivity, and What-If Analyses? Overview of Scenario Analysis Tools and Methods, Advanced Conditional Formatting, Comparing Scenario Methods, Adding Probability to a Data Table.
- **Presenting Model Output:** Preparing an Oral Presentation for Model Results, Preparing a Graphic or Written Presentation for Model Results, Chart Types, Working with Charts, Handy Charting Hints, Dynamic Named Ranges, Charting with Two Different Axes and Chart Types, Creating a Dynamic Chart, Waterfall Charts.

**10****Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

<b>Q. No</b>	<b>Structure of the Questions</b>	<b>Marks</b>
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Financial Modelling and Decision-Making Case Studies, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**REFERENCES:**

1. Using Excel for Business and Financial Modelling: A Practical Guide, by Danielle Stein Fairhurst, Wiley, 3<sup>rd</sup> Edition, 2019
2. Microsoft Excel Professional 2021 Guide: Complete Excel Reference, by CA Manmeet Singh Mehta, Paperback, 1<sup>st</sup> Edition, 2022
3. Microsoft Excel: Advanced Microsoft Excel Data Analysis for Business, by John Slavio, Hardcover, 1st Edition, 2019
4. Excel: Excel for Business, by Francesco Iannello, Createspace, 2016
5. <https://www.w3schools.com/excel/>
6. <https://support.microsoft.com/en-us/excel>
7. <https://exceljet.net/>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- I**

**Title: Office Tools for Data Scientists**

**Vertical - 4  
Skill Enhancement Course (SEC) - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Office Tools for Data Scientists

**Course Code: CHMDSI6**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	<b>Office Tools for Data Scientists</b> is a course designed to equip data professionals with essential skills in using popular office applications for data analysis, visualization, and communication. It covers data cleaning, collaborative work, interactive documentation, and effective reporting, enhancing the ability to extract and present insights from diverse datasets. The course complements core data science subjects by focusing on real-world applications and communication of results. With growing industry demand for data scientists who can manage and present data effectively, this course boosts employability for roles like Data Analyst and Business Intelligence Analyst. It also prepares participants for emerging trends such as AI-driven analytics and collaborative coding environments.
2	<b>Vertical 4</b>	Skill Enhancement Course (SEC)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> Instruct participants on importing data using Excel, OpenOffice, and statistical environments. <b>CO(A) 2.</b> Instruct participants on conducting Descriptive Statistics in Excel, OpenOffice, and statistical environments.	

	<p><b>CO(A) 3.</b> Instruct participants on conducting Correlation, Regression, Confidence Intervals, Random Sampling across multiple statistical tools.</p> <p><b>CO(A) 4.</b> Introduce participants to Power analysis, F-Test, Regression/Correlation analysis using R/RStudio/Rattle, Excel, KNIME.</p> <p><b>CO(A) 5.</b> Familiarize participants with additional data packages and the Analysis ToolPak.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Acquire proficiency in importing data across various platforms.</p> <p><b>CO 2:</b> Generate descriptive statistics using a variety of tools.</p> <p><b>CO 3:</b> Apply correlation tests, Regression, Confidence Intervals, Random Sampling in Excel, OpenOffice, RStudio/Rattle, and KNIME.</p> <p><b>CO 4:</b> Master power analysis techniques, F-Test, and regression/correlation analysis using various statistical tools.</p> <p><b>CO 5:</b> Use additional data packages and the Analysis ToolPak for diverse analysis needs.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Data Tools:</b> Why Data Analysis (Data Science) at All? Where to Get Data, Characteristics of Modern Data Tools: Ease of Use, Cloud Availability and Accessibility, Regular Updates and Integration with AI.</li> <li>• <b>Importing Data:</b> Excel, Excel Analysis ToolPak, OpenOffice, Import into R and Rattle, Import into RStudio, Rattle Import, Import into KNIME, Stoplight Approach; Cloud Integration: Importing from Google Drive, OneDrive, Dropbox</li> <li>• <b>Statistical Tests:</b> Descriptive Statistics, Excel, OpenOffice, RStudio/Rattle, KNIME, Cumulative Probability Charts, Excel, OpenOffice, R/RStudio/Rattle, KNIME, Excel, OpenOffice, R/RStudio/Rattle, KNIME.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>More Statistical Tests:</b> Confidence Interval, Excel, OpenOffice, RStudio/Rattle, KNIME, Random Sampling, Excel, OpenOffice, RStudio/Rattle, KNIME. Lift Charts in KNIME.</li> <li>• <b>Statistical Methods for Specific Tools:</b> Power, R/RStudio/Rattle, F-Test, Excel, R/RStudio/Rattle, KNIME, Multiple Regression/Correlation, Excel, OpenOffice,</li> </ul>

R/RStudio/Rattle, KNIME, Benford's Law, Rattle, Lift, KNIME, Wordcloud, R/RStudio, KNIME, Filtering, Excel, OpenOffice, RStudio/Rattle, KNIME. Using ChatGPT and AI Tools for Summary, Insights, and Visualizations.

- **Additional Data:** Packages, Analysis ToolPak.

**10**

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11**

**REFERENCES:**

1. Data Science Tools, by Christopher Greco, MERCURY LEARNING, 1st Edition, 2019
2. R for Data Science, by Hadley Wickham, Garrett Golemund, O'Reilly, 1st Edition, 2016
3. Data science with KNIME, by Dr Nickholas Anting, NASPSOFT, 1st Edition, 2022
4. Beginning OpenOffice Calc, by Jacek Artymiak, Apress, 2011

- |  |  |
|--|--|
|  | <ol style="list-style-type: none"><li>5. "Practical Statistics for Data Scientists" by Peter Bruce &amp; Andrew Bruce, 3rd Edition, O'Reilly, 20</li><li>6. "Excel Data Analysis for Dummies" by Paul McFedries, Wiley, 2022</li><li>7. "Data Smart: Using Data Science to Transform Information into Insight" by John W. Foreman, Wiley</li><li>8. "Mastering KNIME" by Clemens Grelck, Packt Publishing, 2021</li><li>9. <a href="https://www.w3schools.com/excel/">https://www.w3schools.com/excel/</a></li><li>10. <a href="https://www.w3schools.com/r/">https://www.w3schools.com/r/</a></li><li>11. <a href="https://www.knime.com/">https://www.knime.com/</a></li></ol> |
|--|--|

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B.Sc.**

**Semester- I**

**Vertical – 5**

**Ability Enhancement Course (English)  
2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Introduction to Communication Skills in English**

**Course Code: CHMBSCAECI**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>Effective communication is the cornerstone of academic and professional success. This course introduces learners to foundational skills in English communication, with a focus on both oral and written competencies essential in academic, social, and workplace contexts. It aims to equip learners with the ability to read critically, write precisely, speak confidently, and listen actively. Emphasis is placed on building clarity, coherence, and conciseness in communication, along with an understanding of audience, purpose, and tone.</p> <p>The course integrates grammar reinforcement, vocabulary building, reading comprehension, and practice-oriented modules such as email etiquette, group discussion, and formal writing. Through dynamic classroom interactions and practical assessments, learners will gain confidence in using English effectively and purposefully.</p>
2	<b>Vertical 4</b>	Ability Enhancement Course
3	<b>Type</b> Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>  CO(A)1: To introduce learners to the fundamentals of effective communication and its components.  CO(A)2: To enhance learners' reading comprehension through exposure to multiple genres and contexts.  CO(A)3: To develop grammatical accuracy and lexical resourcefulness for academic and professional communication.  CO(A)4: To strengthen verbal and non-verbal presentation skills and promote interactive speaking abilities.	

	CO(A)5: To build competence in real-world writing tasks such as email drafting, bio-data preparation, and descriptive writing.
<b>8</b>	<b>Course Outcomes:</b> Student will be able to  CO-1: Understand and apply key principles of effective communication in varied contexts. CO-2: Comprehend and analyze written texts using appropriate reading strategies. CO-3: Recognize and correct common grammatical and lexical errors. CO-4: Engage in clear, confident, and context-appropriate spoken interactions. CO-5: Produce structured, coherent, and grammatically correct written content for academic and workplace use.

## Syllabus

### UNIT I: Foundations of English Communication

#### A) Core Concepts of Communication

- Principles of Effective Communication: The 7 Cs
- Verbal and Non-verbal Communication with Examples
- Cross-cultural Communication in the Globalized World
- Technology in Communication: Email, Messaging, Video Conferencing
- Listening for Detail and Intent: Barriers to Listening and Strategies

#### B) Reading Comprehension

- Understanding the Main Idea and Supporting Details
  - Interpreting Tone, Purpose, and Bias
  - Using Context Clues for Vocabulary Building
  - Reading Visual Texts: Graphs, Charts, and Infographics
- Sample readings will include excerpts from news articles, reports, editorials, and educational essays (200–250 words).*

#### C) Grammar and Vocabulary

- Subject-Verb Agreement
- Sentence Structures
- Punctuation and Capitalization
- Commonly Confused Words
- Editing and Proofreading Practice

*A remedial and functional approach will be followed with contextual exercises.*

### UNIT II: Applied Communication Skills

#### A) Speaking and Listening Skills

- Introducing Oneself in Academic/Professional Settings
- Participating in Group Discussions and Expressing Opinions
- Delivering a Short Speech (2–3 minutes) on Familiar Topics
- Understanding and Responding to Instructions
- Listening Comprehension Practice through Audio/Video Clips

#### B) Functional Writing Skills

- Formal Email Writing with Subject and Tone Sensitivity
- Descriptive Paragraph Writing (People, Places, Processes)
- Bio-data and Resume Writing
- Drafting Job Applications (Solicited and Unsolicited)
- Writing a Statement of Purpose

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Question No	Nature of Questions	Marks
Q. 1	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 1</b> <b>OR</b> <b>Essay-Type Question</b> (Attempt any 1 out of 2)- <b>Unit 1</b>	15
Q. 2	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 2</b> <b>OR</b> <b>Essay-Type Question</b> (Attempt any 1 out of 2)- <b>Unit 2</b>	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Students are required to draft a job application letter along with a resume using the following AI assistance: Canva Resume Builder, Resume.oi, Zety, Novopresume, Rezi etc <b>OR</b> Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	<b>Total</b>	<b>20</b>


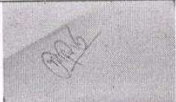

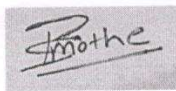
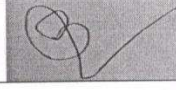
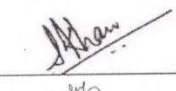
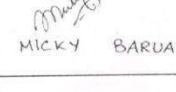

11

**REFERENCES:**

1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Barrass, Robert. *Students Must Write: A Guide to Better Writing in Coursework and Examinations*. Routledge, 2005.
4. Brown, Gillian, and George Yule. *Teaching the Spoken Language: An Approach Based on the Analysis of Conversational English*. Cambridge UP, 1983.
5. Carnegie, Dale. *The Quick and Easy Way to Effective Speaking*. Pocket Books, 2006.
6. Chaney, Lillian, and Jeanette Martin. *Intercultural Business Communication*. 6th ed., Pearson, 2014.
7. Cullen, Pauline, et al. *English Grammar in Use Supplementary Exercises*. Cambridge UP, 2019.
8. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.

9. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
10. Hewings, Martin. *Advanced Grammar in Use: A Self-study Reference and Practice Book for Advanced Learners of English*. 3rd ed., Cambridge UP, 2013.
11. Jones, Leo. *Functions of English: Communication Practice in English*. Cambridge UP, 1981.
12. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
13. Lynch, Tony. *Listening in Language Learning*. Longman, 1988.
14. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
15. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
16. Quirk, Randolph, et al. *A Comprehensive Grammar of the English Language*. Longman, 1985.
17. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
18. Straus, Jane, et al. *The Blue Book of Grammar and Punctuation*. 12th ed., Jossey-Bass, 2021.
19. Wallace, Catherine. *Reading*. Oxford UP, 1992.
20. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

### Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University)	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr.) Kailas Aute



Name & Signature of the Dean: Prof. (Dr.) Nitin Arekar



**Smt**  
**Smt. Chandibai Himathmal Mansukhani College**  
**(Autonomous)**

**First Year**

**Semester- I**

**Title: Communication Skills in Sindhi**

**Vertical - 5**  
**Ability Enhancement Course**  
**2 Credit**

**with effect from**  
**Academic Year 2025-2026**

## Title: Communication Skills in Sindhi

**COURSE CODE: CHMSINIAEC**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	Communication is the core component of commerce and trade. In communication, language plays very significant role. If a student has mastered the skills of language, undoubtedly, he or she would be able to communicate in the best manner. In this course basic part of Sindhi language would be taught based on the NEP 2020. Innovative approaches like critical thinking, creative mind, and use of technology will lead to communicating and participating with different groups. The vocabulary section would be given prominence. The course would be in the Devanagari script so that it can attract majority of the students. Even non-Sindhi students shall have opportunity to adopt this course.
2	<b>Vertical 1</b>	AEC – Ability Enhancement Course
3	<b>Type</b>	Theory + Practicum (Teaching Method: Lecture/ Discussion/Reading)
4	<b>Credit</b>	2 credits (1 credit = 15 hours for theory or 30 hours of Practical work in a semester)
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50Marks
7	<b>Course Objectives:</b> After successful completion of this course: <b>CO(A) 1:</b> The learner will get understanding of communication skills. <b>CO(A) 2:</b> The learner will understand how to accurate the pronunciation of special words in Sindhi <b>CO(A) 3:</b> The learner will improve the conversation skill in Sindhi. <b>CO(A) 4:</b> The learner will become best communicator in Sindhi language	
8	<b>Course Outcomes:</b> Student will be able to <b>CO1:</b> Know the basic special features of Sindhi language. <b>CO2:</b> Understand communication skills. <b>CO3:</b> Knowing the conversation with businessmen and customers <b>CO4:</b> Know the etiquettes with parents, relatives, friends and others in effective way	

## Syllabus

### UNIT I: Fundamental of Sindhi Communication

- Introduction of Communication skills through Pictorial Presentation
- Importance of Language
- Basic aspects of language:
  - i) Types of Language, ii) Role of Language, iii) Changes in Language iv) Non-violent aspects of language v) Language & New generation vi) Language & Modern technology
- New Education Policy (NEP) & Importance of language
- Sindhi language: (Special features of spoken Sindhi language with pronunciation through audio visual presentation)

### UNIT II: Functional Communication

- Importance of Communication
- Types of Communication (Presentation through video clips):
  - i) Verbal, ii) non-verbal, iii) Written iv) Digital Communication
- Characteristics of Communication
- Obstacles in Communication of Sindhi Language
- Methods of Best Communication through role plays
- Spoken Sindhi in Business
- Conversation with customers and proprietors

\*\*\*\*\*

## Syllabus

### यूनिट १: सिंधी राबते जो बुनियाद

- संचारी भाषा: वाक्फियत
- भाषा जी अहमियत
- भाषा जा बुनियादी पहलू  
१) किस्म, २) भाषा जो किरदार, ३) भाषा मे तबदीलियूं, ४) भाषा जा अहिसासाती पहलू ५) बोली ऐ नई पीड़ी  
६) बोली ऐ जदीद टेकनालाजी
- नई तैलीमी नीति ऐं बोलियुन जी अहमियत
- असां जी सिंधी बोली

### यूनिट २: अमली राबतो (असराइतो गालाइण जो तरीको)

- राबते जी अहमियत
- राबते जा किस्म  
१) जिबानी राबतो, २) गैर जिबानी राबतो, ३) लिख्त राबतो ४) डिजीटल राबतो राबते मां फायदा
- राबते में रंडकुं
- बेहतर राबते जा तरीका
- ग्राहकन सां सिंधी बोलीअ मे गुप्तगू
- कारोबार में सिंधी गालाइण

\*\*\*\*\*

**10****Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

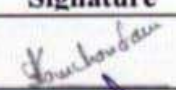
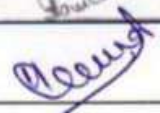
Question No	Nature of Questions	Marks
Q1.A)	Objective Type Questions (Unit- I)	05
Q1.B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-I)	10
Q2.A)	Objective Type Questions (Unit- II)	05
Q2.B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-II)	10
<b>Total</b>		<b>30</b>
<b>Internal Examination: Continuous Evolution - 20 marks</b>		<b>Total 30</b>

	Assessment / evaluation	Marks
1.	<b>Written assignment on any one of the following topics</b> 1) Draft a Notice and Report writing in Sindhi 2) Simulate dialogues such as interview, daily conversation and public speaking in Sindhi (Students are required to use AI assistance in the preparation of their drafts. Eg: Microsoft Copilot, Google Gemini, Google voice Typing tool)	15
2.	Class Attendance and Participation	05
<b>Total</b>		<b>20</b>

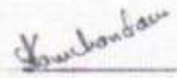
**11****REFERENCE BOOKS:**

1. Sanchari Basha – By Dr. Pushpa Kodwani
2. Sindhi Pahakaa – Dr. Jetly M.K.
3. Sindhi Muhavahra – By Hardwani Lachhman
4. Sindhi Adhyat mak Shabdhkesh – By Hardwani Lachhman
5. Acho Sindhi Sikhu – By Hardwani Lachhman


**Syllabus Committee:**

Sr No	Name of the Faculty	Designation and College	Signature
1.	Dr. Kajal Ramchandani	H.O.D. of Jai Hind College	
2.	Mrs. Komal Totani	Faculty In-Charge, Smt. CHM College	

Name & Signature of the BoS Chairperson: (Dr. Kajal Ramchandani)



Name & Signature of the Dean: (Dr. Nitin Arekar)





**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester - I**

**Title: Environmental Management and  
Sustainable Development-I**

**Vertical - 5  
VEC Subject - 2 Credits**

**With effect from  
Academic Year 2025-2026**

**Title: Environmental Management and Sustainable Development-I**  
**Course Code: CHMVECI**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course introduces students to the basics of environmental management and sustainable development. It explains how ecosystems work, the importance of biodiversity, and the need to protect our natural resources. Students will learn about different environmental problems, human impact on nature, and how to manage disasters. The course also covers Indian environmental movements, ethics, and the role of public awareness. Real-life examples and case studies help students understand the connection between nature and human communities in a simple and practical way.
2	<b>Vertical 5</b>	VEC
3	<b>Type &amp; Teaching Methods</b>	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To introduce about ecosystems, biodiversity and to make aware for the need of conservation.</p> <p><b>CO(A)2:</b> To sensitize students towards environmental concerns, issues, and impacts of human population.</p> <p><b>CO(A)3:</b> To analyze the impact of human population growth and development activities on the environment, including issues related to displacement, disaster response, and rehabilitation.</p> <p><b>CO(A)4:</b> To foster awareness of environmental ethics and the role of cultural and social movements in shaping sustainable environmental practices through communication, policy, and activism.</p>
8	<b>Course Outcomes:</b>	<p>Student will be able to</p> <p><b>CO1:</b> Explain the interrelationships within ecosystems and analyze energy flow and succession, using examples from various ecological zones.</p> <p><b>CO2:</b> Critically evaluate biodiversity levels and conservation strategies, applying knowledge of endemic species, threats, and ecological services to real-world scenarios.</p> <p><b>CO3:</b> Assess the socio-environmental implications of population growth, displacement, and disasters, incorporating case studies to understand sustainable development challenges.</p> <p><b>CO4:</b> Demonstrate an understanding of environmental ethics and advocacy, by interpreting the influence of cultural values, environmental movements, and communication strategies on sustainability.</p>

9

## Syllabus

### UNIT I: Ecosystems, Biodiversity and Conservation

- Introduction, structure, and function of ecosystems; Energy flow: food chains, food webs and ecological succession. Case studies of the following:
  - Forest ecosystem
  - Grassland ecosystem
  - Desert ecosystem
  - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)
- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns.
- India as a mega-biodiversity nation; Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value.

### UNIT II: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi).

10

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hours**

Format of Question Paper

**Attempt any 3 out of 4 questions.**

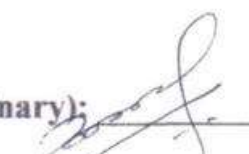
Question No	Nature of Questions	Marks
Q1	Theory based on Unit I	10
Q2	Theory based on Unit I	10
Q3	Theory based on Unit II	10
Q4	Theory based on Unit II	10
<b>TOTAL</b>		<b>30</b>

<b>Internal Examination: Continuous Evaluation - 20 marks</b>		
	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test, Creative writing/visits/role play (Short notes/ MCQ's/ Match the Pairs/ Answer in one sentence/ Quiz)	10
2.	Project /Presentation / Viva/Group Discussion/Case study	10
<b>TOTAL</b>		<b>20</b>

<b>11</b>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Carson, R. (2002). <i>Silent Spring</i>. Houghton Mifflin Harcourt.</li> <li>2. Gadgil, M., &amp; Guha, R. (1993). <i>This Fissured Land: An Ecological History of India</i>. University of California Press.</li> <li>3. Gleeson, B., &amp; Low, N. (Eds.). (1999). <i>Global Ethics and Environment</i>. Routledge.</li> <li>4. Gleick, P. H. (1993). <i>Water in Crisis</i>. Pacific Institute for Studies in Development, Environment &amp; Security; Stockholm Environment Institute; Oxford University Press.</li> <li>5. Sodhi, N. S., Gibson, L., &amp; Raven, P. H. (Eds.). (2013). <i>Conservation Biology: Voices from the Tropics</i>. John Wiley &amp; Sons.</li> <li>6. Thapar, V. (1998). <i>Land of the Tiger: A Natural History of the Indian Subcontinent</i>.</li> <li>7. Warren, C. E. (1971). <i>Biology and Water Pollution Control</i>. W. B. Saunders.</li> <li>8. Wilson, E. O. (2006). <i>The Creation: An Appeal to Save Life on Earth</i>. W. W. Norton.</li> <li>9. Harper, Charles L. (2017). <i>Environment and Society: Human Perspectives on Environmental Issues</i> (6th Edition). Routledge.</li> <li>10. Rajagopalan, R. (2011). <i>Environmental Studies: From Crisis to Cure</i>. Oxford University Press.</li> <li>11. Harris, Frances (2012). <i>Global Environmental Issues</i> (2nd Edition). Wiley-Blackwell.</li> </ol>
-----------	--

Name & Signature of the Dean & Ad-hoc BoS Chairperson (Interdisciplinary):

  
 Dr. Nitin Arekar



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester - I**

**Title: Indian Knowledge System**

**Vertical - 5  
IKS Subject - 2 Credits**

**With effect from  
Academic Year 2025-2026**

**Title: Indian Knowledge System**  
**Course Code: CHMIKSI**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course introduces students to the Indian Knowledge System (IKS), emphasizing its historical depth, cultural relevance, and interdisciplinary value. Rooted in the context of Indian civilization, it explores the holistic development of knowledge from ancient to pre-modern times, including contributions in medicine, mathematics, logic, linguistics, governance, arts, and sciences. By revisiting the traditional education systems and intellectual heritage of India, the course encourages learners to connect ancient insights with contemporary disciplines. It aims to enhance awareness, foster appreciation of indigenous wisdom, and reveal the interconnectedness of various streams of knowledge, aligning with the goals of the NEP 2020.
2	<b>Vertical 5</b>	IKS
3	<b>Type &amp; Teaching Methods</b>	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A)1:</b> To sensitize the students about context in which they are embedded i.e. Indian culture and civilization including its Knowledge System and Tradition. <b>CO(A)2:</b> To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system. <b>CO(A)3:</b> To help to study the enriched scientific Indian heritage. <b>CO(A)4:</b> To introduce the contribution from Ancient Indian system & tradition to modern science & Technology.	
8	<b>Course Outcomes:</b> Student will be able to <b>CO1:</b> Understand and appreciate the rich Indian Knowledge Tradition. <b>CO2:</b> Understand the contribution of Indians in various fields. <b>CO3:</b> Experience increase subject-awareness and self-esteem. <b>CO4:</b> Develop a comprehensive understanding of how all knowledge is ultimately intertwined.	

## Syllabus

### UNIT I: Introduction

- **Introduction to IKS** (What is knowledge System, Characteristic Features of Indian Knowledge System)
- **Why IKS?** (Macaulay's Education Policy and its impact, Need of revisiting Ancient Indian Traditions)
- **Scope of IKS** (The Universality of IKS (from Micro to Macro), development form Earliest times to 18th Century CE)
- **Tradition of IKS** (Ancient Indian Education System: Home, Gurukul, Pathashala, Universities and ancient educational centres)
- **Relevant sites in the vicinity of the Institute** (Water Management System at Kanheri, Temple Management of Ambernath, etc.)

### UNIT II


- Medicine (Ayurveda)
- Alchemy
- Mathematics
- Logic
- Art of Governance (Arthashastra)

### UNIT III (Select Any FIVE out of the following)

- Aesthetics
- Town Planning
- Strategic Studies
- Krishi Shastra
- Vyakaran & Lexicography
- Natyashastra
- Ancient Sports
- Astronomy
- Yoga and Wellbeing
- Linguistics
- Chitrasutra
- Architecture
- Taxation
- Banking
- Trade and Commerce

<b>10</b>	<p><b>Scheme of Examination and Assessment Pattern</b> Paper – 50 Marks</p> <p><b>External Examination: Semester End External - 30 marks Time: 1:00 hours</b> Format of Question Paper</p> <p><b>Attempt all questions.</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Question No</th> <th style="text-align: center;">Nature of Questions</th> <th style="text-align: center;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Q1</td> <td>Attempt any two out of five</td> <td style="text-align: center;">06</td> </tr> <tr> <td style="text-align: center;">Q2</td> <td>Attempt any three out of five</td> <td style="text-align: center;">12</td> </tr> <tr> <td style="text-align: center;">Q3</td> <td>Attempt any three out of fifteen</td> <td style="text-align: center;">12</td> </tr> <tr> <td style="text-align: center;"><b>TOTAL</b></td> <td></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <p><b>Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"></th> <th style="text-align: center;">Assessment / evaluation</th> <th style="text-align: center;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Class test during lectures (MCQ / Short notes / Match the pairs / Puzzles)</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Participation in Workshop / Conference / Seminar / Case Study / Field Visit / Certificate Course / Project presentation / Viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;"><b>TOTAL</b></td> <td></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>	Question No	Nature of Questions	Marks	Q1	Attempt any two out of five	06	Q2	Attempt any three out of five	12	Q3	Attempt any three out of fifteen	12	<b>TOTAL</b>		<b>30</b>		Assessment / evaluation	Marks	1.	Class test during lectures (MCQ / Short notes / Match the pairs / Puzzles)	10	2.	Participation in Workshop / Conference / Seminar / Case Study / Field Visit / Certificate Course / Project presentation / Viva	10	<b>TOTAL</b>		<b>20</b>
Question No	Nature of Questions	Marks																										
Q1	Attempt any two out of five	06																										
Q2	Attempt any three out of five	12																										
Q3	Attempt any three out of fifteen	12																										
<b>TOTAL</b>		<b>30</b>																										
	Assessment / evaluation	Marks																										
1.	Class test during lectures (MCQ / Short notes / Match the pairs / Puzzles)	10																										
2.	Participation in Workshop / Conference / Seminar / Case Study / Field Visit / Certificate Course / Project presentation / Viva	10																										
<b>TOTAL</b>		<b>20</b>																										
<b>11</b>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Concise history of science in India- D.M. Bose, S.N Sen, B.V. Subbarayappa.</li> <li>2. Positive sciences of the Ancient Hindus- Brajendranatha seal, Motilal Banrasidas, Delhi 1958.</li> <li>3. History of Chemistry in Ancient India &amp; Medieval India, P. Ray- Indian Chemicals Society, Calcutta 1956.</li> <li>4. Charaka Samhita- a scientific synopsis, P. Ray &amp; H.N Gupta National Institute of Sciences of India, New Delhi 1965.</li> <li>5. MacDonnell A.A- History of Sanskrit literature.</li> <li>6. Winternitz M- History of Indian Literature Vol. I, II.</li> <li>7. Dasgupta S.N &amp; De S.K- History of Sanskrit literature Vol' I.</li> <li>8. Ramkrishna Mission- cultural heritage of India Vol' I, II.</li> <li>9. Majumdar R. C &amp; Pushalkar A.D- History &amp; culture of the Indian people, Vol. I, II &amp; III.</li> <li>10. Keith A.B- History of Sanskrit literature.</li> </ol>																											

Name & Signature of the Dean & Adhoc BoS Chairperson(Interdisciplinary):

  
 ( Dr. Nitish Arekar )



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester- I**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>															
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2–3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>															
10	<b>Scheme of Examination and Assessment Pattern</b> <b>Based on 3 approved Activities</b> <b>Semester End External - 30 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>
Activity No	Nature of Activities	Marks														
1.	Title of Approved Activity - 1	10														
2.	Title of Approved Activity - 2	10														
3.	Title of Approved Activity - 3	10														
<b>Total</b>		<b>30</b>														
	<b>Internal Examination: Continuous Evaluation – 20 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Assessment / Evaluation</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>			
	Assessment / Evaluation	Marks														
1.	Reflective journal	10														
2.	Presentation/ poster presentation/viva	10														
<b>Total</b>		<b>20</b>														

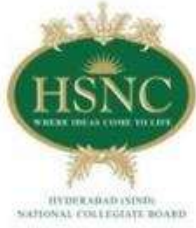
**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak





**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar  
(Autonomous)  
Affiliated to the University of Mumbai**

**Bachelor of Science  
(Data Science)  
(Self-Financing Course)**

**Semester – II**

**Choice Based and Credit Based syllabus  
as per NEP 2020 with effect from the Academic  
Year 2025-2026**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- II**

**Title: Advanced Python Programming**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Advanced Python Programming

**Course Code: CHMDSIII**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	The Advanced Python Programming course is designed for developers looking to deepen their expertise and stand out in today's tech-driven world. Its relevance stems from the growing industry need for professionals who can work confidently with complex Python concepts and build scalable, efficient solutions. The skills gained are immediately useful across software development, data analysis, and automation, making the course a strong complement to other programming studies. As Python continues to dominate in advanced applications, employers increasingly seek developers with this level of proficiency, creating strong demand and excellent career prospects. Completing the course opens doors to roles such as software architect and technical lead, offering significant opportunities for growth in fields where advanced Python skills are essential.
<b>2</b>	<b>Vertical 1</b>	Major
<b>3</b>	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	30 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b>	<b>CO(A) 1.</b> Strengthen advanced Python programming skills including OOP, multithreading, exception handling, and GUI development. <b>CO(A) 2.</b> Enable database interaction and application development with data storage and retrieval.

	<p><b>CO(A) 3.</b> Introduce scientific computing and data analysis using NumPy and Pandas.</p> <p><b>CO(A) 4.</b> Develop skills in data visualization using Matplotlib and Seaborn.</p> <p><b>CO(A) 5.</b> Equip students to design and implement end-to-end Python applications for real-world problems.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Implement Python programs using classes, inheritance, and method overriding.</p> <p><b>CO 2:</b> Create multithreaded applications and handle exceptions effectively.</p> <p><b>CO 3:</b> Develop interactive GUI applications with Python widgets.</p> <p><b>CO 4:</b> Manipulate, analyze, and combine datasets using NumPy and Pandas.</p> <p><b>CO 5:</b> Visualize data and integrate Python applications with databases for practical solutions.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Classes and Objects:</b> Overview of Object Oriented Programming, Class Definition, Data Hiding, Data Encapsulation, Creating Objects, Instances as Arguments, Instances as return values, Built-in Class Attributes, Inheritance, Method Overriding, Constructors and Destructors, Access Specifiers in Python, Polymorphism, Abstraction in Python.</li> <li>• <b>Multithreading and Exception Handling:</b> Thread Module, Creating a Thread, Synchronizing Threads, Built-in Exceptions, and Handling Exceptions.</li> <li>• <b>Graphical User Interface:</b> Creating a GUI in Python, Widgets- Button, Canvas, Checkbutton, Entry, Frame, Label, Listbox, Menubutton, Menu, Message, Radiobutton, Scale, Scrollbar, text, Toplevel, Spinbox, PanedWindow, LabelFrame, tkMessageBox, Handling Standard attributes and Properties of Widgets, Layout Manager, Event Handling.</li> <li>• <b>Working with Databases:</b> Connecting to a MySQL database from Python, Configuring the MySQL connection, Designing the Python GUI database, Using the INSERT command, Using the UPDATE command, Using the DELETE command, Storing and retrieving data from MySQL database.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to NumPy:</b> Understanding Data Types in Python, The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything In Between, Computation on Arrays: Broadcasting, Comparisons, Masks,</li> </ul>

and Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data: NumPy's Structured Arrays.

- **Data Manipulation with Pandas:** Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets: Concat and Append.
- **Combining Datasets:** Merge and Join, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series. High-Performance Pandas: eval() and query(), Data Transformation Techniques, Filtering and Sorting Data, Handling Duplicate Data.
- **Visualization with Matplotlib:** Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends, Customizing Color bars, Multiple Subplots, Text and Annotation, Customizing Ticks, Customizing Matplotlib: Configurations and Stylesheets, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap, Visualization with Seaborn, Bar Charts and Pie Charts, Box Plot and Heatmap Visualization, Statistical Data Visualization using Seaborn, Interactive Visualization Basics.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q.No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10

	<table border="1"> <tr> <td data-bbox="276 199 365 365">2.</td> <td data-bbox="365 199 1273 365">AI-Assisted Python Programming Challenge: Understand, Generate, Debug, and Optimize Code Using Cursor AI, Project, Self-Learning Evaluation, Presentation, etc.</td> <td data-bbox="1273 199 1406 365">10</td> </tr> <tr> <td data-bbox="276 365 365 423"><b>Total</b></td> <td data-bbox="365 365 1273 423"></td> <td data-bbox="1273 365 1406 423"><b>20</b></td> </tr> </table>	2.	AI-Assisted Python Programming Challenge: Understand, Generate, Debug, and Optimize Code Using Cursor AI, Project, Self-Learning Evaluation, Presentation, etc.	10	<b>Total</b>		<b>20</b>
2.	AI-Assisted Python Programming Challenge: Understand, Generate, Debug, and Optimize Code Using Cursor AI, Project, Self-Learning Evaluation, Presentation, etc.	10					
<b>Total</b>		<b>20</b>					
<b>11</b>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1<sup>st</sup> edition (2018)</li> <li>2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1<sup>st</sup> edition (2016)</li> <li>3. Let Us Python, Yashwant Kanetkar, BPB publication , 1<sup>st</sup> edition (2019)</li> <li>4. Programming in Python3, Mark Summerfield, Pearson Education, 2nd edition (2018)</li> <li>5. Learning Python, LutzM, O'Reilly- Shroff, 5th edition, 2013.</li> <li>6. Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009.</li> <li>7. Star Python, Star Certification, Star Certification,1st , 2018.</li> <li>8. <a href="https://docs.python.org/3/">https://docs.python.org/3/</a></li> <li>9. <a href="https://www.w3schools.com/python/">https://www.w3schools.com/python/</a></li> </ol>						

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- II**

**Title: Database Management System**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Database Management System

**Course Code: CHMDSII2**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
1	<b>Description of the Course:</b>	<ul style="list-style-type: none"><li>• <b>Introduction:</b> A Database Management System (DBMS) is software used to store, manage, and retrieve data efficiently while ensuring security and integrity.</li><li>• <b>Relevance:</b> DBMS is essential in business applications for handling large amounts of customer, transaction, and product data efficiently.</li><li>• <b>Applications:</b> DBMS is widely used across industries for effective data management and supports many modern applications.</li><li>• <b>Prerequisites &amp; Course Connection:</b> Basic knowledge of computer architecture, storage, operating systems, and programming helps in understanding DBMS concepts.</li><li>• <b>Industry Demand:</b> DBMS skills are highly valued due to their role in ensuring data integrity, reducing redundancy, supporting data sharing, and maintaining accuracy and security.</li><li>• <b>Job Prospects:</b> Professionals skilled in DBMS are in high demand across industries, as data-driven decision-making continues to grow.</li></ul>
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks

7	<p><b>Course Objectives:</b></p> <p><b>CO(A) 1.</b> To understand data models and entity relationship.</p> <p><b>CO(A) 2.</b> To understand retrieve data and concept of redundancy.</p> <p><b>CO(A) 3.</b> To specify the data requirement in database applications.</p> <p><b>CO(A) 4.</b> To create, manipulate queries in database.</p> <p><b>CO(A) 5.</b> To understand concept of database by organizing, structuring and storing data.</p>
8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Use the concept of database and it's important in software development.</p> <p><b>CO 2:</b> Design database and draw logical structure using Entity relationship.</p> <p><b>CO 3:</b> Construct normalized database and functional dependencies.</p> <p><b>CO 4:</b> Design the database schema with the appropriate data types.</p> <p><b>CO 5:</b> Create, manipulate the database management system to evaluate the business information problem.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction &amp; DBMS Architecture:</b> What is Database? Need of database, Role and Advantages of the DBMS, Types of Databases, Data Processing, Database Systems</li> <li>• <b>Data Models:</b> Data Modelling and Data Models, The Importance of Data Models, Data Model Basic Building Blocks, Business Rules, The evolution of data models, Degrees of Data Abstraction,</li> <li>• <b>Entity Relationship Model and Unified Modelling Language:</b> Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Degree, Recursive Relationships, Associative (Composite) Entities, Developing an ER Diagram.</li> <li>• <b>Advanced Data Modelling:</b> The Extended Entity Relationship Model, Entity Clustering, Entity Integrity: Primary Keys, Design Cases: Learning Flexible Database Design.</li> <li>• <b>SQL for Data Analytics:</b> Introduction to SQL, Joins, Subqueries, Aggregate Functions, Views, Stored Procedures and SQL Queries for Data Analysis and Reporting.</li> </ul>

**UNIT II:**

- **Normalization of Database Tables:** Database Tables and Normalization, The Normalization Process, Surrogate Key Considerations, Higher-Level Normal Forms, Normalization and Database Design.
- **Database Design:** The Information System, The Systems Development Life Cycle, The Database Life Cycle, Conceptual Design, Logical Design, Physical Design, Database Design Strategies, Centralized versus Decentralized Design.
- **Transaction Management and Concurrency Control:** What Is a Transaction? Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods, ANSI Levels of Transaction Isolation, Database Recovery Management, Database Performance Tuning and Query Optimization: Database Performance-Tuning Concepts, Query Processing, Indexes and Query Optimization, Optimizer Choices, SQL Performance Tuning, Query Formulation, DBMS Performance Tuning.
- **Database Administration and Security:** Data as a Corporate Asset, The Need for a Database and Its Role in an Organization, Security, Database Administration Tools, Data Administration Strategy, The DBA's Role in the Cloud, The DBA at Work: Using Oracle for Database Administration.

**10****Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q.No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Case Study on AI-Based Database Management Systems: Intelligent Data Storage, Query Processing, Security, and Predictive Decision-Making, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11 REFERENCES:**

1. Fundamentals of Database Systems by Elmasri Ramez and Navathe Shamkant B, Pearson Education 6th Edition, 2010.
2. Database System Concepts by Silberschatz, Korth, Sudarshan, McGraw Hill, 5th Edition, 2006.
3. Database Management Systems by Ramakrishna, Gehrke, McGraw- Hill, 2007
4. Murach's MySQL Joel Murach, Murach, 2012.
5. Database Systems: Design, Implementation, & Management by Carlos Coronel and Steven Morris, Cengage Learning, 14th Edition, 2022.
6. <https://www.tutorialspoint.com/dbms/index.htm>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- II**

**Title: Major Practical 2**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Major Practical 2

**Course Code: CHMDSII3**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	<p>Advanced Python Programming course provides hands-on training in key Python concepts and practical applications. Students will learn object-oriented programming, multithreading, exception handling, and GUI development, along with database integration using MySQL. The course also emphasizes data manipulation, analysis, and visualization using NumPy, Pandas, and Matplotlib, enabling students to work with real-world datasets. Through practical exercises, participants gain the skills to design, implement, and deploy complete Python applications, preparing them for complex problem-solving and professional software development challenges.</p> <p>Database Management System's practical approach is useful to gain the knowledge for software backend development. It benefits to user by providing data definition, data access, reduced data redundancy, data integrity, data sharing, data organizing, data consistency, data accuracy, and security.</p>
<b>2</b>	<b>Vertical 1</b>	Major
<b>3</b>	<b>Type &amp; Teaching Method</b>	Practical
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	60 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks

7	<p><b>Course Objectives:</b></p> <p><b>CO(A) 1.</b> Develop practical skills in advanced Python programming, including OOP, multithreading, GUI, and database integration.</p> <p><b>CO(A) 2.</b> Perform data manipulation, analysis, and visualization using NumPy, Pandas, and Matplotlib.</p> <p><b>CO(A) 3.</b> Build complete Python applications for real-world problem solving.</p> <p><b>CO(A) 4.</b> To understand relational database design and implement SQL structures, constraints, and essential DML operations.</p> <p><b>CO(A) 5.</b> To retrieve, process, and combine data using basic to advanced queries, including virtual tables and user access control.</p>
8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Implement Python programs using OOP, multithreading, exception handling, and GUI components.</p> <p><b>CO 2:</b> Manipulate, analyze, and visualize data, and perform database operations using Python.</p> <p><b>CO 3:</b> Develop integrated Python applications for practical solutions.</p> <p><b>CO 4:</b> Design, manage, and manipulate databases using SQL operations, table modifications, backups, and aggregate functions.</p> <p><b>CO 5:</b> Retrieve and combine data through advanced queries, create derived tables, and control user access.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Object Oriented Programming Concepts</b> <ol style="list-style-type: none"> <li>a. Design a class that store the information of student and display the same.</li> <li>b. Implement the concept of inheritance using python.</li> <li>c. Create a class called Numbers, which has a single class attribute called MULTIPLIER, and a constructor which takes the parameters x and y (these should all be numbers).           <ol style="list-style-type: none"> <li>i. Write a method called add which returns the sum of the attributes x and y.</li> <li>ii. Write a class method called multiply, which takes a single number parameter a and returns the product of a and MULTIPLIER.</li> </ol> </li> </ol> </li> </ul>

- iii. Write a static method called `subtract`, which takes two number parameters, `b` and `c`, and returns `b - c`.
- iv. Write a method called `value` which returns a tuple containing the values of `x` and `y`. Make this method into a property, and write a setter and a deleter for manipulating the values of `x` and `y`.

- **Classes, Objects, and Inheritance**

- a. Create a Python class `BankAccount` with attributes for account number, account holder, and balance. Include methods to deposit, withdraw, and display balance. Test the class by creating multiple objects.
- b. Implement a class `Employee` with private attributes for name and salary. Use getter and setter methods to access and modify these attributes.
- c. Create a class `Rectangle` with methods to calculate area and perimeter. Use one instance as an argument to another method to compare areas with a second rectangle object.
- d. Demonstrate inheritance by creating a base class `Vehicle` and a subclass `Car` that overrides a method from the base class.

- **Multithreading and Exception Handling**

- a. Write a Python program that creates two threads: one prints numbers from 1–10, and the other prints the square of numbers from 1–10. Use thread synchronization to control execution order.
- b. Create a multithreaded program where two threads print "Hello" and "World" five times each. Ensure the threads run concurrently.
- c. Create a program that accepts user input for a number and divides 100 by that number. Use exception handling to manage `ZeroDivisionError` and `ValueError`.

- **GUI Programming using Tkinter**

- a. Build a GUI calculator with buttons for numbers 0–9 and operations (+, -, \*, /). Display results in an entry widget.
- b. Create a GUI form for user registration with widgets: Entry for name and email, Checkbutton for subscription, Radiobutton for gender, and a Button to submit. Display entered data in a message box.
- c. Write the program for the following:
  - i. Try to configure the widget with various options like: `bg="red"`, `family="times"`, `size=18`.

ii. Try to change the widget type and configuration options to experiment with other widget types like Message, Button, Entry, Checkbutton, Radiobutton, Scale etc.

- **Database Applications**

- a. Design a simple database application that stores the records and retrieve the same.
- b. Design a database application to search the specified record from the database.
- c. Design a database application to that allows the user to add, delete and modify the records.

- **Numpy Array Operations**

- a. Write a Python code to create Numpy Array.
- b. Write a Python code to find minimum elements in array using Numpy.
- c. Write a Python code to find mean of every Numpy array in the given list.
- d. Write a Python code to reverse Numpy array.
- e. Write a Python code to add rows and columns in Numpy array.

- **Array Manipulation Operations**

- a. Write a python code to demonstrate basic operations on single array.
- b. Write a python code to create array with 10 elements and slice element from 1<sup>st</sup> to 5<sup>th</sup> element.
- c. Write a python code to sort an array alphabetically.
- d. Write a python code to create a filter array that will return maximum values from an array.

- **Pandas Series and DataFrame Operations**

- a. Write a python code to demonstrate importing pandas libraries and create data frame object.
- b. Write a Python code to create pandas series from a dictionary of values and array.
- c. Write a Python code to perform arithmetic operations on two pandas series.
- d. Write a Python code to add some data in existing series.

- **DataFrame Selection and Filtering**

- a. Write a Python code to select the rows where percentage greater than 90. Write a Python code to join the two given dataframes along rows and assign all data.
- b. Write a Python code to select rows from dataframe based on values in columns.( use relational and logical operators.)

c. Write python code to filter duplicate rows.

- **Pandas File Handling and Data Processing**

a. Write a python code to demonstrate filter pandas series with Boolean arrays.

b. Write a code to import and export data between pandas and csv files.

c. Read employee.csv file to create dataframe and perform following operations:

i) Display Name, Gender and department of employee.

ii) Display first 5 and last 5 records from employee.csv

d. Write a code to import and export data between pandas and MySQL Database.

e. Write a code to replace all negative values to 0.

**UNIT II:**

- **Database Creation and Management**

a. Display all available databases.

b. Create a new database.

c. Display all tables within a selected database.

- **Table Creation and Data Manipulation**

a. Create tables with and without constraints.

b. Insert, update, and delete records in tables.

c. Perform transaction control operations using COMMIT and ROLLBACK.

- **Table Modification and Database Maintenance**

a. Alter the structure of existing tables.

b. Drop, truncate, and rename tables.

c. Perform database backup and restoration operations.

- **Data Retrieval and Aggregation**

a. Execute simple queries using WHERE clause operators.

b. Use logical operators and SQL keywords with WHERE clause.

c. Perform queries using aggregate functions.

d. Apply GROUP BY and HAVING clauses with aggregate functions.

- **SQL Functions**

a. Implement date functions in SQL queries.

b. Apply string functions for data manipulation.

c. Utilize mathematical functions for computations.

- **Data Retrieval from Multiple Tables**

- a. Perform Inner Join and Outer Join operations.
- b. Use aliases for table names in queries.
- **Subqueries and NULL Handling**
  - a. Write subqueries using the IN clause.
  - b. Write subqueries using the EXISTS clause.
  - c. Handle NULL values in SQL queries.
- **Working with Views**
  - a. Create views.
  - b. Retrieve data from views.
  - c. Drop views.
- **Data Control Language (DCL)**
  - a. Grant permissions to database users.
  - b. Revoke permissions from database users.
- **Employee Payroll Management System (or any domain recommended by the instructor)**
  - a. Identify and define the entities required for the Employee Payroll System.
  - b. Design and create the database and tables with appropriate constraints.
  - c. Insert 10–20 relevant records to support database operations.
  - d. Develop queries using operators, clauses, and SQL functions.
  - e. Create, retrieve, and drop views as required.
  - f. Implement DCL commands using GRANT and REVOKE statements.
  - g. Demonstrate the application of DDL, DML, and DCL commands in the developed system.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	15
Q2	Unit 2	15
<b>Total:</b>		<b>30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	Mini-Projects: Smart Application Development Using Python, SQL, and AI Tools.	10
<b>Total:</b>		<b>20</b>

**11****REFERENCES:**

1. Programming through Python M. T. Savaliya, R.K Maurya, G.M Magar, Staredu Solutions, 1<sup>st</sup> edition (2018)
2. Python DataScience Handbook, Jake VanderPlas, O'Reilly Media, 1<sup>st</sup> edition (2016)
3. Let Us Python, Yashwant Kanetkar, BPB publication , 1<sup>st</sup> edition (2019)
4. Programming in Python3, Mark Summerfield, Pearson Education, 2nd edition (2018)
5. Learning Python, LutzM, O'Reilly- Shroff, 5th edition, 2013.
6. Beginning Python, Magnus LieHetland, Apress, 2nd edition, 2009.
7. Star Python, Star Certification, Star Certification,1st , 2018.
8. <https://docs.python.org/3/>
9. <https://www.w3schools.com/python/>
10. <https://www.w3schools.com/sql/>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B.Sc.  
(Mathematics)**

**Semester- II**

**Title: Applied Logic, Analytical Reasoning and  
Coding Techniques**

**Vertical – 2  
Minor – 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Applied Logic, Analytical Reasoning and Coding Techniques

Course Code: CHMMATHII3

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	<p>This course introduces students to the foundational and applied aspects of <b>logical reasoning and data interpretation</b>, focusing on structured thinking, pattern recognition, spatial reasoning, relational analysis, coding–decoding, and data sufficiency. These competencies form the backbone of problem-solving across disciplines, including mathematics, computer science, and data science.</p> <p>Emphasis is placed on developing the ability to analyze numerical, symbolic, and verbal patterns; interpret and represent relational and directional information; and evaluate the adequacy of data in real-world and mathematical contexts. The course also strengthens skills essential for <b>competitive and entrance examinations</b> such as Banking, Management Aptitude Tests, UPSC/MPSC, SET/NET, GRE/GMAT, among others, where logical thinking and data interpretation constitute core testing components.</p> <p>Through graded difficulty levels and practice-oriented learning, students will gain the analytical capacity, reasoning accuracy, and decision-making clarity required to tackle diverse logical and data-driven problems.</p>
2	<b>Vertical 2</b>	Minor
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p>This course reinforces essential mathematical concepts acquired during school education while engaging learners with advanced, indirect, and analytically challenging problems. It is designed to cultivate critical thinking, strengthen logical and reasoning abilities, and encourage deeper intellectual engagement with numerical, symbolic, and relational information. By developing these core cognitive skills, the course prepares learners to approach complex problem-solving tasks with confidence and enhances their competence for various competitive and entrance</p>

	<p>examinations.</p> <p><b>CO(A) 1.</b> To strengthen foundational abilities in pattern recognition, symbolic manipulation, and sequential reasoning through structured exercises in numerical, alphabetic, and symbolic series.</p> <p><b>CO(A) 2.</b> To develop analytical and deductive reasoning skills by engaging with classification tasks, relational mapping, directional problems, and spatial reasoning scenarios.</p> <p><b>CO(A) 3.</b> To build proficiency in encoding and decoding information using alphabetic, numeric, symbolic, and substitution-based systems relevant to mathematical reasoning and computational logic.</p> <p><b>CO(A) 4.</b> To cultivate the ability to assess data adequacy and interpret information presented in varied forms, enabling learners to determine the minimum required data for decision-making in mathematical and real-life contexts.</p> <p><b>CO(A) 5.</b> To prepare learners for advanced logical reasoning tasks encountered in academic, professional, and competitive examination settings by nurturing critical thinking, precision, and systematic problem-solving abilities.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b></p> <p>After successful completion of the course, learners will be able to:</p> <p><b>CO 1:</b> Analyze numerical, alphabetical, and symbolic sequences to identify underlying patterns and determine missing or predicted elements.</p> <p><b>CO 2:</b> Apply classification and logical comparison skills to identify inconsistencies or odd elements within a given set of numbers, symbols, or objects.</p> <p><b>CO 3:</b> Construct and interpret relational and directional representations—including family trees, generational diagrams, and spatial pathways—to solve reasoning problems.</p> <p><b>CO 4:</b> Apply coding–decoding principles using alphabetic, numeric, symbolic, and substitution-based methods to encode information or interpret coded messages.</p> <p><b>CO 5:</b> Evaluate the sufficiency of given information in mathematical or real-life scenarios and determine the minimum additional data required to reach a valid conclusion.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Foundations of Logical Thinking</b></p> <p><b>1. Number, Letter, and Symbol Series</b></p> <ul style="list-style-type: none"> <li>• Identification of patterns in numerical sequences, including differences, ratios, powers (squares and cubes), and recursive relations.</li> <li>• Completion of missing terms at the beginning, middle, or end of a given sequence.</li> <li>• Analysis of sequences comprising letters or symbols; recognition of embedded patterns and prediction of missing elements.</li> </ul> <p><b>2. Analytical Reasoning: Odd-One-Out</b></p> <ul style="list-style-type: none"> <li>• Determining the element that does not conform to the underlying rule governing a sequence of numbers.</li> <li>• Identifying inconsistencies in sequences composed of letters or symbols by observing</li> </ul>

structural or logical deviations.

### 3. Relational Reasoning

- Understanding common family and social relationship terminologies: parent, child, grandparent, sibling, spouse, nephew, niece, cousin, etc.
- Construction of family diagrams or relational trees using standardized notation:
  - a) **Square** for male, **circle** for female, **triangle** for unspecified/undetermined gender
  - b) **Double arrow** ( $\leftrightarrow$ ) for siblings
  - c) **Equal sign** (=) for marital/spousal relationships
- Interpretation of information across generations through vertical alignment of relational structures.

## UNIT II: Applied Logical Thinking and Data Interpretation

### 1. Direction Sense and Spatial Reasoning

- Understanding and identifying the eight cardinal and intercardinal directions.
- Interpreting angular relationships between directions.
- Application of standard Pythagorean triplets (3-4-5, 6-8-10, 5-12-13, etc.) and  $45^\circ$ – $45^\circ$ – $90^\circ$  triangles in solving distance and movement problems involving perpendicular paths.

### 2. Coding and Decoding Techniques

- Introduction to various coding mechanisms:
  - a) Alphabet-based coding
  - b) Numerical coding
  - c) Symbol coding
  - d) Value-based and substitution coding
- Deciphering coded messages and constructing logical mappings between original and encoded information.

### 3. Data Sufficiency

- Understanding the concept and principles of data sufficiency, focusing on how to determine whether the information provided is adequate to reach a definite conclusion.
- Identifying whether a problem is solvable, unsolvable, or conditionally solvable based on the given data, and recognizing situations where additional information is required.
- Working with problems drawn from elementary mathematics and everyday contexts, such as:
  - Determining whether the **area or perimeter** of a geometric figure (triangle, quadrilateral, circle) can be computed with the given measurements.
  - Checking whether the **value of an unknown variable** in simple algebraic equations can be determined with the available conditions.
  - Assessing whether the **age of a person** or the **relation between two individuals** can be concluded from partial relational information.
  - Evaluating whether the **time, distance, or speed** in a basic motion scenario can be derived from the data provided.

- Judging whether a **quantity comparison** (e.g., which number is larger, which container holds more water) can be made without exact values.
- Emphasis is placed on identifying the minimum additional information required for a conclusive solution, rather than computing the final numerical answer.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No.	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
<b>Total</b>		<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Project, Self-Learning Evaluation, Presentation, etc.	10
		Total 20

11

**REFERENCES:**

1. **Aggarwal, R. S.** *A Modern Approach to Verbal & Non-Verbal Reasoning.* S. Chand Publishing.
2. **Gupta, A. K.** *Logical and Analytical Reasoning.* Ramesh Publishing House.
3. **Aggarwal, R. S.** *Quantitative Aptitude for Competitive Examinations.* S. Chand Publishing.
4. **Sinha, Nishit K.** *Reasoning for Competitive Examinations.* Pearson Education.
5. **Jaikishan & Premkishan.** *How to Crack Test of Reasoning in All Competitive Exams.* Arihant Publications.
6. **Gourav Gupta.** *Logical Reasoning & Data Interpretation.* McGraw Hill / Other Competitive Exam Publishers.
7. *The Pearson Guide to Logical Reasoning & Data Interpretation.* Pearson Education.

Online references:

1. <https://cracku.in/cat-previous-papers>
2. <https://www.selfstudys.com/>
3. <https://testbook.com/reasoning/coding-decoding>
4. <https://testbook.com/reasoning/data-sufficiency-reasoning>
5. <https://www.indiabix.com/>


**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)  
(Affiliated to the University of Mumbai)**

**Board of Studies (BoS) Mathematics**

<b>Sr. No.</b>	<b>Name of the Faculty</b>	<b>Designation and College</b>
1.	Ms. Urmila Pillay	Head and Associate Professor, Department of Mathematics, Smt. CHM College (Autonomous)
2.	Mr. Amish Thakker	Associate Professor, Smt. CHM College (Autonomous)
3.	Ms. Asha Chugh	Associate Professor, Smt. CHM College (Autonomous)
4.	Mr. Mandar Khasnis	Associate Professor, Smt. CHM College (Autonomous)
5.	Dr. Dipak Jadhav	Associate Professor, Smt. CHM College (Autonomous)
6.	Ms. Pooja Rajani	Assistant Professor, Smt. CHM College (Autonomous)
7.	Mr. Salil Sawarkar	Assistant Professor, Smt. CHM College (Autonomous)
8.	Mrs. Usha Hemasundar	Outside University nominee Head and Associate Professor, K.C. College, Churchgate
9.	Dr. Pankit Gandhi	Outside University nominee Professor, K.C. College, Churchgate
10.	Ms. Minal Wankhede	Vice Chancellor Nominee Head and Associate Professor, B.N. Bandodkar College, Thane
11.	Mr. Mandar Dongare	Industry Representative Senior Manager, Customer Success, Teradata India Pvt. Ltd.
12.	Ms. Supriya Bhagat	Alumni Representative Senior Product Data Scientist, Project pro

**Name and Signature of the Ad hoc BoS Chairperson:** Ms. Urmila Pillay 

**Name and Signature of the Dean:**

Dr. Neena Anand 

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B.Sc.  
(Data Science)**

**Semester- II**

**Vertical - 3  
Open Elective Course – 2+2 Credits**

**with effect from  
Academic Year 2025-2026**



HSNC Board's

# Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

(Affiliated to the University of Mumbai)

University College Code: 217 | JD Office: T14



## Faculty of Interdisciplinary

### Vertical 3: List of Open Elective Skill Based Courses for First Year: Semester – II

Sr. No.	Nomenclature of the Paper
1	Cyber and Digital Safety
2	Audio -Video Editing Foundation for Graphics Design and Basics of Animation II
3	Basic Tools of AI for Economics and Education - II
4	English for Professional and Corporate World
5	Urbanisation and Real Estate
6	Business of Travel and Tours-II
7	Managing Family Wealth through Family Office
8	Interactive Web Design using Java Script
9	Basics of Nutrition II
10	Reels Production and Creator Branding
11	Performing Art
12	Data Analysis with Advanced Excel
13	Advanced Political Communication and Media Skills
14	Stress Management
15	Social Media and Society Identity, Power and Digital Citizenship
16	Mushroom Cultivation Training and Trading Level
17	Yoga and Fitness II
18	Basic Perfumery Course (Level-II)
19	Soft Skills II-Personal and Interpersonal Effectiveness
20	Beautician - Strategic Business Planning-II
21	Current Trends of Fashion Designing- Financial Perspective Level-II
22	Basic Accounting-II
23	Digital Marketing II
24	Online Trading and Stock Market-II
25	Event Management Course in Sindhi



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B. Sc.  
(Data Science)**

**Semester- II**

**Title: Discrete Mathematics**

**Vertical - 4  
Vocational Skill Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Discrete Mathematics

**Course Code: CHMDSII6**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Discrete Mathematics provides the foundational mathematical concepts used in Computer Science and Information Technology. This course introduces students to functions, relations, counting techniques, recurrence relations, and the principles of combinatorics which are essential for algorithm analysis and problem-solving. It also covers formal languages, grammars, and finite automata, forming the theoretical basis for compiler design and automata theory. Emphasis is placed on developing logical reasoning, analytical thinking, and the ability to model and solve real-world computational problems. By connecting mathematical theory with practical computer science applications, this course strengthens students' understanding of algorithmic processes, data structures, and programming logic.
2	<b>Vertical 4</b>	Vocational Skill Course (VSC)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives :</b>	<p style="margin-left: 40px;"><b>CO(A) 1.</b> To develop a strong foundation of fundamental concepts of functions, relations, and recurrence relations in discrete mathematics.</p> <p style="margin-left: 40px;"><b>CO(A) 2.</b> To enhance logical reasoning and analytical skills required to solve counting,</p>

	<p>permutation, and combination-based problems. Explain data transmission across different network layers.</p> <p><b>CO(A) 3.</b> To introduce recurrence-based algorithm analysis to connect discrete mathematics with computer science applications.</p> <p><b>CO(A) 4.</b> To provide understanding of formal languages, grammars, and automata theory essential for compiler design and theoretical computer science.</p> <p><b>CO(A) 5.</b> To enable students to apply mathematical modeling and problem-solving techniques in real-world and computational contexts.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Explain and analyze the concepts of functions, relations, and recurrence relations.</p> <p><b>CO 2:</b> Solve combinatorial problems using counting principles, permutations, and combinations.</p> <p><b>CO 3:</b> Apply recurrence relations to determine the time complexity of algorithms.</p> <p><b>CO 4:</b> Construct and simplify finite state machines (FSMs) and convert between RE, NFA, DFA, and Minimal DFA.</p> <p><b>CO 5:</b> Demonstrate the use of regular expressions and formal grammars in text processing, pattern recognition, and automata-based applications.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT 1:</b></p> <ul style="list-style-type: none"> <li>• <b>Functions:</b> Definition of function; Domain, co-domain, range of a function; Examples of standard functions such as identity and constant functions, absolute value function, logarithmic and exponential functions, function composition, flooring and ceiling functions; Injective, surjective and bijective functions; Composite and inverse functions.</li> <li>• <b>Relations:</b> Definition and examples of relation; Properties of relations, Representation of relations using diagraphs and matrices; Binary relations as ordered pairs and verbal description; the reflexive, symmetric, transitive and antisymmetric properties of binary relations, Equivalence relation; Partial Order relation, Closure operations on Relations, Hasse Diagrams.</li> <li>• <b>Recurrence Relations:</b> Definition and Formulation of recurrence relations; Solution of a recurrence relation; Solving recurrence relations- Back tracking method, Linear homogeneous recurrence relations with constant coefficients; Homogeneous solution of</li> </ul>

linear homogeneous recurrence relation with constant coefficients; Particular solution of non-linear homogeneous recurrence relation with constant coefficients;

- **Graphs:** Graph terminology; undirected graphs, simple, complete, path, cycle, adjacency matrix, connectivity; Euler’s path and Hamiltonian circuit; graph representation, trees; Digraphs and connectivity problems - Reachability matrix analysis; Warshall’s algorithm.

**UNIT 2:**

- **Counting Principles:** Basic Counting Principles (Sum and Product Rule); Pigeonhole Principle (without proof) - Simple examples; Inclusion Exclusion Principle (Sieve formula) (without proof); Counting using Tree diagrams.
- **Permutations and Combinations:** Permutation without and with repetition; Combination without and with repetition; Binomial numbers and identities: Pascal Identity, Vandermonde’s Identity, Pascal triangle, Binomial theorem (without proof) and applications; Multinomial expressions, Multinomial theorem (without proof) and applications.
- **Languages, Grammars and Machines:** Languages and Grammars – Introduction, Phase structure grammar, Types of grammar, derivation trees; Finite-State Machines with Output; Finite-State Machines with No Output, NFA to DFA conversion and Minimization of DFA.
- Regular Expression and Regular Language. Applications of Regular Expressions in searching and text processing.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q.No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Discrete Mathematics Problem Solving and Analysis Using Wolfram Alpha, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11 Books and References:**

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications, McGraw-Hill.
2. Tremblay J. P. and Manohar R, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill.
3. Kolman Bernard, Busby Robert C., and Ross Sharon C., Discrete Mathematical Structures, Pearson Education.
4. Susanna S. Epp, Discrete Mathematics with Applications, Cengage Learning.
5. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, Pearson Education
6. <https://www.geeksforgeeks.org/engineering-mathematics/discrete-mathematics-tutorial/>
7. <https://www.geeksforgeeks.org/engineering-mathematics/combinatorics/>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B.Sc.  
(Data Science)**

**Semester- II**

**Title: Web Technology**

**Vertical - 4  
Skill Enhancement Course (SEC) - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Web Technology**  
**Course Code: CHMDSII7**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course introduces the fundamentals of web development, covering Internet concepts, HTML5 structure, and CSS styling. Students will also learn to add interactivity using JavaScript and jQuery, and manage data using JSON. The course focuses on building basic, functional, and interactive web pages.
2	<b>Vertical 4</b>	Skill Enhancement Course
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To introduce students to Internet fundamentals and web terminology.</p> <p><b>CO(A) 2.</b> To develop skills in creating structured web pages using HTML5.</p> <p><b>CO(A) 3.</b> To teach CSS techniques for styling and layout management.</p> <p><b>CO(A) 4.</b> To enable learners to use JavaScript and jQuery for interactivity and dynamic behavior.</p> <p><b>CO(A) 5.</b> To understand JSON for data handling and communication in web development.</p>
8	<b>Course Outcomes:</b> Student will be able to:	<p><b>CO 1:</b> Describe the basic concepts of the Internet and web environment.</p> <p><b>CO 2:</b> Design and structure web pages using HTML5.</p> <p><b>CO 3:</b> Apply CSS properties to format and style web content.</p>

- CO 4:** Implement client-side interactivity using JavaScript and jQuery.
- CO 5:** Create, read, and use JSON data for web-based applications.

9

## Syllabus

### UNIT I:

- **Introduction to Internet & Web :** Concept of Internet and its characteristics, Key applications of the Internet, Basic web-related terms: websites, browsers, URLs, protocols.
- **HTML 5:** Structure of an HTML document, Doctypes, Headings, Paragraphs, Text Formatting, Anchors and Hyperlinks, Lists, Tables, Comments, Classes and IDs, Linking Resources, Images, Image Maps.
- **HTML OTHER ELEMENTS:** Input Control Elements, Forms, Div Element, Sectioning Elements, Navigation Bars, Label Element, Output Element, Void Elements, Media basics: inserting audio & video, Progress Element, Selection Menu Controls, Embed, SVG, Canvas, Tabindex.
- **CSS:** Implementing Styles using CSS – Stylesheets, Formatting Text and Links using CSS, CSS Selectors, Changing Background, Adding Border, Margin and Padding, Setting Dimensions, Using Inline Container to mark up a part of a text.
- **Tailwind CSS:** Introduction to Tailwind CSS, installation and setup, utility-first styling approach, responsive web design, styling text, colors, backgrounds, margins, padding, borders, flexbox, grid layout, customizing components, and creating modern user interfaces using Tailwind CSS.

### UNIT II:

- **Java Script Events and Event Handlers:** Introduction to Modern JavaScript (ES6+), HTML Events, DOM Events, DOM Event Listener, onAbort, onBlur, onChange, onClick, onDbIclick, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onReset, onResize, onSelect, onSubmit, onUnload, Form Validation Example.
- **jQuery:** Introduction, Syntax, Selectors, Events, Effects, Hide/Show, Fade, Slide, Animate, stop(), Callback, DOM manipulation: get/set text & html, add/remove elements.
- **JSON:** Introduction, JSON Grammar, JSON Values, JSON Tokens, Syntax, JSON vs

XML, Data Types, Objects, Arrays, Creating and reading JSON data, Data Interchange, JSONP, Parsing JSON using JavaScript.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q.No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Self-Learning and Implementation of Advanced Web Technologies, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Web Design with HTML, CSS, JavaScript and JQuery, by Jon Duckett, Paperback, 1st Edition, 2014
2. HTML 5 Black Book, by DT Editorial Services, Paperback, 2nd Edition, 2016
3. Beginning JSON, by Ben Smith, Apress, 1st Edition, 2015
4. Web Design: The Complete Reference, by Thomas Powell, TMH, 2009
5. <https://www.w3schools.com/>
6. <https://www.tutorialspoint.com/index.htm>
7. <https://www.javatpoint.com/>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year B.Sc.**

**Semester- II**

**Vertical – 5**

**Ability Enhancement Course (English)  
2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Advanced English for Workplace and Academic Communication**

**Course Code: CHMBSCAECII**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	In an increasingly competitive academic and professional landscape, learners require advanced communication skills that enable clarity, precision, critical thinking, and professionalism. This course focuses on practical, real-world communication abilities needed for college-level academic work, job applications, workplace collaboration, and digital interactions.  Through hands-on tasks, real-world assignments, and communication practice, learners become adept in using English confidently and appropriately in diverse settings.
2	<b>Vertical 5</b>	<b>AEC: Advanced English for Workplace and Academic Communication</b>
3	<b>Type</b> Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>  CO(A)1: To develop advanced communication skills required for academic and professional success.  CO(A)2: To train learners in report writing, summary writing, and formal documentation.  CO(A)3: To enhance proficiency in digital and virtual communication platforms.  CO(A)4: To strengthen presentation, interview, and workplace communication skills.  CO(A)5: To build confidence in expressing ideas clearly to varied audiences.	
8	<b>Course Outcomes:</b> After completing this course, learners will be able to:  <b>CO-1:</b> Demonstrate clarity, precision, and professionalism in communication.  <b>CO-2:</b> Interpret and summarize written texts, visuals, and data accurately.  <b>CO-3:</b> Prepare well-structured reports, emails, and professional documents.	

**CO-4:** Use digital tools and virtual communication etiquette effectively.  
**CO-5:** Communicate confidently in interviews, presentations, and teamwork situations

9

**Syllabus**

**UNIT I: Communication for Academic & Professional Settings (15 Hours)**

**A. Communication in Academic & Workplace Contexts**

1. Features of formal communication
2. Audience-centered communication
3. Ethics in communication: integrity, attribution, clarity
4. Explaining concepts in simple and clear language
5. Interpreting graphs, charts, tables, and infographics
6. Summarizing data concisely

**B. Grammar & Style for Professional Writing**

1. Tone: formal, neutral, objective
2. Avoiding redundancy and ambiguity
3. Active vs. passive structures
4. Editing, revising, and proofreading techniques

**UNIT II: Practical Documentation & Employability Skills (15 Hours)**

1. Report writing (academic/field-based/observational)
2. Project summary reports
3. Preparing short presentations
4. Creating informational posters or digital slides
5. Writing a formal complaint or request email
6. Creating a short informational or awareness write-up

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

All questions are compulsory:

Question No	Nature of Questions	Marks
Q. 1	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 1</b> <b>OR</b> Attempt <b>Essay Type</b> question. (1 out of 2) - <b>Unit 1</b>	15
Q. 2	<b>Short Notes</b> (Attempt any 3 out of 5) - <b>Unit 2</b> <b>OR</b>	15

	Attempt <b>Essay Type</b> question. (1 out of 2) - Unit 2	
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**




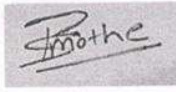
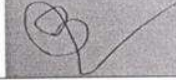
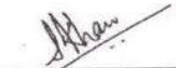
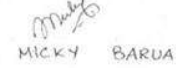

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Assignments on <b>any one</b> of the following topics: Academic/Scientific Report/ Informational Poster / Digital Infographic (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Otter.ai, Grammarly, Google Gemini, Canva, Piktochart, etc)	15
2.	Class Attendance and Participation	05
	<b>Total</b>	<b>20</b>

**11**

**References:**



1. Adler, Ronald B., et al. *Understanding Human Communication*. 15th ed., Oxford UP, 2021.
2. Bailey, Stephen. *Academic Writing: A Handbook for International Students*. 5th ed., Routledge, 2018.
3. Cargill, Margaret, and Patrick O'Connor. *Writing Scientific Research Articles*. Wiley-Blackwell, 2013.
4. Eastwood, John. *Oxford Guide to English Grammar*. Oxford UP, 2005.
5. Gerson, Sharon J., and Steven M. Gerson. *Technical Communication: Process and Product*. 9th ed., Pearson, 2021.
6. Hewings, Martin. *Advanced Grammar in Use*. Cambridge UP, 2013.
7. Kumar, Sanjay, and Pushp Lata. *Communication Skills*. 2nd ed., Oxford UP, 2018.
8. McCarthy, Michael, and Felicity O'Dell. *Academic Vocabulary in Use*. Cambridge UP, 2008.
9. Nordquist, Richard. *The Essentials of English Grammar*. McGraw-Hill Education, 2016.
10. Seely, John. *The Oxford Guide to Writing and Speaking*. Oxford UP, 2005.
11. Zinsser, William. *On Writing Well: The Classic Guide to Writing Nonfiction*. Harper Perennial, 2016.

### Syllabus Committee:

Sr. No	Name of the Faculty	Designation and College	Signature
1.	Prof. (Dr.) Kailas Aute	Professor & Head, Dept. of English, Smt. CHM College	
2.	Prof. (Dr.) B. R. Hiramani,	(VC Nominee, University of Mumbai) Pancham Khemraj College, Sawantwadi	
3.	Prof. (Dr.) Vikas Raskar	(Subject Expert outside University) Hutatma Rajguru Mahavidyalay, Rajguru Nagar, Khed, (Affiliated to Savitribai Phule University)	
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University)	
5.	Mr. Ananda Pandhare	Asst. Professor, Dept. of English, Smt. CHM College	
6.	Ms. Sana Khan	Asst. Professor, Dept. of English, Smt. CHM College	
7.	Dr. Micky Barua	Faculty Vidyalankar Institute of technology, Alumni Member	 MICKY BARUA
8.	Ms. Sofy Verghese	Accenture, Industry Representative	

Name & Signature of the Ad-hoc BoS Chairperson: Prof. (Dr.) Kailas Aute

Name & Signature of the Dean: Prof. (Dr.) Nitin Arekar

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester- II**

**Title: Communication Skills in Sindhi**

**Vertical – 5**

**Ability Enhancement Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Communication Skills in Sindhi

**COURSE CODE: CHMSINIAEC**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	Communication is the core component of commerce and trade. In communication, language plays very significant role. If a student has mastered the skills of language, undoubtedly, he or she would be able to communicate in the best manner. In this course basic part of Sindhi language would be taught based on the NEP 2020. Innovative approaches like critical thinking, creative mind, and use of technology will lead to communicating and participating with different groups. The vocabulary section would be given prominence. The course would be in the Devanagari script so that it can attract majority of the students. Even non-Sindhi students shall have opportunity to adopt this course.
2	<b>Vertical 1</b>	AEC – Ability Enhancement Course
3	<b>Type</b>	Theory + Practicum (Teaching Method: Lecture/ Discussion/Reading)
4	<b>Credit</b>	2 credits (1 credit = 15 hours for theory or 30 hours of Practical work in a semester)
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50Marks
7	<b>Course Objectives:</b> After successful completion of this course: <b>CO(A) 1:</b> The learner will get understanding of communication skills. <b>CO(A) 2:</b> The learner will understand how to accurate the pronunciation of special words in Sindhi <b>CO(A) 3:</b> The learner will improve the conversation skill in Sindhi. <b>CO(A) 4:</b> The learner will become best communicator in Sindhi language	
8	<b>Course Outcomes:</b> Student will be able to <b>CO1:</b> Know the basic special features of Sindhi language. <b>CO2:</b> Understand communication skills. <b>CO3:</b> Knowing the conversation with businessmen and customers <b>CO4:</b> Know the etiquettes with parents, relatives, friends and others in effective way	

**Communication Skills in Sindhi****UNIT I: Everyday & Professional Communication in Sindhi**

- Daily Life Conversation Skills: Greetings and introductions, asking for information, making requests/giving instructions, small talk in simple Sindhi
- Workplace & Business Communication: Customer interaction, Office enquiries, permissions, complaints, Bank/shop/travel conversation, Basic telephone conversation, Short Event Reports

**UNIT II: Digital & Modern Communication in Sindhi**

- Email & Message Writing: Professional emails, WhatsApp/SMS etiquette, Announcements, reminders
- Product and Promotive Communication: Short ads, Taglines & slogans, Simple product description, Pitch Presentation, Interview / Communication for Market

\*\*\*\*\*

## Syllabus

### Communication Skills in Sindhi

#### यूनिट १: रोज़मरह जी जिंदगी में गुफ्तगू (सिंधीअ में):

- वाकुफ़ियत डियण ऐ ज़ाण हासुल करण, वेंती मोकिलण, अर्ज करण, हिदायतू डियण, सौली सिंधीअ में ग़ालाईण.
- कम करण वारी जग़ह ते राबतो ऐ कारोबारी राबतो: ग्राहकनि सा गुफ्तगू, ऑफिस में पूछताछ, परमीशन, शिकायत पत्र, बैंक जे करमचारियुनि सा गुफ्तगू, ग्राहकनि सा ग़ालिहाइणि, बेसिक टेलीफोनिक संवादु, नंडे जशन जी रिपोर्ट.



#### यूनिट २: डिजिटल ऐ आधुनिक संवादु (सिंधी में):

- ईमेल ऐ मैसेज लिखण, पेशेवर ईमेल, वाट्सप ऐ समसे (Message) जा शिष्टाचार (Etiquettes), घोषणा याद डियारण वारो नोट (Reminders),
- उत्पाद ऐ प्रचार प्रसार संवादु, नंडो विज्ञापन (Small Ads), टैगलाइन ऐ स्लोगन सौलो उत्पाद वर्णन.
- पिच प्रिन्टेशन, इंटरव्यू, मार्केट रिसर्च जे लाइ संवादु.


\*\*\*\*\*

<b>10</b>	<b>Scheme of Examination and Assessment Pattern</b>	
	Paper – 50 Marks	
	<b>External Examination: Semester End External - 30 marks Time: 1:00 hour</b>	
	Format of Question Paper	
	<b>Question No</b>	<b>Nature of Questions</b>
	Q1.A)	Objective Type Questions (Unit- I)
	Q1. B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-I)
	Q2.A)	Objective Type Questions (Unit- II)
	Q2. B)	Attempt ANY 2 out of 4- (5 marks each) (Unit-II)
	<b>Total</b>	
<b>Internal Examination: Continuous Evolution - 20 marks</b>		<b>Total 30</b>
	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	<b>Written assignment on any one of the following topics</b> 1) Draft a formal letter and formal E_mail in Sindhi 2) Write a conversation between Customer and Shopkeeper, Nurse and patient. (Students are required to use AI assistance in the preparation of their drafts. Eg: Notion AI, Powtoon, Elicit)	15
2.	Class Attendance and Participation	05
<b>Total</b>		<b>20</b>
<b>11</b>	<b>REFERENCE BOOKS:</b> 1. Sanchari Basha – By Dr. Pushpa Kodwani 2. Sindhi Pahakaa – Dr. Jetly M.K. 3. Sindhi Muhavahra – By Hardwani Lachhman 4. Sindhi Adhyat mak Shabdhkesh – By Hardwani Lachhman 5. Acho Sindhi Sikhu – By Hardwani Lachhman	

**Syllabus Committee:**

Sr No	Name of the Faculty	Designation and College	Signature
1.	Dr. Kajal Ramchandani	H.O.D. of Jai Hind College	
2.	Mrs. Komal Totani	Faculty In-Charge, Smt. CHM College	

Name & Signature of the BoS Chairperson: (Dr. Kajal Ramchandani) 

Name & Signature of the Dean: (Dr. Nitin Arekar) 



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester - II**

**Title: Environmental Management and  
Sustainable Development - II**

**Vertical - 5  
VEC Subject - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Environmental Management and Sustainable Development - II****Course Code: CHMVEC2**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course examines the relationship between environmental pollution and human health, with detailed coverage of air, water, soil, noise, thermal, and radioactive pollution and their sources, standards, and impacts. It enables learners to understand pollution generation processes, waste management challenges, and the assimilative capacity of the environment. The course also introduces environmental laws, constitutional provisions, and regulatory frameworks, along with tools such as Environmental Management Systems (ISO 14001), life cycle analysis, and cost–benefit analysis. Emphasis is placed on sustainable practices, pollution control measures, the 3R concept, ecolabeling, and global initiatives such as the Sustainable Development Goals and Mission LiFE.
2	<b>Vertical 5</b>	VEC
3	<b>Type &amp; Teaching Methods</b>	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A)1:</b> To develop a comprehensive understanding of various types of environmental pollution, their sources, standards, and impacts on human health and ecosystems.</p> <p><b>CO(A)2:</b> To familiarize students with environmental laws, constitutional provisions, and regulatory frameworks related to environmental protection and management.</p> <p><b>CO(A)3:</b> To equip learners with knowledge of environmental management tools, pollution control measures, and sustainable waste management practices.</p> <p><b>CO(A)4:</b> To create awareness about global and national sustainability initiatives such as the Sustainable Development Goals, Mission LiFE, and their role in achieving sustainable development.</p>

8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO1:</b> Identify and analyze different types of environmental pollution and assess their impacts on human health and ecological systems.</p> <p><b>CO2:</b> Explain key environmental laws, constitutional provisions, and institutional mechanisms for environmental protection.</p> <p><b>CO3:</b> Apply environmental management tools and sustainable waste management practices in real-world contexts.</p> <p><b>CO4:</b> Evaluate sustainability initiatives such as the SDGs and Mission LiFE and relate them to environmental management and sustainable development practices.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Environmental Pollution and Health</b></p> <ul style="list-style-type: none"> <li>• Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution.</li> <li>• Air pollution: Sources of air pollution; Primary and secondary pollutants; Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards.</li> <li>• Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life.</li> <li>• Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health.</li> <li>• Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health.</li> <li>• Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.</li> </ul> <p><b>UNIT II: Environmental Management</b></p> <ul style="list-style-type: none"> <li>• Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights;</li> <li>• Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Life cycle analysis; Cost-benefit analysis</li> <li>• Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme.</li> <li>• Introduction to Millennium Development Goals, Sustainable Development Goals, &amp; Mission Life.</li> </ul>

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hours**

Format of Question Paper

**Attempt any 3 out of 4 questions.**

Question No	Nature of Questions	Marks
Q1	Theory Question based on Unit I	10
Q2	Theory Question based on Unit I	10
Q3	Theory Question based on Unit II	10
Q4	Theory Question based on Unit II	10
<b>TOTAL</b>		<b>30</b>

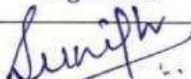
**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Assignment / Project	10
2.	Case Study / Assignment	10
<b>TOTAL</b>		<b>20</b>

11

**REFERENCES:**

1. Barrow, C. J. (2012). *Environmental management for sustainable development* (2nd ed.). Routledge.
2. Doabia, T. S. (2023). *Environmental and pollution laws in India* (4th ed.). Eastern Book Company.
3. Kumar, S. (2009). *Environmental policies in India*. Northern Book Centre.
4. Rajagopalan, R. (2023). *Environmental studies* (4th ed.). Oxford University Press India.
5. Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2007). *An introduction to sustainable development*. Earthscan.
6. Singh, J., Singh, A., & Gupta, S. (2019). *Environmental science and engineering*. New Age International Publishers.

Sr No	Name of the Faculty	Designation and College	Signature
1.	Dr. Sunil Lalchandani	Dean, Faculty of Interdisciplinary	



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester- II**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>															
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2–3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>															
10	<b>Scheme of Examination and Assessment Pattern</b> <b>Based on 3 approved Activities</b> <b>Semester End External - 30 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>
Activity No	Nature of Activities	Marks														
1.	Title of Approved Activity - 1	10														
2.	Title of Approved Activity - 2	10														
3.	Title of Approved Activity - 3	10														
<b>Total</b>		<b>30</b>														
	<b>Internal Examination: Continuous Evaluation – 20 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Assessment / Evaluation</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>			
	Assessment / Evaluation	Marks														
1.	Reflective journal	10														
2.	Presentation/ poster presentation/viva	10														
<b>Total</b>		<b>20</b>														

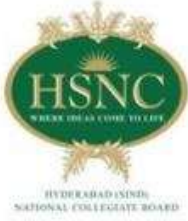
**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak





**HSNC Board's**  
**Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar**  
**(Autonomous)**  
**Affiliated to the University of Mumbai**

**Bachelor of Science**  
**(Data Science)**  
**(Self-Financing Course)**

**Semester – III**

**Choice Based and Credit Based syllabus**  
**as per NEP 2020 with effect from the Academic**  
**Year 2025-2026**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Title: Design and Analysis of Algorithms**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Design and Analysis of Algorithms

**Course Code: CHMDSIII1**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course covers fundamental techniques for designing and analysing algorithms, along with essential data structures like linked lists, stacks, queues, trees, and graphs. Students will learn to evaluate algorithm efficiency, apply sorting and searching algorithms, and select appropriate techniques to solve computational problems effectively.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To introduce the fundamental concepts of algorithms, their properties, and the importance of efficient algorithm design.</p> <p><b>CO(A) 2.</b> To develop a deep understanding of data structures such as linked lists, stacks, queues, trees, and graphs to support algorithmic problem-solving.</p> <p><b>CO(A) 3.</b> To teach mathematical techniques for analyzing algorithm efficiency using asymptotic notations and mathematical analysis of recursive and non-recursive algorithms.</p> <p><b>CO(A) 4.</b> To equip students with the ability to apply efficient algorithms for sorting, searching, and graph traversal in real-world scenarios.</p>

	<p><b>CO(A) 5.</b> To enable students to compare, select, and justify appropriate algorithms and data structures based on time and space complexity requirements.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Understand and explain the fundamental principles and properties of algorithms and data structures, and apply them to solve computational problems.</p> <p><b>CO 2:</b> Analyze the time and space complexity of algorithms using asymptotic notations and mathematical techniques for both recursive and non-recursive algorithms.</p> <p><b>CO 3:</b> Implement and apply various data structures such as linked lists, stacks, queues, trees, and graphs for solving different computational problems.</p> <p><b>CO 4:</b> Design and implement efficient algorithms for searching, sorting, and graph- based operations, evaluating their comparative performance in terms of complexity.</p> <p><b>CO 5:</b> Evaluate and choose appropriate algorithmic techniques and data structures for solving new and complex problems, demonstrating critical thinking and problem-solving abilities.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction:</b> What Is an Algorithm, characteristics of algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamentals of Data Structures and its basic operations.</li> <li>• <b>Fundamentals of the Analysis of Algorithm Efficiency:</b> The Analysis Framework, Asymptotic Notations (<math>O</math>, <math>\Omega</math>, <math>\Theta</math>), Space, and time complexity, Growth of functions.</li> <li>• <b>Linked Lists:</b> What is a Linked List?, Linked Lists ADT, Why Linked Lists?, Operations on Linked list, Arrays Overview, Array Operations Comparison of Linked Lists with Arrays, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists.</li> <li>• <b>Stacks:</b> What is a Stack? How Stacks are used, Stack ADT, Applications, Stack Operations, Implementation of stack using linked lists and Arrays, What is recursion, Recursion vs Iteration, recursion applications like Factorial of a number, Fibonacci series, Tower of Hanoi problem.</li> </ul> <p><b>UNIT II:</b></p>

- **Queues:** What is a Queue? How are Queues Used?, Basic queue operations Queue ADT, Implementation of queues using linked lists and Arrays, Applications.
- **Trees:** What is a Tree?, Basic tree terminologies, Binary Trees, Types of Binary Trees, Properties of Binary Trees, Binary Tree Traversals, Generic Trees (N-ary Trees), Threaded Binary Tree Traversals (Stack or Queue-less Traversals), Expression Trees, Binary Search Trees (BSTs), Balanced Binary Search Trees, AVL (Adelson-Velskii and Landis) Trees.
- **Graph Algorithms:** Introduction, Basic graph terminologies , Applications of Graphs, Graph Representation, Graph Traversals, Shortest Path Algorithms (Dijkstra's Algorithm), and Minimal Spanning Tree (Prim's and Kruskal's Algorithm).
- **Sorting:** What is Sorting?, Why is Sorting Necessary?, Classification of Sorting Algorithms, Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Heap Sort, Quick Sort, Tree Sort.
- **Searching:** What is Searching?, Why do we need Searching?, Types of Searching, Unordered Linear Search, Sorted/Ordered Linear Search, Binary Search, Interpolation Search, Comparing Basic Searching Algorithms.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Algorithm Consultant: Analyze, Compare, and Recommend Data Structures and Algorithms for Real-World Problems, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11 REFERENCES:**

1. Introduction to Design and Analysis of Algorithms by Anany Levitin 3rd Ed Publisher: Pearson
2. Data Structures and Algorithms Made Easy by Narasimha Karumanchi Publisher: CareerMonk
3. Data Structures (English, Paperback, Lipschutz Seymour)
4. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
5. Ellis Horowitz, Sartaj Sahni, S. Rajsekar. "Fundamentals of computer algorithms" University Press.
6. Data Structures and Algorithms Made Easy, Narasimha Karumanchi, CareerMonk Publications, 2016.
7. [https://www.tutorialspoint.com/data\\_structures\\_algorithms/index.htm](https://www.tutorialspoint.com/data_structures_algorithms/index.htm)
8. <https://www.geeksforgeeks.org/data-structures/>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Title: Data Warehousing**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Data Warehousing

**Course Code: CHMDSIII2**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	The Data Warehousing syllabus covers essential concepts for building and managing data warehouses to support business intelligence. It includes an introduction to data warehousing, its characteristics, and differences from operational databases. Key topics include data warehouse architecture, components like ETL processes and reporting tools, and design principles such as star and snowflake schemas. The course also focuses on fact and dimension tables, measures, denormalization, ETL challenges, and an overview of OLAP systems.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	
	<b>CO(A) 1.</b> To introduce the evolution of Decision Support Systems and the need for Strategic Information Systems.	
	<b>CO(A) 2.</b> To understand the fundamental concepts, architecture, and components of Data Warehousing.	

	<p><b>CO(A) 3.</b> To explore Data Warehouse processing techniques including ETL, OLAP, and data marts.</p> <p><b>CO(A) 4.</b> To discuss and understand changing dimensions and learn about aggregate tables and determine their usage.</p> <p><b>CO(A) 5.</b> To explain the differences between operational databases and decision support systems for business intelligence.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Explain the evolution and purpose of Decision Support Systems and Strategic Information Systems.</p> <p><b>CO 2:</b> Describe the architecture, components, and design approaches of a Data Warehouse.</p> <p><b>CO 3:</b> Demonstrate understanding of ETL processes, OLAP operations, and metadata usage.</p> <p><b>CO 4:</b> Elaborate changing dimensions with respect to current trends &amp; using aggregate tables.</p> <p><b>CO 5:</b> Handle the processes of data preprocessing, data transformation and data reduction.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Evolution of Decision Support System:</b> Need for Strategic Information System, Failures of Past Decision Support Systems, Operational Database vs Decision Support System, Data Warehouse defined, The Data Warehousing Movement, Evolution of Business Intelligence.</li> <li>• <b>Data Warehousing:</b> Introduction, Need for Data Warehouse, Features of data Warehouse, Framework of the data warehouse, Data Warehouse Architecture, Approaches of Data Warehouse Design, Properties of Data Warehouse, Types of Data Warehouse Architecture, Differences between Operational Database Systems and Data Warehouses.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Data Warehouse Processing:</b> ETL in Data Warehousing, ETL vs ELT, Introduction to OLAP, Characteristics of OLAP, OLTP vs OLAP, OLAP Operations: Slice, Dice, Rollup, Drilldown and Pivot, Back-End Tools and Utilities, Types of OLAP, Role of</li> </ul>

Metadata.

- **Data Warehouse Models:** Enterprise Data Warehouse (EDW), Data Mart, Virtual Data Warehouse, Hybrid Data Warehouse, Data Warehouse vs DataMart
- **Data Warehouse Modeling:** Conceptual Modelling of Data Warehouse, Dimensional Modelling, Star Schema, Snowflake Schema, Dimensional Tables, Multi- Dimensional Data Modelling.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Data Warehouse Storytelling: Transforming Business Data into Strategic Insights, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11**

**REFERENCES:**

1. Data warehousing fundamentals for it professionals by Paulraj Ponniah, A John Wiley & sons, inc., publication
2. Data Warehousing: Design, Development And Best Practices by Soumendra Mohanty (Author), Tata McGraw Hill Education (Publisher).
3. Data warehousing by Reema Theraja , Oxford University Press 2009.
4. Alex Berson, Stephen J.Smith, “Data warehousing Data mining and OLAP”, Tata McGraw- Hill, 2nd Edition.
5. Building the data warehouse by William h. Inmon, Wiley publishing, inc.
6. <https://www.tutorialspoint.com/dwh/index.htm>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Title: Data Mining**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Data Mining**  
**Course Code: CHMDSIII3**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course offers a comprehensive introduction to Data Mining and its various techniques and applications. It covers the fundamental concepts, processes, and methodologies involved in extracting meaningful patterns and knowledge from large datasets. The syllabus emphasizes key topics such as data pre-processing, frequent pattern mining, classification, prediction, clustering, and mining complex data types.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To learn concept of Data Mining.</p> <p><b>CO(A) 2.</b> To understand various data preprocessing techniques.</p> <p><b>CO(A) 3.</b> To study pattern discovery methods.</p> <p><b>CO(A) 4.</b> To understand and apply classification and prediction techniques.</p> <p><b>CO(A) 5.</b> To learn clustering techniques and analyze complex data types, including graph, spatial, multimedia, and web data for advanced mining tasks.</p>
8	<b>Course Outcomes:</b> Student will be able to:	<p><b>CO 1:</b> Acquire knowledge of Data Mining.</p>

	<p><b>CO 2:</b> Apply appropriate data preprocessing techniques to clean, integrate, and transform data for mining tasks.</p> <p><b>CO 3:</b> Discover frequent patterns, associations, and correlations using efficient algorithms.</p> <p><b>CO 4:</b> Implement classification, prediction, and clustering techniques on varied datasets and evaluate model performance.</p> <p><b>CO 5:</b> Analyze and mine complex data types including graph, spatial, multimedia, and web data, and understand their relevance in real-world scenarios.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Data Mining:</b> Evolution of Database system, What is data mining? data mining vs knowledge discovery in database, data mining issues, Social implication of data mining, Information Retrieval, Decision support System.</li> <li>• <b>Data preprocessing and exploration:</b> Data Preprocessing, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.</li> <li>• <b>Mining Frequent Patterns, Associations, and Correlations:</b> Basic Concepts, Market Basket Analysis, Frequent item set, Closed item set Mining Various Kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining, Apriori Algorithm.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Classification and Prediction:</b> Basic concepts of classification and prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back- propagation Associative Classification, Classification by Association Rule Analysis, Evaluating Accuracy: Holdout, Cross Validation.</li> <li>• <b>Cluster Analysis:</b> What Is Cluster Analysis?, Types of Data in Cluster Analysis, Partitioning Methods (k-means,k-medoids), Hierarchical Methods (Agglomerative, Divisive), Density-Based Methods, Model-Based Clustering Methods, Clustering</li> </ul>

High-Dimensional.

- **Graph Mining, Social Network Analysis, and Multi-relational Data Mining:** Introduction to Graph Mining, Social Network Analysis, Multi- relational Data Mining. Mining Object, Spatial, Multimedia, Text, and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Data Mining and Predictive Analytics: Classification, Clustering, Visualization, and Decision-Making Using Orange Data Mining, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. M. H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education.
2. J. Han and M. Kamber, "Data Mining: Concepts and Techniques", Second Edition, Elsevier
3. Krzysztof J, Cios, W. Pedrycz, R, W. Swiniarski, L.A. Kurgan, "Data Mining" A Knowledge Discovery Approach", Springer (Unit I).
4. C. Ballard, Dynamic Warehousing and Data Mining Made Easy, ReddBooks, IBM (SPD)
5. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2005.
6. <https://www-users.cse.umn.edu/~kumar001/dmbook/index.php>
7. <http://www.mmds.org/>
8. <https://nptel.ac.in/courses/106105174>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Title: Design and Analysis of Algorithms and  
Data Warehousing & Data Mining Practical**

**Vertical - 1  
Major Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

## **Title: Design and Analysis of Algorithms and Data Warehousing & Data Mining**

### **Practical**

**Course Code: CHMDSIII4**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	The course offers practical, hands-on experience aimed at building a solid foundation in both the Design and Analysis of Algorithms and Data Warehousing & Data Mining. In the algorithms component, students gain knowledge of designing efficient algorithms, analyzing their time and space complexities. This helps in solving computational problems systematically and optimizing performance. In the Data Warehousing & Data Mining practical component, learners explore real-world applications by implementing data mining techniques like classification, clustering, and prediction. They also work with data warehouse concepts including ETL processes thereby equipping themselves with the skills required to extract meaningful insights from large datasets and support decision-making processes.
<b>2</b>	<b>Vertical 1</b>	Major
<b>3</b>	<b>Type &amp; Teaching Method</b>	Practical
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	60 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks

7	<p><b>Course Objectives:</b></p> <p><b>CO(A) 1.</b> Understand and analyze the time and space complexity of algorithms.</p> <p><b>CO(A) 2.</b> Design and implement fundamental algorithms and assess their performance.</p> <p><b>CO(A) 3.</b> Understand and implement graph algorithms for solving real-world problems.</p> <p><b>CO(A) 4.</b> Understand and apply core concepts of ETL, preprocessing, classification, clustering, and association rule mining in data-driven applications.</p> <p><b>CO(A) 5.</b> Apply data mining tools like WEKA to implement real-world algorithms and evaluate their effectiveness on various datasets.</p>
8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Analyze and compute the time complexity of algorithms.</p> <p><b>CO 2:</b> Implement and evaluate various sorting, searching, and graph algorithms with performance comparison on large datasets.</p> <p><b>CO 3:</b> Develop efficient algorithmic solutions for computational problems involving trees, graphs, and dynamic data structures.</p> <p><b>CO 4:</b> Perform ETL operations using Power BI tool; analyze and model structured data for warehousing applications.</p> <p><b>CO 5:</b> Apply data mining techniques on diverse datasets using WEKA tool, and implement specialized tasks in text, web, spatial and multimedia mining.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Algorithm Analysis - Time Complexity Calculation:</b> Develop a Python or C++ program to find the time complexity of a given algorithm using step counting method. Analyze both recursive and non-recursive algorithms.</li> <li>• <b>Implementing and Analyzing Sorting Algorithms:</b> Implement Bubble Sort, Insertion Sort, and Merge Sort for a list of integers. Compare their time complexities for different input sizes (n=1000, 5000, 10000).</li> <li>• <b>Singly Linked List Operations:</b> Implement a Singly Linked List with the following operations: Insert at beginning ,Insert at end Insert at given position ,Delete from beginning ,Delete from end ,Search an</li> </ul>

element ,Display list

- **Circular Linked List Operations:**

Implement a Circular Linked List and demonstrate Insertion and Deletion operations at various positions.

- **Stack using Linked List and Array:**

Implement a Stack ADT using both: Arrays Singly Linked List Compare and explain the advantages/disadvantages of each. Implement Tower of Hanoi in python.

- **Balanced Parentheses Checker using Stack:**

Design a program to check if a given expression has balanced parentheses using a Stack.

- **Queue using Array and Linked List:**

Implement a Queue ADT using both-Array (Circular Queue) and Linked List. Compare memory usage and performance for different sizes of input.

- **Binary Tree Traversals:** Create a Binary Tree. Implement Preorder, Inorder, and Postorder Traversals (Recursive and Iterative using Stacks).

- **Expression Tree Construction:**

Construct an Expression Tree for a given postfix expression and evaluate the expression using the tree.

- **AVL Tree Implementation:**

Implement an AVL Tree with insertion and rotation operations. Display the tree after each insertion.

- **Graph Representation and Traversals:**

Create a Graph using an Adjacency List and Adjacency Matrix. Implement Depth First Search (DFS) and Breadth First Search (BFS) for the graph.

- **Shortest Path using Dijkstra's Algorithm:**

Implement Dijkstra's Algorithm to find the shortest path from a source node to all other nodes in a weighted graph.

- **Minimum Spanning Tree using Prim's and Kruskal's Algorithms:**

Write a program to compute MST (Minimum Spanning Tree) for a connected graph using Prim's Algorithm and Kruskal's Algorithm

- **Sorting Algorithm Performance Comparison:**

Implement Quick Sort and Heap Sort for large arrays ( $n = 10000$ ) and compare their performance using the time library.

- **Searching Techniques Comparison Implement:**

Linear Search Binary Search Interpolation Search

**UNIT II:**

- **ETL Operations using Power BI:**

Perform data extraction, transformation, and loading (ETL) operations on a sample dataset using Power BI.

- **Employee Dataset Creation using WEKA:**

Create and manage an Employee dataset using the WEKA Data Mining tool.

- **Data Format Conversion and ARFF Processing:**

Study data mining file formats and perform conversions between Text and ARFF file formats.

- **Data Preprocessing and Cleaning:**

Apply preprocessing techniques to prepare training datasets for data mining tasks.

- **Data Discretization and Visualization:**

Implement data discretization techniques and create visual representations of the processed data.

- **Classification using J48 and ID3 Algorithms:**

Implement and analyze classification models using J48 and ID3 decision tree algorithms.

- **Classification using Naïve Bayes Algorithm:**

Build and evaluate a classification model using the Naïve Bayes algorithm.

- **Decision Tree Construction and Analysis:**

Generate and analyze decision tree models for classification tasks.

- **Cluster Analysis using Data Mining Tools:**

Implement clustering algorithms and interpret the resulting clusters.

- **Classification using k-Nearest Neighbor (k-NN):**

Implement the k-NN algorithm and evaluate its classification performance.

- **Association Rule Mining using Apriori Algorithm:**

Generate frequent itemsets and association rules using the Apriori algorithm.

- **Text Mining and Analysis:**

Apply text mining techniques to extract meaningful information from textual datasets.

- **Multimedia Data Mining:**

Perform mining and analysis of multimedia data such as images, audio, or video datasets.

- **Web Mining using Clustering Techniques:**

Apply clustering algorithms to web data and analyze user behavior or web patterns.

- **Spatial Data Mining:**

Implement spatial mining techniques to discover patterns and relationships in geographical datasets.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	15
Q2	Unit 2	15
<b>Total:</b>		<b>30</b>

**Note:**

- **Certified Journal** is **compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	AI-Powered Infographic Design: Visualizing Data Structures and Data Mining Concepts, Viva/ Case Study/ MCQs/ Mini-Projects/ Complete the code block/ Develop the incomplete portion of the code etc.	10
<b>Total:</b>		<b>20</b>

**11 REFERENCES:**

1. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education.
2. J. Han and M. Kamber, "Data Mining: Concepts and Techniques", Second Edition, Elsevier.
3. Krzysztof J. Cios, W. Pedrycz, R. W. Swiniarski, L. A. Kurgan, "Data Mining" A Knowledge Discovery Approach", Springer (Unit I).
4. Dr. CarolynK. Hamm, "Oracle Data Mining", RampantTechPress, SPD.
5. Hands-On Data Structures and Algorithms with Python" by Dr. Basant Agarwal and Benjamin Baka
6. C. Ballard, Dynamic Warehousing and Data Mining Made Easy, ReddBooks, IBM (SPD)
7. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2005.
8. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.
9. Z. Tang and J MacLennan, "Data Mining with SQL Server 2005", Wiley
10. Data Structure and Algorithm Using Python, Rance D. Necaie, Wiley India Edition, 2016.
11. <https://www.geeksforgeeks.org/python-data-structures/>
12. <https://ml.cms.waikato.ac.nz/weka/index.html>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.**

**Semester- III**

**Title: Fundamentals of Operations Research**

**Vertical – 2**

**Minor Course: 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Operations Research -I

**Course Code: CHMMTIII8**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<b>Introduction:</b> Operations Research (OR) is a discipline focused on the application of advanced analytical methods to support effective decision-making. This course offers a comprehensive understanding of core concepts and techniques in operations research, with emphasis on linear programming, transportation problems, and assignment problems.
2	<b>Vertical 2</b>	Minor
3	<b>Type</b>	Theory
4	<b>Credit</b>	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To understand the fundamental concepts and structure of Linear Programming Problems (LPP). <b>CO(A) 2.</b> To develop the ability to formulate and solve LPPs using appropriate methods. <b>CO(A) 3.</b> To analyze the concept of duality in linear programming and its managerial significance. <b>CO(A) 4.</b> To design and evaluate efficient transportation schedules. <b>CO(A) 5.</b> To apply assignment models for optimal allocation of jobs to machines.	
8	<b>Course Outcomes:</b> <b>CO 1:</b> To develop the skills to formulate and solve Linear Programming Problems (LPP) for optimizing cost, time, profit, or loss. <b>CO 2:</b> To understand and analyze the concept of duality in LPP and its significance in managerial decision-making. <b>CO 3:</b> To design optimal transportation schedules that minimize cost and maximize efficiency. <b>CO 4:</b> To allocate jobs to machines effectively using assignment models for optimal resource utilization. <b>CO 5:</b> To explore advanced topics in Operations Research, including transportation problems, and assignment problems.	

## Syllabus

### UNIT I:

- **Linear Programming:** Mathematical formulation of maximization and minimization problems; concepts of solution, feasible solution, basic feasible solution, and optimal solution. Graphical method for two-variable problems. Simplex method for problems with two or more variables, including the Big M method. Introduction to duality and its application in solving LPPs; relationship between primal and dual solutions, and the economic interpretation of dual variables.

### UNIT-II:

- **Transportation Problem:** Concept and mathematical formulation; solution concepts including feasible solution and initial basic feasible solution using North West Corner Rule, Matrix Minima Method, and Vogel's Approximation Method. Optimal solution through MODI Method, including optimality testing and improvement procedures. Variants include unbalanced and maximization-type transportation problems.
- **Assignment Problem:** Concept and mathematical formulation; solution methods including Complete Enumeration and Hungarian Method. Variants include unbalanced and maximization-type problems. Introduction to the Travelling Salesman Problem (TSP) as a special case.

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks      Time: 01:00 hours**

Format of Question Paper

Question	Based on	Options	Marks
<b>Q.1.</b>	Unit – 1	Any 2 out of 4	10
<b>Q.2.</b>	Unit – 2	Any 2 out of 4	10
<b>Q.3.</b>	Unit – 1 and Unit – 2	Any 2 out of 4	10
			<b>Total 30</b>

**Internal Examination: Continuous Evaluation – 20 marks**

	Assessment / evaluation	Marks
1.	<b>Class Test –</b> It should be conducted using any learning management system such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Presentation, Demonstration, Case Study, Seminar, Posters, Mini-Project, Role play etc.	10
		<b>Total 20</b>

**REFERENCES:**

1. Operations Research: Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons.
2. Schaum Series book in O.R. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.
3. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons.
4. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
5. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.
6. Operations Research: S.D.Sharma. 11th edition, Kedar Nath Ram Nath & Company.
7. Quantitative Techniques For Managerial Decisions: J.K.Sharma , (2001), MacMillan India Ltd.
8. Operations Research: Theory and Applications, J K Sharma, Trinity Press, 6th Edition , 2017
9. Introduction to Operations Research, Frederick S. Hillier, Gerald J. Lieberman, McGraw Hill Education; 11th edition, 2021
10. Operations Research, P K Gupta, S. Chand Publications, 7th Edition, 2018
11. Operations Research, P. Rama Murthy, New Age Publication, 2nd Edition
12. Operations Research: An Introduction, 10th Edition, Hamdy A. Taha, Pearson Education, 2019

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Mathematics)**

**Semester- III**

**Title: Practicals based on Fundamentals of  
Operations Research**

**Vertical – 2**

**Minor Course: 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Practical's based on Operations Research -I

**Course Code: CHMMTIII9**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<b>Introduction:</b> Operations Research (OR) is a scientific approach to decision-making that involves the use of advanced analytical methods. This course aims to provide a thorough understanding of fundamental OR techniques, with a primary focus on linear programming, transportation problems, and assignment problems, to support optimal and efficient decision-making.
2	<b>Vertical 2</b>	Minor
3	<b>Type</b>	Practical
4	<b>Credit</b>	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To gain a foundational understanding of the concepts and structure of Linear Programming Problems (LPP).</p> <p><b>CO(A) 2.</b> To build the skills required to formulate and solve LPPs using suitable analytical methods.</p> <p><b>CO(A) 3.</b> To examine the concept of duality in linear programming and interpret its managerial relevance.</p> <p><b>CO(A) 4.</b> To develop and assess cost-effective and efficient transportation schedules.</p> <p><b>CO(A) 5.</b> To apply assignment models for the optimal distribution of tasks or jobs to available resources.</p>
8	<b>Course Outcomes:</b>	<p><b>CO 1:</b> Develop the skills to formulate and solve Linear Programming Problems (LPP) for optimizing cost, time, profit, or loss.</p> <p><b>CO 2:</b> Understand and analyze the concept of duality in LPP and its relevance to managerial decision-making.</p> <p><b>CO 3:</b> Design efficient transportation schedules to minimize cost and improve operational effectiveness.</p> <p><b>CO 4:</b> Apply assignment models for optimal job-to-machine allocation and resource utilization.</p> <p><b>CO 5:</b> Explore advanced topics in Operations Research, with a focus on transportation and assignment problems.</p>

<b>9</b>	<p><b>Practical 1:</b> a) Formulation and graphical solution of Linear Programming Problems (LPP). b) Solving minimization, maximization problems using the graphical methods</p> <p><b>Practical 2:</b> Application of the Simplex Method for solving minimization, maximization LPPs with standard constraints.</p> <p><b>Practical 3:</b> (a) Implementation of the Big-M Method for solving LPPs with artificial variables. (b) Application of the Two-Phase Method as an alternative to Big-M Method for artificial variable problems</p> <p><b>Practical 4:</b> Understanding and solving problems involving Duality.</p> <p><b>Practical 5:</b> a) Formulation of the Transportation Problem and obtaining the Initial Basic Feasible Solution using the <b>North West Corner Rule (NWCR)</b>. b) Application of the <b>Matrix Minima Method</b> to find the Initial Basic Feasible Solution. Solving Assignment Problems for optimal job allocation.</p> <p><b>Practical 6:</b> a) Implementation of <b>Vogel's Approximation Method (VAM)</b> for finding the Initial Basic Feasible Solution. b) Comparison of NWCR, Matrix Minima, and VAM in terms of initial cost effectiveness.</p> <p><b>Practical 7:</b> a) Computation of the <b>Optimal Solution using the MODI Method</b>. b) Handling <b>Unbalanced Transportation Problems</b> using balancing techniques. c) Solving <b>Maximization-type Transportation Problems</b> by converting them into equivalent minimization models.</p> <p><b>Practical 8:</b> a) Mathematical formulation and solution of <b>Assignment Problems</b> using the <b>Hungarian Method</b>. b) Application of the <b>Complete Enumeration Method</b> to a small-scale assignment problem for comparison.</p> <p>All above practical problems solving manual and using TORA/Excel Solver.</p>
----------	---

<b>10</b>	<p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern</b> Paper – 50 Marks</p> <p><b>External Examination: Semester End External - 30 marks Time: 02:00 hours</b> Format of Question Paper</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Question</th> <th style="text-align: center;">Practical Questions Based on</th> <th style="text-align: center;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><b>Q.1.</b></td> <td style="text-align: center;">Practical 1, 2, 3 and 4</td> <td style="text-align: center;">15</td> </tr> <tr> <td style="text-align: center;"><b>Q.2.</b></td> <td style="text-align: center;">Practical 5, 6, 7 and 8</td> <td style="text-align: center;">15</td> </tr> <tr> <td colspan="2"></td> <td style="text-align: right;"><b>Total 30</b></td> </tr> </tbody> </table> <p><b>Note:</b></p> <ul style="list-style-type: none"> <li>• <b>Certified Journal</b> is <b>compulsory</b> for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination</li> <li>• Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is an essential component of the evaluation process.</li> </ul>	Question	Practical Questions Based on	Marks	<b>Q.1.</b>	Practical 1, 2, 3 and 4	15	<b>Q.2.</b>	Practical 5, 6, 7 and 8	15			<b>Total 30</b>
Question	Practical Questions Based on	Marks											
<b>Q.1.</b>	Practical 1, 2, 3 and 4	15											
<b>Q.2.</b>	Practical 5, 6, 7 and 8	15											
		<b>Total 30</b>											

**Internal Examination: Continuous Evaluation – 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Practical Assignments / Experiments / Hands-On Tests / Presentations / Demonstrations / Online Class Test / Case Studies / Mini-Projects / Complete the code block / Develop the incomplete portion of the code etc.	15
2.	Journal	05
		<b>Total 20</b>

**11**

**REFERENCES:**

1. Operations Research: Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons.
2. Schaum Series book in O.R. Richard Bronson. 2nd edition Tata McGraw Hill Publishing Company Ltd.
3. Operations Research: Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons.
4. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
5. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.
6. Operations Research: S.D.Sharma.11th edition, Kedar Nath Ram Nath & Company.
7. Quantitative Techniques For Managerial Decisions: J.K.Sharma , (2001), MacMillan India Ltd.
8. Operations Research: Theory and Applications, J K Sharma, Trinity Press, 6th Edition , 2017
9. Introduction to Operations Research, Frederick S. Hillier, Gerald J. Lieberman, McGraw Hill Education; 11th edition, 2021
10. Operations Research, P K Gupta, S. Chand Publications, 7th Edition, 2018
11. Operations Research, P. Rama Murthy, New Age Publication, 2nd Edition
12. Operations Research: An Introduction, 10th Edition, Hamdy A. Taha, Pearson Education, 2019

**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)  
(Affiliated to the University of Mumbai)**

**Board of Studies (BoS) Mathematics**

<b>Sr. No.</b>	<b>Name of the Faculty</b>	<b>Designation and College</b>
1.	Ms. Urmila Pillay	Head and Associate Professor, Department of Mathematics, Smt. CHM College (Autonomous)
2.	Mr. Amish Thakker	Associate Professor, Smt. CHM College (Autonomous)
3.	Ms. Asha Chugh	Associate Professor, Smt. CHM College (Autonomous)
4.	Mr. Mandar Khasnis	Associate Professor, Smt. CHM College (Autonomous)
5.	Dr. Dipak Jadhav	Associate Professor, Smt. CHM College (Autonomous)
6.	Ms. Pooja Rajani	Assistant Professor, Smt. CHM College (Autonomous)
7.	Mr. Salil Sawarkar	Assistant Professor, Smt. CHM College (Autonomous)
8.	Mrs. Usha Hemasundar	Outside University nominee Head and Associate Professor, K.C. College, Churchgate
9.	Dr. Pankit Gandhi	Outside University nominee Professor, K.C. College, Churchgate
10.	Ms. Minal Wankhede	Vice Chancellor Nominee Head and Associate Professor, B.N. Bandodkar College, Thane
11.	Mr. Mandar Dongare	Industry Representative Senior Manager, Customer Success, Teradata India Pvt. Ltd.
12.	Ms. Supriya Bhagat	Alumni Representative Senior Product Data Scientist, Project pro

Name and Signature of the Ad hoc BoS Chairperson: Ms. Urmila Pillay



Name and Signature of the Dean:

Dr. Neena Anand



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Vertical - 3  
Open Elective Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Faculty of Interdisciplinary**

**Vertical 3: List of Open Elective Skill Based Courses for Second Year: Semester – III**

Sr. No.	Nomenclature of the Paper
1	Data Analysis And Visualization Using Excel
2	2D Animation And Motion Graphics
3	Advance Tools Of AI For Economics And Education - I
4	English For Journalism And Advertising
5	Urbanization And Real Estate: Infrastructure, Technology And Urban Change
6	Tourism Marketing
7	Managing Family Wealth Through Family Office-III
8	Responsive & Modern Web Designing
9	Basics Of Nutrition -3
10	Reel Making For Media And Social Change
11	Preforming Art- Dance-3
12	Data Analysis With Excel And Power BI
13	Digital Political Strategy, AI And Public Engagement Skills
14	Psychology Of Personal Relationship-I
15	Introduction To Sociology And Digital Society
16	Mushroom Cultivation Training And Trading Level 3
17	Yogasanas: Intermediate Series
18	Perfumery Course Level 3
19	Workplace And Professional Skills
20	Beautician: Strategic Business Planning III
21	Current Trends In Fashion Designing: Financial Perspective Level 3
22	Basics Of Accounting-III
23	Digital Marketing -III
24	Advanced Trading Strategies In Stock Market



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Title: Linear Algebra**

**Vertical - 4  
Vocational Skill Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Linear Algebra**  
**Course Code: CHMDSIII8**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Linear Algebra explores vector spaces and linear mappings, essential for fields like computer science and engineering. Key topics include matrix operations, solving linear equations, vector spaces, linear transformations, determinants, eigenvalues, and orthogonality. This course equips learners with fundamental problem-solving tools for scientific and engineering applications.
2	<b>Vertical 1</b>	Vocational Skill Course(VSC)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To develop foundational understanding of matrices and matrix algebra.</p> <p><b>CO(A) 2.</b> To equip students with techniques for solving systems of linear equations using various methods.</p> <p><b>CO(A) 3.</b> To introduce the concept of vector spaces and linear transformations.</p> <p><b>CO(A) 4.</b> To explore the role of inner product spaces and orthogonality in vector analysis.</p> <p><b>CO(A) 5.</b> To provide students with knowledge of eigenvalues, eigenvectors, and matrix diagonalization techniques.</p>

8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Perform matrix operations and apply matrix algebra to solve linear equations and model vector equations.</p> <p><b>CO 2:</b> Solve systems of linear equations using echelon forms, Gaussian and Gauss-Jordan elimination, and interpret the nature of their solutions.</p> <p><b>CO 3:</b> Analyze and construct vector spaces and subspaces, determine linear dependence/independence, and compute bases and dimensions.</p> <p><b>CO 4:</b> Apply concepts of linear transformations, including kernel, image, rank-nullity, and matrix representation under change of basis.</p> <p><b>CO 5:</b> Compute eigenvalues and eigenvectors, perform diagonalization, and apply the Cayley-Hamilton theorem and Jordan canonical forms in matrix analysis.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Algebra of Matrices:</b> Introduction and operations on matrices.</li> <li>• <b>Systems of linear equations:</b> Linear Equations, System of linear equations, Homogeneous and Non-Homogeneous linear systems, Equivalent systems, Solution of linear systems- Triangular form, Echelon form, Gaussian elimination method, Gauss Jordan method.</li> <li>• <b>Field:</b> Definition, examples –Real Numbers (<math>\mathbb{R}</math>), Complex Numbers (<math>\mathbb{C}</math>), Playing with <math>GF(2)</math>.</li> <li>• <b>Vectors:</b> Definition of vectors, Geometric and algebraic representation, Types of vectors, Vector addition, Scalar-vector multiplication, Combining vector addition and scalar multiplication, Dot product and their properties, Cross Product.</li> <li>• <b>Vector Spaces:</b> Definition, linear combinations, Span, Subspace, Row space, Column space, linear dependence and linear independence, basis and dimension.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Linear Transformations:</b> Definition, examples, Kernel and Image of a linear mapping, Null space, Rank and nullity dimension theorem, Algebra of linear transformations.</li> <li>• <b>Linear Transformation and Matrices:</b> Matrix representation of a linear</li> </ul>

transformation, Change of Basis, Similarity.

- **Inner Product Spaces & Orthogonality:** Inner product Spaces, Properties, Orthogonality, Orthogonal Sets, Orthonormal Sets, Gram-Schmidt Orthogonalization process.
- **Determinants:** Determinants by Cofactor Expansion, Properties of the Determinant, Cramer's Rule, Applications of Determinants.
- **Diagonalization, Eigenvalues and Eigenvectors:** Characteristic polynomial, Definition and computation of eigen values and eigenvectors, Properties of eigenvalues and eigenvectors, Cayley-Hamilton theorem, Minimal polynomial, Derogatory matrices, Similarity of matrices, Diagonalization of matrices, Jordan canonical forms.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Powered Meme Creation: Simplifying Linear Algebra Through Visual Humor, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11 REFERENCES:**

1. Lipschutz, S., & Lipson, M. (2018). Linear Algebra (4th ed.), Schaum's Outlines - McGraw Hill
2. Klein, P. (2013). Coding the Matrix Linear Algebra through Applications to Computer Science (1st ed.), Newtonian Press
3. Lay, S., & Lay, C., & Macdonald, J. (2016). Linear Algebra and Its Applications (5th ed.), Pearson Education
4. Davis, E., & Peters, A. (2012). Linear Algebra and Probability for Computer Science Applications (1st ed.), CRC Press
5. Strang, G. (2007). Linear Algebra and Its Applications (4th ed.), Cengage Learning
6. Anton, H., & Rorres, C. (2013). Elementary linear algebra: applications version. John Wiley & Sons.
7. Singh, K. (2014). Linear Algebra: step by step (1st ed.), Oxford University Press
8. Knop, L. (2008). Linear Algebra: A First Course with Applications (1st ed.), CRC Press
9. Little, J., & Damiano, D. (2011). A Course in Linear Algebra (1st ed.), Dover Publications
10. Cohn, P. (2017). Elements of Linear Algebra (1st ed.), CRC Press
11. Singh, A. (2014). Elements of Computation Theory (1st ed.), Springer.
12. Lang, S. (2012). Introduction to linear algebra. Springer Science & Business Media.
13. <https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B.A  
(Hindi)**

**Semester – III**

**Title : हिंदी भाषा : कौशल के आधार**

**Vertical - 5  
Ability Enhancement Course 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title : हिंदी भाषा : कौशल के आधार**

**Course Code : CHMAECHINIII**

Sr.No.	Heading	Particulars
1.	<b>Description of the Course :</b>	विद्यार्थियों के लिए हिंदी एक सामान्य भाषा होने के साथ विशेष भाषा तब बन जाती है जब वह हिंदी के माध्यम से अपने कौशल में अभिवृद्धि करें, हिंदी के माध्यम से रोजगार के कई अवसरों को प्राप्त करें, इस दृष्टि से पाठ्यक्रम अत्यंत लाभवर्धक और उपयोगी सिद्ध होगा, हिंदी भाषा में कौशल विकास की असीम संभावनाएं हैं और कौशल के विभिन्न आयाम जुड़े हुए हैं जो अलग – अलग दिशाओं में देखे जा सकते हैं, पाठ्यक्रम विद्यार्थियों में लेखन, वाचन कौशल की अभिवृद्धि करने के साथ रोजगारपरक अवसर प्रदान करता है।
2.	<b>Vertical : 5</b>	AEC
3.	<b>Type : Teaching Method</b>	Theory + Practicum Lecture / Discussion / Presentation / Self Study, etc.
4.	<b>Credit :</b>	2 Credits
5.	<b>Hours Allotted :</b>	30 Hours
6.	<b>Marks Allotted :</b>	50 Marks
7.	<b>Course Objectives :</b> CO(A)1 : विद्यार्थियों को लेखन, वाचन कौशल का ज्ञान देना एवं रोजगार के अवसरों से जोड़ना। CO(A)2 : विद्यार्थियों को लेखन, वाचन कौशल से परिचय करते हुए अभिव्यक्ति की शैलियों का विकास करना। CO(A)3 : विद्यार्थियों को भाषण कला के विविध रूपों को समझाना, मौलिकता में अभिवृद्धि लाना एवं विशेषज्ञता दिलाना। CO(A)4 : विद्यार्थियों को श्रवण कौशल की विशेषताओं से परिचय कराते हुए श्रवण कौशल के लाभों से अवगत कराना।	

8.	<p><b>Course Outcomes :</b></p> <p><b>CO1 :</b> विद्यार्थियों का लेखन, वाचन कौशल के ज्ञान प्राप्ति के साथ मौलिक अभिव्यक्ति में बदलाव आएगा ।</p> <p><b>CO2 :</b> विद्यार्थियों का लेखन, वाचन कौशल द्वारा मानसिक विकास होगा, पठन शक्ति, शैली का विकास होगा ।</p> <p><b>CO3 :</b> विद्यार्थियों को लेखन, भाषण कौशल से भषिक – शक्ति, शैलियों का संवर्धन होगा विशेषज्ञता आएगी ।</p> <p><b>CO4 :</b> विद्यार्थियों को लेखन, वाचन, श्रावण, भाषण कौशल की विशेषताओं और उपयोगिता का ज्ञान प्राप्त होगा ।</p>
9.	<b>Syllabus</b>
	<b>UNIT I : हिंदी भाषा कौशल के आधार</b>
	<p>1.1 लेखन कौशल का अर्थ एवं स्वरूप लेखन कौशल की उपयोगिता एवं महत्व</p> <p>1.2 लेखन कौशल की विधियाँ एवं विशेषताएँ</p> <p>1.3 वाचन कौशल का अर्थ, स्वरूप एवं विशेषताएँ</p> <p>1.4 वाचन कौशल की उपयोगिता एवं विधियाँ</p>
	<b>UNIT II : हिंदी भाषा कौशल के आधार</b>
	<p>2.1 भाषण कौशल का अर्थ एवं स्वरूप</p> <p>2.2 भाषण कौशल का महत्व एवं उपयोगिता</p> <p>2.3 भाषण कौशल की विधियाँ एवं विशेषताएँ</p> <p>2.4 श्रवण कौशल का अर्थ, स्वरूप एवं विशेषताएँ</p> <p>2.5 श्रवण कौशल का महत्व एवं उपयोगिता</p>

10.

**Scheme of Examination and Assessment Pattern**

**Paper – 50 Marks**

**External Examination : Semester End External – 30 Marks Time : 1:00 Hour**

**Format of Question Paper**

**All Questions are Compulsory**

मूल्यांकन प्रारूप	इकाई	अंक
<b>बाह्य मूल्यांकन</b>		
प्रश्न 1 : चार प्रश्नों में से किन्हीं दो प्रश्नों के उत्तर लिखिए ।	इकाई 1	15
प्रश्न 2 : चार प्रश्नों में से किन्हीं दो प्रश्नों के उत्तर लिखिए ।	इकाई 2	15 □
<b>कुल अंक</b>		<b>30</b>

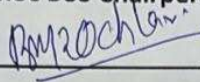
मूल्यांकन प्रारूप	अंक
<b>आंतरिक मूल्यांकन</b>	
<ul style="list-style-type: none"> <li>● AI Writing Tools की सहायता से हिंदी लेखन कौशल का अभ्यास, भाषा-संपादन, व्याकरण सुधार, सारांश लेखन एवं रचनात्मक लेखन करना।</li> <li>● AI की सहायता से दिए गए विषयों पर भाषण, लेख, संवाद एवं लघु-प्रस्तुति तैयार करना तथा भाषा, शैली एवं प्रभावशीलता का विश्लेषण करना।</li> <li>● AI Voice Tools का उपयोग करके हिंदी वाचन, भाषण, उच्चारण, स्वर, गति एवं प्रवाह का अभ्यास करना तथा AI आधारित Feedback प्राप्त करना।</li> <li>● AI Speech-to-Text एवं Text-to-Speech Tools की सहायता से श्रवण एवं वाचन कौशल विकसित करना तथा उच्चारण की शुद्धता का अभ्यास करना।</li> <li>● AI की सहायता से Reading Comprehension, प्रश्नोत्तर, शब्दार्थ, शब्दावली (Vocabulary) एवं भाषा-अभ्यास गतिविधियाँ तैयार करना।</li> <li>● AI आधारित Mock Interview, Group Discussion तथा Public Speaking गतिविधियों के माध्यम से भाषण एवं संप्रेषण कौशल विकसित करना।</li> <li>● AI की सहायता से हिंदी Podcast, Audio Narration एवं Listening Exercises तैयार करना तथा श्रवण कौशल का मूल्यांकन करना।</li> </ul>	20
<b>कुल अंक</b>	<b>20</b>

<b>11.</b>	<b>संदर्भ ग्रंथ सूची –</b> <ol style="list-style-type: none"><li>1. हिंदी भाषा शिक्षण के विविध आयाम – प्राध्यापक डॉ. राठौर, किनले एडिशन</li><li>2. अभिनव पत्र लेखन – डॉ. अनिल सिंह</li><li>3. हिंदी के व्यावहारिक रूप – डॉ. संतोष मोटवानी, परिदृश्य प्रकाशन, मुंबई</li><li>4. हिंदी भाषा लेखन कौशल – गुलीबाबा पब्लिकेशन प्राइवेट लिमिटेड</li></ol>
------------	--

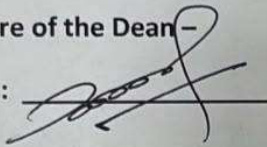
Bos in Hindi :

Sr No	Name of the Faculty	Designation and College
1.	Dr. Bhavna M.Rochlani	I/C HOD Asst. Professor CHM College Ulhasnagar
2.	Dr. Ajeet Kumar Rai	Associate Professor KC College Mumbai
3.	Dr. Santosh Motwani	Associate Professor RKT College Ulhasnagar

Name & Signature of the Ad-hoc BoS Chairperson -

Dr. Bhavna M. Rochlani : 

Name & Signature of the Dean -

Dr. Nitin Arekar : 



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year BA/BCom/BSc/SFC  
(Marathi)**

**Semester- III**

**Vertical -5  
Ability Enhancement Course (AEC) -2 Credits**

**with effect from  
Academic Year 2026-2027**

Title: लेखन कौशल्ये – १ (कार्यालयीन लेखनव्यवहार आणि पत्रव्यवहार)

COURSE CODE: CHMAECMARIII

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	(कार्यालयीन लेखनव्यवहार आणि पत्रव्यवहार)  लेखन ओळख ते लेखन कौशल्य हा बराच मोठा प्रवास आहे. वाचन आणि लेखनाच्या सरावाने, लेखन कौशल्य विकसित करता येते. बहुतेक वेळा आपण मिळवलेले ज्ञान हे लिखित स्वरूपात मांडावे लागते. त्यासाठी आपण लेखन कौशल्याचे योग्य उपयोजन करतो. लेखने म्हणजे मजकूर तंतोतंत उतरवणे नव्हे. एखादे निवेदन, वृत्त, निबंध, पुस्तकाची टिपणे, अर्ज यांसाठी लेखन आवश्यक असते. कार्यालयीन पत्रव्यवहार, कार्यवृत्ते, नोंदी, जाहिरात, टिप्पणी ही सर्व उपयोजित लेखन कौशल्ये आहेत. कार्यालयीन पत्रव्यवहार करणे हे एक वेगळ्या प्रकारचे कौशल्य आहे. त्यातील काही उपयोजन कौशल्यांचा विचार या अभ्यासपत्रिकेत अपेक्षित आहे. कार्यालयीन लेखन व्यवहार आणि पत्रव्यवहार या अभ्यासपत्रिकेत शिकविला जाईल.
2	<b>Vertical 5</b>	Ability Enhancement Course
3	<b>Type</b>	Theory
4	<b>Credit</b>	2 Credits (1 Credit = 15 Hours for Theory or 30 Hours of Practical Work in a Semester)
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<b>CO(A) 1:</b> कार्यालयीन लेखन व्यवहार स्वरूप समजावून सांगणे. <b>CO(A) 2:</b> कार्यालयीन पत्रव्यवहाराचे स्वरूप समजावून सांगणे. <b>CO(A) 3:</b> प्रभावी कार्यालयीन लेखनासाठी आवश्यक असणाऱ्या क्षमता आणि तंत्रांचा परिचय करून देणे,
8	<b>Course Outcomes:</b>	प्रस्तुत अभ्यासक्रम शिकल्यानंतर: <b>CO1:</b> विद्यार्थ्यांना कार्यालयीन लेखन व्यवहाराचे स्वरूप समजेल, <b>CO2:</b> विद्यार्थ्यांना कार्यालयीन पत्रव्यवहाराचे स्वरूप समजेल. <b>CO3:</b> प्रभावी कार्यालयीन लेखनासाठी आवश्यक असणाऱ्या तंत्रांचा विद्यार्थ्यांना परिचय होईल.

<p>9</p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I कार्यालयीन लेखनव्यवहार</b></p> <p>१. जाहीर निवेदन आणि माहितीपत्रक</p> <p>२. इतिवृत्त लेखन</p> <p>३. टिप्पणी लेखन</p> <p>(६० मिनिटांच्या १५ तासिका, श्रेयांकन १)</p> <p>(सूचना : विद्यार्थ्यांमध्ये उपरोक्त कार्यालयीन लेखन व्यवहार व पत्रव्यवहार करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)</p> <p><b>UNIT II: कार्यालयीन पत्रव्यवहार</b></p> <p>१. कार्यालयीन/प्रशासनिक पत्र</p> <p>२. नोकरीसाठी अर्जलेखन</p> <p>३. पत्रात्मक लेखन: नवी रूपे (शुभेच्छा, निमंत्रण)</p> <p>(६० मिनिटांच्या १५ तासिका, श्रेयांकन-१)</p> <p>(सूचना : विद्यार्थ्यांमध्ये उपरोक्त कार्यालयीन लेखन व्यवहार व पत्रव्यवहार करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)</p>																					
<p>10</p>	<p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern</b></p> <p style="text-align: center;">Paper – 50 Marks</p> <p style="text-align: center;"><b>External Examination: Semester End External - 30 marks Time: 1:00 hours</b></p> <p style="text-align: center;">Format of Question Paper</p> <p>All questions are compulsory:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Q. No</th> <th style="text-align: center;">Nature of Questions</th> <th style="text-align: center;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Q1</td> <td>Essay type question on Module 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">Q2</td> <td>Essay type question on Module 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">Q6</td> <td>MCQs 15 out of 20, 10 MCQs on each module</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table> <p><b>Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="text-align: center;">Project and presentation / Viva</th> <th style="text-align: center;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td> <ul style="list-style-type: none"> <li>● AI च्या साहाय्याने जाहीर निवेदन आणि माहितीपत्रक तयार करणे. त्यामध्ये शीर्षक, उद्दिष्ट, कार्यक्रमाचे वेळापत्रक, संपर्क इत्यादींची आकर्षक मांडणी करणे.</li> <li>● AI साधने वापरून सभेचे Audio/Video नुसार इतिवृत्त तयार करणे.</li> </ul> </td> <td style="text-align: center;">20</td> </tr> </tbody> </table>	Q. No	Nature of Questions	Marks	Q1	Essay type question on Module 1	10	Q2	Essay type question on Module 2	10	Q6	MCQs 15 out of 20, 10 MCQs on each module	10	<b>Total</b>		<b>30</b>		Project and presentation / Viva	Marks	1.	<ul style="list-style-type: none"> <li>● AI च्या साहाय्याने जाहीर निवेदन आणि माहितीपत्रक तयार करणे. त्यामध्ये शीर्षक, उद्दिष्ट, कार्यक्रमाचे वेळापत्रक, संपर्क इत्यादींची आकर्षक मांडणी करणे.</li> <li>● AI साधने वापरून सभेचे Audio/Video नुसार इतिवृत्त तयार करणे.</li> </ul>	20
Q. No	Nature of Questions	Marks																				
Q1	Essay type question on Module 1	10																				
Q2	Essay type question on Module 2	10																				
Q6	MCQs 15 out of 20, 10 MCQs on each module	10																				
<b>Total</b>		<b>30</b>																				
	Project and presentation / Viva	Marks																				
1.	<ul style="list-style-type: none"> <li>● AI च्या साहाय्याने जाहीर निवेदन आणि माहितीपत्रक तयार करणे. त्यामध्ये शीर्षक, उद्दिष्ट, कार्यक्रमाचे वेळापत्रक, संपर्क इत्यादींची आकर्षक मांडणी करणे.</li> <li>● AI साधने वापरून सभेचे Audio/Video नुसार इतिवृत्त तयार करणे.</li> </ul>	20																				

		<p>त्यानंतर विद्यार्थ्यांनी त्यात आवश्यक ती सुधारणा करणे.</p> <ul style="list-style-type: none"> <li>● AI चा वापर करून कार्यालयीन टिप्पणी तयार करणे. त्यातील भाषा, रचना, औपचारिकता इत्यादींचे परीक्षण करून सुधारित टिप्पणी तयार करणे.</li> <li>● AI साधनांच्या माध्यमातून प्रशासनिक पत्रांचे विविध नमुनारूप तयार करणे. भाषेची औपचारिकता तपासणे.</li> <li>● AI साधनांच्या साहाय्याने नोकरीसाठी अर्ज तयार करणे. दिलेल्या जाहिरातीवर आधारित Cover Letter तयार करणे.</li> <li>● विविध प्रसंगांसाठी AI साधनांच्या आधारे निमंत्रणपत्र व शुभेच्छापत्र तयार करणे.</li> </ul> <p>AI साधने: <a href="#">ChatGPT</a>, <a href="#">Google Gemini</a>, <a href="#">Claude</a>, <a href="#">Perplexity AI</a>, <a href="#">NotebookLM</a>, <a href="#">Canva</a>, <a href="#">CapCut</a>, <a href="#">InVideo</a>, <a href="#">Grammarly</a>, <a href="#">QuillBot</a>, <a href="#">Whisper</a>, <a href="#">ElevenLabs</a></p>	
			<b>Total 20</b>
<b>11</b>	<p><b>संदर्भ ग्रंथ (Reference Books) :</b></p> <ol style="list-style-type: none"> <li>१. प्रशासनिक लेखन, भाषा संचालनालय, महाराष्ट्र शासन, मुंबई, १९६६</li> <li>२. भाषिक सर्जन आणि उपयोजन, राजन गवस, अरुण शिंदे, गोमटेश्वर पाटील, दर्या प्रकाशन, पुणे, २०१२</li> <li>३. परब प्रकाश, व्यावहारिक मराठी, मिथुन प्रकाशन, डोंबिवली पूर्व, मुंबई, १९८९</li> <li>४. नाईक सदानंद, राजभाषा मराठी, व्यावहारिक मराठी, प्रका-नागरी सेवा प्रबोधिनी, मुंबई, २००२</li> <li>५. तावरे स्नेहल (संपा.), व्यावहारिक मराठी, स्नेहवर्धन प्रकाशन, पुणे, चौथी आवृत्ती, २०११</li> <li>६. केतकी मोडक, संतोष शेणई, सुजाता शेणई (संपा.), उपयोजित मराठी, पद्मगंधा प्रकाशन, २०१२</li> <li>७. नसीराबादकर ल. रा., व्यवहारिक मराठी, भाषा विकास संशोधन संस्था, कोल्हापूर २०२३</li> </ol>		

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- III**

**Title: Field Project**

**Vertical – 6**

**Field Project : 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Field Project

**Course Code: CHMDSIII9**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	Field projects offer students a practical learning experience by engaging them directly with real-world contexts. Students design questionnaires or interview schedules, interact with actual users or institutions, and gather first-hand data from the field. Through careful analysis of this data, they gain insights into real issues and challenges, helping them connect theory with practice. The project concludes with drawing meaningful conclusions and suggesting realistic improvements, thereby strengthening analytical skills, communication abilities, and professional awareness.
2	<b>Vertical 2</b>	Field Project
3	<b>Type</b>	Field Work + Survey + Discussion + Report Writing
4	<b>Credit</b>	2 credits
5	<b>Hours allotted</b>	30 hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To expose students to real-world data science applications through field-based projects. <b>CO(A) 2.</b> To apply data collection, analysis, and visualization techniques to practical problems. <b>CO(A) 3.</b> To develop analytical thinking and data-driven decision-making skills. <b>CO(A) 4.</b> To gain experience in working with real datasets and domain stakeholders. <b>CO(A) 5.</b> To promote ethical and responsible use of data in real-world contexts.	

<b>8</b>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO1:</b> Identify real-world problems suitable for data-driven analysis.</p> <p><b>CO2:</b> Collect and prepare data from field and secondary sources.</p> <p><b>CO3:</b> Apply data science techniques to analyze and visualize data.</p> <p><b>CO4:</b> Interpret results and communicate insights effectively.</p> <p><b>CO5:</b> Practice ethical and professional standards in data handling and analysis.</p>
----------	--

<b>9</b>	<p style="text-align: center;"><b>Syllabus</b></p> <p>Each student is required to select one topic from the given list. The topics are designed to help you explore the real-world application of Data Science concepts through data collection, analysis, and interpretation. Select a topic that truly interests you and can be realistically carried out, as you will be expected to work with real datasets, interact with stakeholders or data sources, apply analytical and statistical techniques, and derive data-driven insights. The chosen topic must be discussed and approved by the instructor to ensure it is clear, relevant, and not duplicated by other students.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Sr. No.</th> <th style="text-align: center;">Name of the Topic</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>Retail Sales Forecasting: Challenges and Practices in Local Stores</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Field Analysis of Data Analytics Tools Used by HR Professionals</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Use of Data in Employee Feedback and Performance Reviews</td> </tr> <tr> <td style="text-align: center;">4</td> <td>Sentiment Analysis of Local Brands on Instagram/Twitter (with field validation)</td> </tr> <tr> <td style="text-align: center;">5</td> <td>Data-Driven Analysis of Political Discourse During Local Elections</td> </tr> <tr> <td style="text-align: center;">6</td> <td>Predicting Health Risk Factors Using Community-Level Health Records</td> </tr> <tr> <td style="text-align: center;">7</td> <td>Field Study on Adoption of Data Analytics in Local Clinics or Hospitals</td> </tr> <tr> <td style="text-align: center;">8</td> <td>Analysis of Seasonal Disease Patterns Using Government Health Data</td> </tr> <tr> <td style="text-align: center;">9</td> <td>Assessment of Mental Health Trends Among Students Using Survey and Text Mining</td> </tr> <tr> <td style="text-align: center;">10</td> <td>Field Survey on Student Engagement with Online Learning Platforms</td> </tr> </tbody> </table>	Sr. No.	Name of the Topic	1	Retail Sales Forecasting: Challenges and Practices in Local Stores	2	Field Analysis of Data Analytics Tools Used by HR Professionals	3	Use of Data in Employee Feedback and Performance Reviews	4	Sentiment Analysis of Local Brands on Instagram/Twitter (with field validation)	5	Data-Driven Analysis of Political Discourse During Local Elections	6	Predicting Health Risk Factors Using Community-Level Health Records	7	Field Study on Adoption of Data Analytics in Local Clinics or Hospitals	8	Analysis of Seasonal Disease Patterns Using Government Health Data	9	Assessment of Mental Health Trends Among Students Using Survey and Text Mining	10	Field Survey on Student Engagement with Online Learning Platforms
Sr. No.	Name of the Topic																						
1	Retail Sales Forecasting: Challenges and Practices in Local Stores																						
2	Field Analysis of Data Analytics Tools Used by HR Professionals																						
3	Use of Data in Employee Feedback and Performance Reviews																						
4	Sentiment Analysis of Local Brands on Instagram/Twitter (with field validation)																						
5	Data-Driven Analysis of Political Discourse During Local Elections																						
6	Predicting Health Risk Factors Using Community-Level Health Records																						
7	Field Study on Adoption of Data Analytics in Local Clinics or Hospitals																						
8	Analysis of Seasonal Disease Patterns Using Government Health Data																						
9	Assessment of Mental Health Trends Among Students Using Survey and Text Mining																						
10	Field Survey on Student Engagement with Online Learning Platforms																						

11	Learning Outcome Prediction Based on Attendance and Engagement Metrics
12	Field Survey and Analysis of Public Transport Efficiency Using GPS & User Feedback
13	Smart City Readiness Assessment Using Data Metrics in a Selected Area
14	Waste Management Optimization Using Field Data Collection and Analysis
15	Traffic Congestion Analysis Using Field Observation and Live Sensor Data
16	Field Study on Credit Score Awareness and Usage Among Young Adults
17	Digital Payment Trends in Semi-Urban and Rural Markets
18	Behavioral Insights into Financial Planning Among College Students
19	Impact of Data Analytics on Loan Disbursement in NBFCs
20	Adoption of UPI and Cashless Economy: A Field Investigation
21	Field-Based Carbon Footprint Estimation for Households
22	Use of Data Science in Urban Water Usage Analytics
23	Data-Driven Social Impact Evaluation of Local NGOs
24	Sustainable Transport Choices: A Data Collection and Analysis Project
25	E-Waste Disposal Habits and Data-Backed Awareness Campaign Recommendations

## Guidelines for Field Project

Following are the general guidelines for the conduct of Field Project (Semester III & IV)

### Head of the Department (HOD)/ Field Project Co-ordinator

1. To ensure that FP program aligns with departmental and academic objectives as per NEP Structure within syllabus framework.
2. Appointment of field project incharges from the faculty of the department for group of Students.
3. To conduct orientation of FP Supervisor and decide the time line of the project.
4. To support the student for Filed Project.

### FP Supervisor:

1. To give Guidelines for the field project.
2. To monitor student progress and provide guidance.

### Project (Dissertation) Report:

Students are required to submit a report of the field project at the end of the semester in following suggested format.

The project should be typed on A4 sheets

Font Size 12, Times New Roman, 1.5 line Spacing

The project report shall have student details with signature of Field Project Incharge and photographs if any and it should be of minimum of 10 pages.

10

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Nature of Evaluation	Marks
Field Project Report	30
<b>Total 30</b>	

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Involvement of Survey of Field Project	05
2.	Field Visit Participation and Completion	10
3.	Overall Impression	05
		<b>Total 20</b>

11

**Appendix I**

**Attendance of the Student: Active Participation**

I, the undersigned Ms./Mr. \_\_\_\_\_ Roll No. \_\_\_\_\_ studying in the \_\_\_\_\_ Year of \_\_\_\_\_ Full-time Course, is doing my project work under the guidance of Dr./Ms./Mr. \_\_\_\_\_. I wish to state that I have met my Internal guide on the following dates mentioned below for Project Guidance: -

Sr No                  Date                  Signature of the Internal Guide

Signature of the Candidate

Signature of Field Project Supervisor

**Appendix II**

**Name of the Department/College/Institute**

**Certificate**

I hereby certify that Mr./Ms. \_\_\_\_\_ Student of \_\_\_\_\_ studying in \_\_\_\_\_, has completed a project titled \_\_\_\_\_ in the area of \_\_\_\_\_ specialization for the academic year 2025–2026 to the best of my knowledge the work of the student is original and the information included in the project is correct.

Field Project Supervisor

Head of the Department

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester- III**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>															
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2-3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>															
10	<b>Scheme of Examination and Assessment Pattern</b> <b>Based on 3 approved Activities</b> <b>Semester End External - 30 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>
Activity No	Nature of Activities	Marks														
1.	Title of Approved Activity - 1	10														
2.	Title of Approved Activity - 2	10														
3.	Title of Approved Activity - 3	10														
<b>Total</b>		<b>30</b>														
	<b>Internal Examination: Continuous Evaluation – 20 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Assessment / Evaluation</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>			
	Assessment / Evaluation	Marks														
1.	Reflective journal	10														
2.	Presentation/ poster presentation/viva	10														
<b>Total</b>		<b>20</b>														

**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak





**HSNC Board's**  
**Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar**  
**(Autonomous)**  
**Affiliated to the University of Mumbai**

**Bachelor of Science**  
**(Data Science)**  
**(Self-Financing Course)**

**Semester – IV**

**Choice Based and Credit Based syllabus**  
**as per NEP 2020 with effect from the Academic**  
**Year 2025-2026**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)  
Semester- IV**

**Title: Big Data**

**Vertical – 1  
Major Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Big Data**  
**Course Code: CHMDSIV1**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course provides an in-depth understanding of Big Data technologies, architectures, and processing frameworks used to manage and analyze massive datasets. It covers the evolution from 3Vs to 32Vs, along with key tools such as Hadoop, Spark, Flink, and NoSQL databases. The course also focuses on real-time data analytics, resource management strategies in cloud environments, and performance optimization techniques for distributed data processing systems. Through hands-on exposure and case studies, students will gain the skills needed to design, optimize, and manage scalable Big Data solutions for real-world applications.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> Explain the evolution of Big Data, from the 3Vs to 32Vs, and describe the role of Big Data Analytics, Machine Learning, and Cloud Computing in processing and analyzing large datasets.</p> <p><b>CO(A) 2.</b> Demonstrate proficiency in working with Hadoop Ecosystem components like HDFS, MapReduce, Spark, and Flink, and apply these tools for processing and analyzing large datasets.</p>

	<p><b>CO(A) 3.</b> Compare traditional relational databases with NoSQL databases and evaluate appropriate NoSQL data models for different types of Big Data applications.</p> <p><b>CO(A) 4.</b> Apply resource management techniques and optimize performance in Big Data processing environments, particularly in cloud-based infrastructures using MapReduce job scheduling and HDFS performance tuning.</p> <p><b>CO(A) 5.</b> Design real-time data processing pipelines using streaming platforms and apply techniques like packing algorithms to enhance data replay performance on multicore systems.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Explain the evolution of Big Data technologies, from 3Vs to 32Vs, and demonstrate understanding of Hadoop, Spark, Flink, and their role in Big Data Analytics and Real-Time Processing.</p> <p><b>CO 2:</b> Analyze the role of NoSQL databases in Big Data ecosystems and evaluate suitable data models for specific Big Data applications.</p> <p><b>CO 3:</b> Apply resource management techniques for Big Data processing systems in cloud environments and assess the effectiveness of single-resource and multi-resource management strategies.</p> <p><b>CO 4:</b> Design and implement distributed data processing workflows using MapReduce, and optimize system performance through efficient job scheduling, storage, and data processing techniques.</p> <p><b>CO 5:</b> Demonstrate proficiency in real-time data analytics by developing stream processing solutions and apply packing algorithms to enhance Big Data replay performance on multicore systems.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Big Data Science:</b> Introduction and Historical Interpretation of Big Data, From 3Vs to 32Vs, Big Data Analytics and Machine Learning, Big Data Analytics and Cloud Computing, Hadoop, HDFS, MapReduce, Spark, and Flink. Introduction to Data Science Lifecycle and CRISP-DM Model, Introduction to Distributed Computing and Parallel Processing.</li> <li>• <b>Real-Time Analytics:</b> Computing Abstractions for Real-Time Analytics, Real-Time</li> </ul>

Processing for Big Data, Data Stream Processing Platforms, Data Stream Analytics Platforms, Data Analysis and Analytic Techniques, Finance Domain Requirements, Event-Driven Architecture and Streaming Pipelines.

- **Database Techniques for Big Data:** Background, NoSQL Movement, NoSQL Solutions for Big Data Management, NoSQL Data Models.

**UNIT II:**

- **Resource Management in Big Data Processing Systems:** Types of Resource Management, Big Data Processing Systems and Platforms, Single-Resource Management in the Cloud, Multi resource Management in the Cloud, Related Work on Resource Management.
- **Local Resource Consumption Shaping: A Case for MapReduce:** Local Resource Shaper, Evaluation.
- **System Optimization for Big Data Processing:** Basic Framework of the Hadoop Ecosystem, Parallel Computation Framework: MapReduce, Job Scheduling of Hadoop, Performance Optimization of HDFS and HBase.
- **Packing Algorithms for Big Data Replay on Multicore:** Performance Bottlenecks, the Replay Method, Packing Algorithms, and Load Balancing in Distributed Systems, Task Parallelism and Data Parallelism, Multicore and Distributed Computing Challenges.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-assisted Big Data Analytics Tools, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11**

**REFERENCES:**

1. Big Data Principles and Paradigms, Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Publisher: Morgan Kaufmann.
2. Big Data: Principles and best practices of scalable real-time data systems, Nathan Marz and James Warren Publisher: Manning Publications.
3. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, David Loshin Publisher, Morgan Kaufmann
4. <https://www.tutorialspoint.com/hadoop/index.htm>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)  
Semester- IV**

**Title: Artificial Intelligence**

**Vertical – 1  
Major Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Artificial Intelligence

**Course Code: CHMDSIV2**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Artificial Intelligence is used to develop computer systems that make machines to perform tasks like human being problem solving, thinking, learning, and reasoning. Machine learning is a subset of artificial intelligence. AI enables computer machines to learn from data without explicit programming, improving their performance over time by analyzing patterns and making predictions based on that data.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To introduce the basics and foundations of AI and intelligent agents.</p> <p><b>CO(A) 2.</b> To develop skills in solving problems using various search techniques.</p> <p><b>CO(A) 3.</b> To understand logical reasoning using propositional and First-Order Logic.</p> <p><b>CO(A) 4.</b> To learn classical and advanced AI planning methods.</p> <p><b>CO(A) 5.</b> To explore real-world AI applications through domain-specific case studies.</p>

8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Describe the fundamental concepts of AI and intelligent agents.</p> <p><b>CO 2:</b> Apply uninformed, informed, and adversarial search strategies.</p> <p><b>CO 3:</b> Use propositional and First-Order Logic for knowledge representation and inference.</p> <p><b>CO 4:</b> Implement planning techniques for solving AI-based problems.</p> <p><b>CO 5:</b> Analyze AI applications in selected real-world domains.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Artificial Intelligence:</b> Definition, history and foundations of Artificial Intelligence, characteristics and goals of AI, applications of AI in Data Science and industry, intelligent agents and environment, rational agents and nature of environments, structure and behaviour of intelligent agents.</li> <li>• <b>Solving Problems by Searching:</b> Problem solving agents and problem formulation, state space representation of problems, searching for solutions, uninformed search techniques including Breadth First Search (BFS), Depth First Search (DFS) and Uniform Cost Search, informed search techniques including Best First Search and A* Algorithm, heuristic functions.</li> <li>• <b>Adversarial Search and Intelligent Decision Making:</b> Game playing and optimal decisions in games, Minimax algorithm, Alpha-Beta pruning, stochastic and partially observable games, state-of-the-art game playing programs, Local Search Algorithms: Hill Climbing and Simulated Annealing, Genetic Algorithms</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Logical Agents and Knowledge Representation:</b> Knowledge-based agents, The Wumpus World, logic and knowledge representation, propositional logic and propositional theorem proving, effective propositional model checking, agents based on propositional logic.</li> <li>• <b>First Order Logic and Inference:</b> Syntax and semantics of First Order Logic, knowledge engineering in First Order Logic, propositional logic versus First Order Logic, unification and lifting, forward and backward chaining, resolution techniques.</li> </ul>

	<ul style="list-style-type: none"> <li>• <b>Planning and Intelligent Systems:</b> Definition of classical planning, planning as state space search, planning graphs and other classical planning approaches, analysis of planning approaches, time, scheduling and resource management, hierarchical planning, planning and acting in nondeterministic domains, multi-agent planning.</li> <li>• <b>Modern AI Applications and Industry Case Studies:</b> generative AI and Large Language Models (LLMs), Explainable AI (XAI) and responsible AI, AI ethics, fairness and data privacy.</li> <li>• <b>Domain specific AI Case studies from the following (Any 2):</b> <ol style="list-style-type: none"> <li>a) Artificial Intelligence Trailblazers</li> <li>b) Retail, Consumer Goods and Food and Beverage Companies</li> <li>c) Media, Entertainment and Telecom Companies</li> <li>d) Services, Financial and Healthcare Companies</li> <li>e) Manufacturing, Automotive, Aerospace and Industry 4.0 Companies</li> </ol> </li> </ul>												
10	<p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern</b></p> <p style="text-align: center;">Paper – 50 Marks</p> <p style="text-align: center;"><b>External Examination: Semester End External - 30 marks Time: 1:00 hour</b></p> <p style="text-align: center;">Format of Question Paper</p> <p style="text-align: center;"><b>Internal Examination: Continuous Evaluation - 20 marks</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 80%;">Assessment / evaluation</th> <th style="width: 15%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Project, Self-Learning Evaluation, Presentation, etc.</td> <td style="text-align: center;">10</td> </tr> <tr> <td></td> <td><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>		Assessment / evaluation	Marks	1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10	2.	Project, Self-Learning Evaluation, Presentation, etc.	10		<b>Total</b>	<b>20</b>
	Assessment / evaluation	Marks											
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10											
2.	Project, Self-Learning Evaluation, Presentation, etc.	10											
	<b>Total</b>	<b>20</b>											

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

11

**REFERENCES:**

1. Artificial Intelligence: A Modern Approach, Stuart Russel and Peter Norvig, Pearson 3rd edition, 2015
2. A First Course in Artificial Intelligence, Deepak Khemani, TMH, First edition, 2017
3. Artificial Intelligence: A Rational Approach, Rahul Deva, Shroff publishers, 1st edition, 2018
4. Artificial Intelligence Elaine Rich, Kevin Knight and Shivashankar Nair, TMH, 3rd Edition, 2009
5. Artificial Intelligence & Soft Computing for Beginners, Anandita Das Bhattacharjee, SPD, 1st Edition, 2013
6. Artificial Intelligence in Practice, Bernard Marr John, Wiley & Sons Ltd (For Case Studies), 2019

<https://www.geeksforgeeks.org/artificial-intelligence/artificial-intelligence/>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)  
Semester- IV**

**Title: Machine Learning**

**Vertical – 1  
Major Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Machine Learning**  
**Course Code: CHMDSIV3**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	The Machine learning syllabus covers fundamental and basics concepts of machine learning and its various applications. Students will learn a comprehensive understanding of the concepts, algorithms, and techniques used in ML. It begins with an introduction of machine learning and explore the types, supervised and unsupervised learning methods, classification algorithms, regression models, performance evaluation metrics, clustering techniques, dimensionality reduction, and association rule mining. It covers applications and challenges associated with ML.
2	<b>Vertical 1</b>	Major
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To introduce students to the fundamental concepts and principles of Machine Learning.</p> <p><b>CO(A) 2.</b> To discuss and understand changing dimensions and learn about aggregate tables and determine their usage.</p> <p><b>CO(A) 3.</b> To provide hands-on experience in implementing and evaluating machine learning models.</p> <p><b>CO(A) 4.</b> To develop critical thinking and problem-solving skills in the context of machine learning.</p>

	<p><b>CO(A) 5.</b> To enable students to apply machine learning techniques to real-world problems and datasets</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Understand fundamental machine learning concepts and system workflows.</p> <p><b>CO 2:</b> Apply supervised and unsupervised algorithms effectively.</p> <p><b>CO 3:</b> Evaluate model performance using standard classification metrics.</p> <p><b>CO 4:</b> Analyze model behaviour regarding bias, variance, and dimensionality reduction.</p> <p><b>CO 5:</b> Implement regression, probabilistic models, clustering, and association rule mining.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>● <b>Introduction to Machine Learning:</b> Machine Learning (ML), Need for Machine Learning, ML from Knowledge-driven to Data Driven, Applications of Machine Learning, Machine learning process, Problems suitable for Machine Learning, Advantages, Disadvantages and Challenges of Machine Learning, Challenges of ML, General architecture of ML systems.</li> <li>● <b>Types of Machine Learning:</b> Supervised and Unsupervised Learning, Workflow, Semi-supervised Learning, and Reinforced Learning.</li> <li>● <b>Underlying Concepts in Machine Learning:</b> Inductive Learning, Generalization, Bias and Variance, Overfitting and Underfitting, Parametric and Non-Parametric algorithms, Feature Engineering Basics, Data Preprocessing Techniques, Handling Missing Data and Outliers, Train-Test Split Concepts.</li> <li>● <b>Classification Algorithms:</b> Concept of Classification, Binary classification, Multi-Class Classification, Multi Label Classification K-Nearest Neighbour Method: need and Working of KNN, Computing Distance, Pros and Cons of KNN.</li> <li>● <b>Decision Tree based Algorithm:</b> Terminologies and assumptions, Working of Decision Trees, ID3 Algorithm, Attribute selection Methods (Entropy, Gini Impurity, and Information Gain).</li> <li>● <b>Performance Evaluation:</b> Classification Metrics-Accuracy, Sensitivity, Precision, F1 Score, ROC/AUC Curve, Cross Validation.</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>● <b>Support Vector Machines:</b> Working of SVM, SVM Concepts-Support Vectors, Hard Margin, soft Margin, Kernels, Advantages and Disadvantages of SVM</li> <li>● <b>Probabilistic Learning:</b> Introduction to Bayes Learning, Interpretation of Bayes Rule,</li> </ul>

Benefits and shortfalls of Bayesian Learning, Naïve Bayes Classifier, Characteristics of Naïve Bayes.

- **Regression Methods:** Linear Regression Models, Logistic Regression, Unsupervised Learning: Concept of unsupervised Learning, Importance and Challenges of unsupervised Learning, Clustering and its applications, Types of Clustering Techniques, Hierarchical Clustering: Introduction, Types of Hierarchical Clustering, Issues with Hierarchical Clustering.
- **Partition algorithm:** K-means Clustering, steps of K-means Clustering, Issues, Strength and Weakness of K-means clustering. Elbow Method, Curse of Dimensionality.
- **Dimensionality Reduction:** Criteria for Reduction, Feature Reduction and Selection, Principal Component Analysis(PCA), Introduction to Feature Extraction Techniques,
- **Association rule Mining:** Basic Concepts, Market Basket Analysis, and Apriori algorithm.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Automated Machine Learning: Model Building, Training, and Performance Evaluation Using GitHub Copilot and AutoML Tools, Project, Self-Learning Evaluation, Presentation.	10
	<b>Total</b>	<b>20</b>

**11 REFERENCES:**

1. Machine Learning: Concepts, Techniques and Applications, T V Geetha S, Sendhilkumar, CRC Press, Taylor and Francis, 1st Edition, 2023.
2. Machine Learning for Decision Sciences with Case Studies in Python, S. Sumathi, Suresh V. Rajappa, CRC Press, Taylor and Francis 1st Edition 2022.
3. Machine Learning by S Sridhar Oxford University Press, 1st Edition 2021
4. [https://www.tutorialspoint.com/machine\\_learning/index.htm](https://www.tutorialspoint.com/machine_learning/index.htm)

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)  
Semester- IV**

**Title: BigData and AIML Practical**

**Vertical – 1  
Major Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: BigData and AIML Practical

**Course Code: CHMDSIV4**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course provides hands-on experience in implementing various Big Data Techniques and machine learning algorithms and techniques. Students will gain proficiency in applying classification algorithms like K-Nearest Neighbor (KNN), decision trees, Support Vector Machines (SVM), and Naïve Bayes, as well as regression models such as linear regression and logistic regression.
2	<b>Vertical 1</b>	Major
3	<b>Type</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> Artificial Intelligence Apply machine learning techniques to real-world datasets and problem scenarios.</p> <p><b>CO(A) 2.</b> Develop skills in model evaluation and performance assessment.</p> <p><b>CO(A) 3.</b> Understand the key issues in Machine Learning and its associated applications.</p> <p><b>CO(A) 4.</b> Gain the knowledge of classification and regression techniques.</p> <p><b>CO(A) 5.</b> Understand and implement the techniques for extracting the knowledge using prescribed techniques.</p>
8	<b>Course Outcomes:</b> Student will be able to:	<p><b>CO 1:</b> Practically implement machine learning algorithms such as KNN, decision trees, SVM, Naïve Bayes, linear regression, and logistic regression.</p> <p><b>CO 2:</b> Apply these algorithms to real-world datasets and problem scenarios.</p>

	<p><b>CO 3:</b> Develop the skill in evaluating and assessing the performance of machine learning models using appropriate metrics.</p> <p><b>CO 4:</b> Apply clustering techniques, including hierarchical clustering and K-means clustering, for grouping and segmentation tasks.</p> <p><b>CO 5:</b> Explore skills to process algorithms using prescribed techniques.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: BigData Practical</b></p> <ul style="list-style-type: none"> <li> <p>• <b>Hadoop Installation and Configuration</b></p> <p>To install and configure Hadoop in pseudo-distributed mode on a local machine or cloud platform and demonstrate file upload to HDFS, retrieval from HDFS, and basic file operations using Hadoop commands.</p> </li> <li> <p>• <b>MapReduce Word Count Program</b></p> <p>To implement a MapReduce program to count word frequencies from a large dataset stored in HDFS and analyze the mapper and reducer outputs.</p> </li> <li> <p>• <b>MapReduce for Statistical Analysis</b></p> <p>To implement a MapReduce program to process financial transactions dataset and compute the total transaction amount for each customer using key-value pairs.</p> </li> <li> <p>• <b>Apache Spark Basics</b></p> <p>To set up Apache Spark on a local machine or cloud environment, load a sample dataset into an RDD, and demonstrate basic transformations and actions such as map, filter, and reduce.</p> </li> <li> <p>• <b>Spark Streaming</b></p> <p>To perform real-time stream processing using Spark Streaming by ingesting a live data stream (e.g., Twitter feed or socket stream) and compute word frequencies in real time.</p> </li> <li> <p>• <b>Apache Flink Stream Processing</b></p> <p>To install and configure Apache Flink and implement a Flink streaming application to read streaming data from a text socket and compute the running count of words in real time.</p> </li> <li> <p>• <b>NoSQL Database using MongoDB or Cassandra</b></p> <p>To set up a NoSQL database such as MongoDB or Cassandra, create a</p> </li> </ul>

collection/table, insert large amounts of sample data, and demonstrate queries for data retrieval, aggregation, and filtering.

- **Comparative Study of NoSQL Databases**

To compare the data models of different NoSQL databases (MongoDB, Cassandra, HBase) by designing a schema for a sample e-commerce application and evaluating read and write latencies.

- **Hadoop Job Scheduling and YARN Resource Manager**

To implement a Hadoop job scheduler configuration and demonstrate how to manage multiple MapReduce jobs using YARN resource manager in a multi-tenant cluster.

- **Multi-node Hadoop Cluster using Docker**

To configure a multi-node Hadoop cluster using Docker or cloud instances, submit a large MapReduce job, and monitor cluster resource utilization using the ResourceManager UI.

- **Hadoop Performance Tuning**

To demonstrate performance tuning techniques in Hadoop such as block size optimization, combiner usage, speculative execution management, and mapper/reducer tuning on a large dataset.

- **HBase Operations**

To set up HBase on Hadoop and demonstrate data insertion, update, and retrieval for a time-series dataset representing sensor data.

## **UNIT II: AIML Practical**

### **AL Practical:**

- **Depth First Search (DFS)**

To implement the Depth First Search algorithm for traversing graphs and exploring state spaces in Artificial Intelligence applications.

- **Breadth First Search (BFS)**

To implement Breadth First Search for systematic exploration of nodes and shortest path identification in unweighted graphs.

- **Water Jug Problem**

To represent and solve the Water Jug Problem using state space search and intelligent problem-solving techniques.

- **N-Queen Problem**

To implement the N-Queen problem using backtracking algorithms and constraint satisfaction approaches.

- **Travelling Salesman Problem (TSP)**

To solve the Travelling Salesman Problem using heuristic and optimization techniques in Artificial Intelligence.

- **Tower of Hanoi**

To implement recursive techniques for solving the Tower of Hanoi problem and analyze state transitions.

- **Block World Problem**

To develop a planning-based solution for the Block World problem using AI problem-solving strategies.

- **Tic-Tac-Toe using Minimax Algorithm**

To design and implement a Tic-Tac-Toe game using the Minimax algorithm for intelligent decision making.

- **Alpha-Beta Pruning**

To implement Alpha-Beta pruning for improving the efficiency of adversarial search algorithms.

- **Hill Climbing Algorithm**

To implement the Hill Climbing algorithm for solving optimization and local search problems.

**ML Practical:**

- **K-Nearest Neighbor (KNN) Algorithm**

To implement the K-Nearest Neighbor (KNN) algorithm for classification and prediction using suitable datasets.

- **Decision Tree using ID3 Algorithm**

To build a Decision Tree model using the ID3 algorithm for classification and rule-based prediction.

- **Support Vector Machine (SVM)**

To develop a Support Vector Machine (SVM) model for classification of datasets and analyze its performance.

- **Naïve Bayes Classifier**

To build a Naïve Bayes classifier for probabilistic prediction and classification tasks

using sample datasets.

- **Linear Regression**

To implement Linear Regression for predicting continuous values and analyzing relationships between variables.

- **Logistic Regression**

To perform prediction using Logistic Regression for binary classification problems and evaluate model outcomes.

- **Classification Model Evaluation**

To evaluate a classification model using performance metrics such as accuracy, precision, recall, and F1-score.

- **Hierarchical Clustering**

To perform data segmentation by applying Hierarchical Clustering techniques and analyze cluster formation.

- **K-Means Clustering Algorithm**

To implement the K-Means clustering algorithm for grouping similar data points into clusters.

- **Principal Component Analysis (PCA)**

To utilize Principal Component Analysis (PCA) for dimensionality reduction to improve the efficiency and interpretability of machine learning models.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Question	Based On	Format of Question Paper	Marks
Q1	Unit 1		15
Q2	Unit 2		15
<b>Total:</b>			<b>30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination. Students are required to perform 75% of the Practical for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	AI-Powered Big Data Innovation Challenge: Designing Intelligent Solutions for Real-World Problems,/ Viva/ Case Study/ MCQs/ Mini-Projects/ Complete the code block/ Develop the incomplete portion of the code etc.	10
<b>Total: 20</b>		

11

**REFERENCES:**

1. Python Machine learning for Beginners, AI Publishing LLC, First 2020.
2. Hands of Machine learning with Scikit-Learn, Keras, and Tensorflow, Aurilien Geron, O'Reilly Publication, Third Edition, 2022.
3. Artificial Intelligence: A Modern Approach, Third Edition, Stuart J. Russell and Peter Norvig, 2010
4. Introduction to Artificial Intelligence, Marc Toussaint February 4, 2019  
Artificial Intelligence, Elaine Rich, Kevin Knight, & Shivashankar B Nair, McGraw Hill, 3rd ed.,2009
6. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010
7. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publication 2021
8. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, First Edition, Pearson Education 2018.
9. <https://hadoop.apache.org/docs/stable/>
10. <https://spark.apache.org/docs/latest/>
11. <https://www.mongodb.com/docs/>
12. <https://www.geeksforgeeks.org/artificial-intelligence/artificial-intelligence/>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Minor Course Provided By  
B.Sc. ( Mathematics )**

**Semester- IV**

**Title: Mathematical Modelling for Computer  
Applications**

**Vertical – 2  
Minor Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Mathematical Modelling for Computer Applications**  
**(Course Code: CHMMATHIV4 )**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course provides an application-focused understanding of how mathematical models help explain and predict behaviours in modern computer systems. Students learn foundational modelling concepts and explore growth, decay, and spread processes relevant to digital platforms, user dynamics, and information or malware propagation. The course also introduces graph-based network models, influence and diffusion behaviours, and basic system and queue modelling used to analyse server performance and network congestion. Emphasis is placed on intuitive reasoning, real-world scenarios, and developing a modelling mindset for analysing complex computing environments.
2	<b>Vertical 2</b>	Minor
3	<b>Type &amp; Teaching Method</b>	Theory
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	By the end of this course, learners will be able to: <ul style="list-style-type: none"> <li><b>CO(A) 1.</b> Explain the fundamental principles of mathematical modelling, including model types, assumptions, formulation, validation, and interpretation, in the context of computer-based systems.</li> <li><b>CO(A) 2.</b> Analyse and interpret growth, decay, and spread/epidemic processes (e.g., user growth, viral content, malware propagation) using conceptual and graphical representations of exponential, logistic, and SIR-type models.</li> <li><b>CO(A) 3.</b> Apply graph-based modelling concepts such as connectivity, centrality, shortest paths, and influence propagation to understand real-world networked systems, including communication and social networks.</li> <li><b>CO(A) 4.</b> Evaluate influence, diffusion, and cascading behaviours in digital platforms and networked environments, identifying the factors governing information spread, opinion formation, and viral phenomena.</li> </ul>

	<p><b>CO(A) 5.</b> Model and interpret basic system and queue behaviours—including arrival, service, waiting, and congestion—to understand performance characteristics of servers, cloud services, and networked systems.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> After successful completion of the course, learners will be able to:</p> <p><b>CO 1:</b> Describe key modelling concepts—model types, assumptions, formulation, and validation—and explain their role in analysing computer-based systems.</p> <p><b>CO 2:</b> Interpret growth, decay, and epidemic/spread behaviours using conceptual, graphical, and application-oriented models relevant to digital platforms and networks.</p> <p><b>CO 3:</b> Apply basic graph and network modelling ideas (nodes, edges, paths, connectivity, centrality) to understand communication networks and social influence patterns.</p> <p><b>CO 4:</b> Analyse diffusion, influence, and cascading processes that govern viral information, trending content, and behavioural spread in online systems.</p> <p><b>CO 5:</b> Examine simple system and queue models to interpret server performance, congestion patterns, and latency behaviour in computing environments.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Foundations, Growth Models and Spread/Epidemic Models</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Mathematical Modelling:</b> Purpose and role of models in computing. Types of models: deterministic/probabilistic, discrete/continuous. Steps in modelling: assumptions, formulation, validation, interpretation. Case discussions: system performance modelling, traffic growth, user dynamics</li> <li>• <b>Growth and Decay Models (Application-Oriented):</b> Exponential and logistic growth (conceptual, graphical understanding), Stability and long-term behaviour. <b>Real-world applications such as:</b> User-growth modelling for a digital platform, Forecasting server traffic or demand spikes, Modelling viral content growth</li> <li>• <b>Epidemic and Spread Models in Computing:</b> SIR-type models: compartments, flows, parameters. Epidemic thresholds, peak behaviour (conceptual). <b>Real-world applications such as:</b> Information/malware spread on networks, Misinformation propagation on social media, Contagion behaviour in distributed systems</li> </ul> <p><b>UNIT II: Network Models, Influence Models and System Behaviour Models</b></p> <ul style="list-style-type: none"> <li>• <b>Network Models (Graph-Based Modelling): Graph concepts:</b> nodes, edges, weighted/unweighted, paths. Connectivity, shortest paths, centrality (conceptual). <b>Real-world applications such as :</b> Communication and data networks, Routing intuition, Network congestion behaviour, Social network influence modelling (spread of opinions, influence scores)</li> <li>• <b>Influence and Diffusion Models:</b> Threshold models, cascading behaviour. Influence maximization (conceptual, no algorithms). Diffusion of ideas/information in networks. <b>Real-world Applications such as:</b> Viral marketing, Social influence dynamics, Trend propagation online</li> <li>• <b>System Behaviour and Queue Models:</b> Concept of discrete-time system modelling. Intuitive introduction to queues: arrival, service, waiting. Behaviour of servers under increasing load. <b>Real-</b></li> </ul>

**world applications such as:** Simple server/queue behaviour simulation, Cloud service delay modelling, Network latency and buffering

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No.	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Mini-Project, Case Study, Seminar, Posters, Self-Learning Evaluation, Presentation, etc.	10
		<b>Total 20</b>

11

**REFERENCES:**

1. Edwards, D., & Hamson, M. (1990). *Guide to mathematical modelling*. Springer.
2. Kapur, J. N. (1988). *Mathematical modelling*. Wiley Eastern.
3. Kermack, W. O., & McKendrick, A. G. (1991). *Contributions to the mathematical theory of epidemics* (Vol. 1). Springer.
4. Newman, M. E. J. (2010). *Networks: An introduction*. Oxford University Press.
5. Kleinrock, L. (1975). *Queueing systems, volume I: Theory*. Wiley.
6. Barabási, A.-L. (2016). *Network science*. Cambridge University Press.
7. Easley, D., & Kleinberg, J. (2010). *Networks, crowds, and markets: Reasoning about a highly connected world*. Cambridge University Press.
8. Pastor-Satorras, R., Castellano, C., Van Mieghem, P., & Vespignani, A. (2015). *Epidemic processes in complex networks*. Oxford University Press.
9. Trivedi, K. S. (2002). *Probability and statistics with reliability, queuing, and computer science applications* (2nd ed.). Wiley.
10. Mitzenmacher, M., & Upfal, E. (2005). *Probability and computing: Randomized algorithms and probabilistic analysis*. Cambridge University Press.
11. Taha, H. A. (2017). *Operations research: An introduction* (10th ed.). Pearson.

- |  |   |
|--|---|
|  | <ol style="list-style-type: none"><li>12. Singiresu, S. R. (2016). <i>Engineering optimization: Theory and practice</i> (5th ed.). Wiley India.</li><li>13. Rao, S. S. (2010). <i>Applied numerical methods for engineers and scientists</i>. PHI Learning.</li><li>14. Kanti Swaroop, P., &amp; Mohan, M. (2014). <i>Operations research</i>. Sultan Chand &amp; Sons.</li><li>15. Negi, L. R. (2014). <i>Mathematical models in operations research</i>. McGraw Hill Education.</li></ol> |
|--|---|

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Minor Course Provided By  
B.Sc. (Mathematics)**

**Semester- IV**

**Title: Practicals based on Mathematical Modelling  
for Computer Applications**

**Vertical – 2  
Minor Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Practicals based on Mathematical Modelling for Computer Applications**  
**(Course Code: CHMMATHIV5)**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course provides an application-focused understanding of how mathematical models help explain and predict behaviours in modern computer systems. Students learn foundational modelling concepts and explore growth, decay, and spread processes relevant to digital platforms, user dynamics, and information or malware propagation. The course also introduces graph-based network models, influence and diffusion behaviours, and basic system and queue modelling used to analyse server performance and network congestion. Emphasis is placed on intuitive reasoning, real-world scenarios, and developing a modelling mindset for analysing complex computing environments.
2	<b>Vertical 2</b>	Minor
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To enable students to understand and apply the fundamental steps of mathematical model building—including problem formulation, assumption identification, and graphical interpretation—through practical, real-world computing scenarios.</p> <p><b>CO(A) 2.</b> To develop the ability to construct, compare, and analyse growth-based models (exponential, logistic, and combined growth–decay) for applications such as user growth prediction, server load behaviour, and viral content dynamics.</p> <p><b>CO(A) 3.</b> To equip learners with hands-on skills in designing and interpreting epidemic-style SIR models for understanding information/malware propagation and evaluating intervention or control strategies in networked systems.</p> <p><b>CO(A) 4.</b> To introduce students to graph-based network modelling and analysis, enabling them to compute fundamental network metrics, identify bottlenecks,</p>

	<p>model routing behaviour, and understand influence dynamics in social networks.</p> <p><b>CO(A) 5.</b> To apply modelling techniques to system performance scenarios by simulating queue behaviours, analysing server load patterns, and interpreting performance outcomes for computing and communication systems.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> After successful completion of the course, learners will be able to:</p> <p><b>CO 1:</b> Apply the complete model-building process—problem identification, assumption setting, formulation, and visualization—to real computing scenarios such as user-growth prediction.</p> <p><b>CO 2:</b> Construct and compare exponential, logistic, and combined growth–decay models, and interpret their behaviour through graphical and analytical techniques relevant to server load and viral content dynamics.</p> <p><b>CO 3:</b> Implement and analyse SIR-based epidemic models to study malware or information spread in networks, and evaluate the impact of intervention or control strategies.</p> <p><b>CO 4:</b> Build and analyse graph-based network models, compute essential graph metrics, and identify network bottlenecks and routing behaviours through hands-on network simulations.</p> <p><b>CO 5:</b> Develop and execute practical simulations of influence diffusion, recommendation behaviour, and queue-based system performance models to interpret real-world server, congestion, and latency patterns.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>PRACTICAL 1: Introduction to Model Building - User Growth Prediction</b></p> <ul style="list-style-type: none"> <li>a) Understanding the Model Building Process: Problem Formulation and Visualization</li> <li>b) Applying Different Model Types: Solving Simple Growth Prediction Problems</li> </ul> <p><b>PRACTICAL 2: Exponential vs. Logistic Growth - Server Load Modelling</b></p> <ul style="list-style-type: none"> <li>a) Formulation and Graphical Solution of Exponential Growth Problems</li> <li>b) Solving Logistic Growth Problems Using Graphical and Analytical Methods</li> </ul> <p><b>PRACTICAL 3: Viral Content Spread Simulation</b></p> <ul style="list-style-type: none"> <li>a) Implementation of Combined Growth-Decay Models for Viral Dynamics</li> <li>b) Application of Parameter Sensitivity Analysis to Viral Spread Models</li> </ul> <p><b>PRACTICAL 4: SIR Epidemic Model - Malware Propagation</b></p> <ul style="list-style-type: none"> <li>a) Understanding and Solving SIR Compartmental Models for Network Security</li> <li>b) Application of Control Measures and Intervention Strategies</li> </ul> <p><b>PRACTICAL 5: Network Fundamentals - Social Network Analysis</b></p> <ul style="list-style-type: none"> <li>a) Formulation of Network Models and Computing Basic Graph Metrics</li> <li>b) Application of Centrality Measures</li> </ul> <p><b>PRACTICAL 6: Network Flow and Bottlenecks - Routing Model</b></p> <ul style="list-style-type: none"> <li>a) Formulation and Solution of Maximum Flow Problems</li> <li>b) Comparison of Routing Strategies</li> </ul> <p><b>PRACTICAL 7: Influence and Recommendation Systems</b></p> <ul style="list-style-type: none"> <li>a) Implementation of Probabilistic Influence Spread Models in Social Networks</li> </ul>

- b) Application of Seed Selection Strategies and Adoption Rate Sensitivity Analysis
- PRACTICAL 8: System Queuing and Server Performance Modelling**
- a) Mathematical Formulation and Manual Calculation of Queuing Systems
- b) Multi-Server Systems and Priority Queuing

10

**Scheme of Examination and Assessment Pattern**  
Paper – 50  
**External Examination: Semester End External - 30 marks**

Sr. No.	Nature of Evaluation	Marks
<b>Project Evaluation:</b>		
1)	Problem definition and justification	05
2)	Model design and assumptions	05
3)	Implementation quality	05
4)	Analysis depth	05
5)	Presentation and documentation	10
		<b>Total 30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

Sr. No.	Nature of Evaluation	Marks
<b>Project Evaluation:</b>		
1)	Week 1: Choose topic, define problem, get approval	03
2)	Week 2: Design model, start implementation	05
3)	Week 3: Complete implementation, run scenarios	06
4)	Week 4: Analysis, visualization (Interpretation and Validation)	06
5)	Week 5: Report writing, Presentation and submission	--
		<b>Total 20</b>

**Integrated Project - Network Modelling Case Study:** Apply all learned concepts to build a complete modelling project.

**Project Options (Choose ONE):**

**1. Misinformation Spread on Social Media**

- Model how false information spreads through a social network.
- Combine: SIR model + Network structure
- Components: Believers (I), Skeptics (S), Fact-checkers (R)
- Include: Network centrality, threshold effects, intervention strategies

**2. User Growth and Churn on a Platform**

- Model user acquisition and retention for an app.
- Combine: Logistic growth + Network effects
- Components: New users, Active users, Churned users, Referrals
- Include: Growth rate, retention rate, network-driven virality

**3. Network Congestion and Load Balancing**

- Model traffic distribution in a server network.
- Combine: Flow models + Queuing concepts
- Components: Multiple servers, varying capacities, request routing

- Include: Bottlenecks, load distribution, optimization

#### 4. Open Choice

- Propose your own computing-related modelling problem.
- Must incorporate at least TWO concepts from the course
- Must have clear application to computer science
- Get instructor approval before starting

#### Project Requirements for internals:

##### 1. Problem Definition:

- Clear statement of problem
- Why is modelling useful here?
- What are you trying to predict/understand?

##### 2. Model Design:

- Clearly state all assumptions
- Define model type and justify choice
- Explain parameters and their meanings
- Draw diagrams of model structure

##### 3. Implementation:

- Build working simulation (Excel/Python)
- Show calculations/code clearly
- Demonstrate model runs with different parameters

##### 4. Analysis:

- Present results with visualizations (graphs, charts)
- Compare different scenarios
- Identify key insights and patterns
- Discuss thresholds, peaks, optimal points

##### 5. Interpretation and Validation:

- Do results make sense?
- What are model limitations?
- How could the model be improved?
- Real-world applicability

#### Deliverables for external evaluation:

##### 1. Written Report (1500-2000 words):

- All sections above
- Professional formatting
- References to course concepts

##### 2. Visualizations:

- Minimum 3 graphs/charts
- Network diagrams where applicable
- Clear labels and legends

##### 3. Presentation (10 minutes):

- Problem overview
- Model explanation
- Key results
- Insights and recommendations

##### 4. Working Model:

	<ul style="list-style-type: none"> <li>○ Excel file or Python code</li> <li>○ Commented and organized</li> <li>○ Runnable by instructor</li> </ul>
<p><b>11</b></p>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Edwards, D., &amp; Hamson, M. (1990). <i>Guide to mathematical modelling</i>. Springer.</li> <li>2. Kapur, J. N. (1988). <i>Mathematical modelling</i>. Wiley Eastern.</li> <li>3. Kermack, W. O., &amp; McKendrick, A. G. (1991). <i>Contributions to the mathematical theory of epidemics</i> (Vol. 1). Springer.</li> <li>4. Newman, M. E. J. (2010). <i>Networks: An introduction</i>. Oxford University Press.</li> <li>5. Kleinrock, L. (1975). <i>Queueing systems, volume I: Theory</i>. Wiley.</li> <li>6. Barabási, A.-L. (2016). <i>Network science</i>. Cambridge University Press.</li> <li>7. Easley, D., &amp; Kleinberg, J. (2010). <i>Networks, crowds, and markets: Reasoning about a highly connected world</i>. Cambridge University Press.</li> <li>8. Pastor-Satorras, R., Castellano, C., Van Mieghem, P., &amp; Vespignani, A. (2015). <i>Epidemic processes in complex networks</i>. Oxford University Press.</li> <li>9. Trivedi, K. S. (2002). <i>Probability and statistics with reliability, queuing, and computer science applications</i> (2nd ed.). Wiley.</li> <li>10. Mitzenmacher, M., &amp; Upfal, E. (2005). <i>Probability and computing: Randomized algorithms and probabilistic analysis</i>. Cambridge University Press.</li> <li>11. Taha, H. A. (2017). <i>Operations research: An introduction</i> (10th ed.). Pearson.</li> <li>12. Singiresu, S. R. (2016). <i>Engineering optimization: Theory and practice</i> (5th ed.). Wiley India.</li> <li>13. Rao, S. S. (2010). <i>Applied numerical methods for engineers and scientists</i>. PHI Learning.</li> <li>14. Kanti Swaroop, P., &amp; Mohan, M. (2014). <i>Operations research</i>. Sultan Chand &amp; Sons.</li> <li>15. Negi, L. R. (2014). <i>Mathematical models in operations research</i>. McGraw Hill Education.</li> </ol>

**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)  
(Affiliated to the University of Mumbai)**

**Board of Studies (BoS) Mathematics**

<b>Sr. No.</b>	<b>Name of the Faculty</b>	<b>Designation and College</b>
1.	Ms. Urmila Pillay	Head and Associate Professor, Department of Mathematics, Smt. CHM College (Autonomous)
2.	Mr. Amish Thakker	Associate Professor, Smt. CHM College (Autonomous)
3.	Ms. Asha Chugh	Associate Professor, Smt. CHM College (Autonomous)
4.	Mr. Mandar Khasnis	Associate Professor, Smt. CHM College (Autonomous)
5.	Dr. Dipak Jadhav	Associate Professor, Smt. CHM College (Autonomous)
6.	Ms. Pooja Rajani	Assistant Professor, Smt. CHM College (Autonomous)
7.	Mr. Salil Sawarkar	Assistant Professor, Smt. CHM College (Autonomous)
8.	Mrs. Usha Hemasundar	Outside University nominee Head and Associate Professor, K.C. College, Churchgate
9.	Dr. Pankit Gandhi	Outside University nominee Professor, K.C. College, Churchgate
10.	Ms. Minal Wankhede	Vice Chancellor Nominee Head and Associate Professor, B.N. Bandodkar College, Thane
11.	Mr. Mandar Dongare	Industry Representative Senior Manager, Customer Success, Teradata India Pvt. Ltd.
12.	Ms. Supriya Bhagat	Alumni Representative Senior Product Data Scientist, Project pro

Name and Signature of the Ad hoc BoS Chairperson: Ms. Urmila Pillay



Name and Signature of the Dean:

Dr. Neena Anand



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- IV**

**Vertical - 3  
Open Elective Course – 2 Credits**

**with effect from  
Academic Year 2025-2026**



HSNC Board's

# Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

(Affiliated to the University of Mumbai)

University College Code: 217 | JD Office: T14



## Faculty of Interdisciplinary

### List of Skill Based Open Electives for Second Year: Semester – IV

Sr. No.	Semester IV Subject
1	Digital Interface, Web Design And Publishing
2	3D Modeling And Character Animation Fundamentals
3	Advance Tools Of AI For Economics And Education - II
4	English For Leadership and Strategic Communication
5	Urbanization And Real Estate: Applied Urban Planning, Design And Sustainable Cities
6	Travel Agency And Tour Operators Business
7	Managing Family Wealth Through Family Office-IV
8	Advanced Web Designing & Portfolio Development
9	Basics Of Nutrition - 4
10	Reel Strategy And Influencer Management
11	Preforming Art- Dance-4
12	Data Analysis Project Based Approach
13	Strategic Political Communication, Digital Governance And AI-Driven Public Engagement Skills
14	Psychology Of Personal Relationship-II
15	Digital Society And Social Change
16	Mushroom Cultivation Training And Trading Level 4
17	Pranayama And Yogic Breathing Practices
18	Perfumery Course Level 4
19	Career Launchpad: Communication And Employability Skills
20	Beautician: Strategic Business Planning -IV
21	Current Trends In Fashion Designing: Financial Perspective Level 4
22	Basics Of Accounting-IV
23	Digital Marketing -IV
24	Online Trading For Investment Management



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)  
Semester- IV**

**Title: Testing of Hypothesis**

**Vertical – 4  
Skill Enhancement Course– 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Testing of Hypothesis

Course Code: CHMDSIV8

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Data collection and hypothesis testing are crucial for data analysts. Accurate data collection ensures reliable insights, while hypothesis testing helps validate assumptions with statistical evidence. This process supports data-driven decisions, reduces bias, and quantifies uncertainty. By combining clean data and rigorous analysis, data analysts provide businesses with trusted recommendations, driving smarter strategies and improving overall decision-making effectiveness in competitive environments.
2	<b>Vertical 4</b>	SEC
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To introduce basic principles and importance of research. <b>CO(A) 2.</b> To develop skills in defining research problems and hypotheses. <b>CO(A) 3.</b> To understand research designs, sampling, and data collection methods. <b>CO(A) 4.</b> To learn hypothesis testing and statistical analysis techniques. <b>CO(A) 5.</b> To apply statistical tests using Python/Excel in research.	

<p>8</p>	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Understand fundamental concepts and ethics of research.</p> <p><b>CO 2:</b> Formulate research problems, hypotheses, and conduct literature reviews.</p> <p><b>CO 3:</b> Choose suitable research designs, sampling methods, and data collection techniques.</p> <p><b>CO 4:</b> Apply hypothesis testing and key statistical methods in research.</p> <p><b>CO 5:</b> Perform and interpret statistical analyses using Python/Excel.</p>
<p>9</p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Research:</b> Overview of research: Definition, types, and importance of research.</li> <li>• <b>Formulating Research Problem and Hypothesis:</b> Identifying research problems, formulating research questions, and crafting hypotheses.</li> <li>• <b>Review of Literature:</b> How to conduct and write a literature review, importance of literature in research.</li> <li>• <b>Research Design and Methodology:</b> Understanding research designs (Exploratory, Descriptive, Experimental) and choosing methodology Sampling Methods and Techniques: Probability and non-probability sampling methods and techniques.</li> <li>• <b>Data Collection Methods:</b> Techniques for collecting data: Surveys, interviews, observations, and instruments.</li> <li>• <b>Data Analysis Techniques:</b> Introduction to data analysis: Descriptive and inferential statistics.</li> <li>• <b>Introduction to Writing a Research Paper:</b> Structure and organization of a research paper: Abstract, Introduction, Methodology, Results.</li> <li>• <b>Ethics in Research:</b> Ethical considerations in research: Integrity, plagiarism, informed consent.</li> <li>• <b>Introduction to Hypothesis Testing:</b> Definition and basic concepts of hypothesis testing, types of hypotheses.</li> <li>• <b>Steps in Hypothesis Testing:</b> Formulating hypotheses, choosing appropriate tests, calculating test statistics, and p-values.</li> </ul>

- **Types of Errors in Hypothesis Testing:** Type I and Type II errors, Power of the test, and reducing errors.

**UNIT II:**

- **t-tests:** One-Sample, Independent, and Paired One-sample t-test, Independent t-test, Paired t-test and their applications, Application of T-Test for Testing hypothesis using Python/Excel.
- **Analysis of Variance (ANOVA) One-way and Two-way ANOVA:** Theory, and assumptions, Application of ANOVA for Testing hypothesis using Python/Excel.
- **Chi-Square Test for Independence:** Chi-square goodness-of-fit test, test of independence, and its application, Application of Chi-Square for Testing hypothesis using Python/Excel.
- **Correlation and Regression Analysis:** Pearson correlation, Simple linear regression, and Multiple regression, Application of Correlation and Regression using Python/Excel.
- **Non-Parametric Tests:** Mann-Whitney U test, Wilcoxon signed-rank test, Kruskal-Wallis test and when to use them, Python program based on above techniques.
- **F-Test and its Applications:** F-test for comparing variances, and its use in ANOVA and regression analysis, Python Program for F-Test
- **Z-test for Proportions and Means:** Z-test for sample means and proportions, assumptions and calculations, Python Program for Z-Test
- **Tests for Normality:** Shapiro-Wilk, Kolmogorov-Smirnov tests for normality, visual tools (Q-Q plots, Histograms), Python Program for Test of Normality.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Powered Research Explorer: Literature Review and Research Paper Analysis Using Elicit, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Research Methodology – Methods and Techniques-C. R. Kothari-New Age International (P) Ltd., Publishers
2. Fundamentals Of Mathematical Statistics - S.C. Gupta , V.K. Kapoor Sultan Chand & Sons.
3. Business Research Methods Allan Bryman Emma Bell OXFORD University Press
4. Business Research Methods Donald R. Cooper Pamela S. SchindlerMcGraw-Hill/Irwin, 12th Ed
5. Hypothesis Testing, Pearson Higher Education
6. Statistical Analysis Handbook, Dr Michael J de Smith, The Winchelsea Press, Drumlin Security Ltd, Edinburgh, 2018
7. An Introduction to Statistical Methods and Data Analysis, R. Lyman Ott &Michael Longnecker, Thomson Learning
8. <https://www.statisticshowto.com/>
9. <https://conjointly.com/kb/>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani  
College  
(Autonomous)**

**Second Year B.A  
(Hindi)**

**Semester – IV**

**Title : हिंदी भाषा : व्यावहारिक प्रयोग  
Vertical - 5  
AEC – 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title : हिंदी भाषा : व्यावहारिक प्रयोग****Course Code : CHMAECHINIV**

Sr.No.	Heading	Particulars
1.	<b>Description of the Course :</b>	<p>भाषा का जीवन में सदैव महत्व रहा है, जीवन और भाषा का चोली – दामन का संबंध है, जब हमारी भाषा मधुर और सार्थक होती है तो श्रेता पर विशिष्ट प्रभाव पड़ता है, भाषा का यदि सही और सार्थक रूप से प्रयोग किया जाए तो मुनष्य जीवन में कहीं भी असफल नहीं हो सकता है, इसी भाषा के माध्यम से हम सभी को अपनी ओर आकर्षित भी करते हैं, वर्तमान युग में रोजगार में बहुत से क्षेत्र भाषा से जुड़े हुए हैं, जिसके माध्यम से विद्यार्थी इनका लाभ ग्रहण कर सकते हैं, भाषाई क्षमता हमारे विचारों की संवाहक होती है, आज डिजिटल युग में अभिव्यक्ति के कई माध्यमों का प्रसार हुआ है, इन माध्यमों में भाषा ही सशक्त तत्व है जो आपकी अभिव्यक्ति को पूरे जगत को अवगत कराती है, भाषा का महत्व हर समय, हर माध्यम में रहा है, परंतु भाषा का सार्थक रूप का प्रयोग आज बहुत आवश्यक है। आज हिंदी अंतरराष्ट्रीय स्तर पर प्रयोग में लाई जा रही है, तकनीक, सूचना प्रौद्योगिकी सोशल मीडिया, राजनीति की भाषा हिंदी बन चुकी है, जीवन में कई क्षेत्रों में व्यावहारिक स्तर पर हमें अपनी भाषा के लिखित स्वरूप के कार्यों को करना होता है और ऐसे में कार्य-दक्षता महत्व रखती है, हिंदी भाषा में व्यावहारिक प्रयोग को केंद्र में रखकर और इन्हीं पहलुओं को ध्यान में रखते हुए इस पाठ्यक्रम का गठन किया गया है, हम हिंदी भाषा को सही और शुद्ध रूप में प्रयोग कर अभिव्यक्ति को सफल बनाएँ और बिना व्याकरण के यह संभव नहीं है, इस दृष्टि से पाठ्यक्रम सर्वाधिक लाभकारी सिद्ध होगा</p>
2.	<b>Vertical : 5</b>	AEC
3.	<b>Type :</b> <b>Teaching Methods :</b>	Theory + Practium Lecture / Discussion / Presentation / Self Study, etc.

4.	<b>Credit :</b>	2 Credits (1 Credit = 15 Hours for Theory)
5.	<b>Hours Allotted :</b>	30 Hours
6.	<b>Marks Allotted :</b>	50 Marks
7.	<b>Course Objectives :</b> <b>CO(A)1:</b> विद्यार्थियों को राजभाषा हिंदी का विधिवत ज्ञान प्रदान करना । <b>CO(A)2:</b> विद्यार्थियों को राजभाषा हिंदी के संवैधानिक महत्त्व से परिचित करवाना । <b>CO(A)3:</b> विद्यार्थियों को संज्ञा आदि का ज्ञान प्रदान करना । <b>CO(A)4:</b> विद्यार्थियों को कारकों, वाक्य रचना एवं भाषिक चिन्हों आदि का ज्ञान प्रदान करना ।	
	<b>Course Outcomes :</b> <b>CO1 :</b> विद्यार्थियों को राजभाषा हिंदी का ज्ञान प्राप्त होगा, एवं दक्षता प्राप्त होगी । <b>CO2 :</b> विद्यार्थियों को राजभाषा हिंदी के संवैधानिक महत्त्व की जानकारी प्राप्त होगी । <b>CO3 :</b> विद्यार्थियों को हिंदी – संज्ञा आदि का ज्ञान प्राप्त होने के साथ भाषा के शुद्ध, व्यावहारिक रूप का ज्ञान होगा । <b>CO4 :</b> विद्यार्थियों को कारकों, वाक्य रचना एवं भाषिक चिन्हों आदि का ज्ञान प्राप्त होगा ।	
9.	<b>Syllabus</b>	
	<b>UNIT I :</b>	
	1. हिंदी भाषा – सामान्य परिचय	
	2. राजभाषा हिंदी – संवैधानिक महत्त्व	
	3. वर्णमाला – स्वर एवं व्यंजन	
	4. शब्द भेद – सामान्य परिचय (संज्ञा आदि)	
	<b>UNIT II :</b>	
	1. वाक्य – सामान्य परिचय	
	2. वर्तनी – शुद्धता का प्रयोग एवं सावधानियाँ	
	3. कारक एवं विराम चिन्ह	
	4. निबंध लेखन – ( सामाजिक निबंध, आत्मकथात्मक निबंध, समसामायिक निबंध )	

10.

**Scheme of Examination and Assessment Pattern**

**Paper – 50 Marks**

**External Examination : Semester End External – 30 Marks Time : 1:00 Hours**

**Format of Question Paper**

**All Questions are Compulsory**

मूल्यांकन प्रारूप	इकाई	अंक
<b>बाह्य मूल्यांकन</b>		
प्रश्न 1 : चार प्रश्नों में से किन्हीं दो प्रश्नों के उत्तर लिखिए ।	इकाई 1	15
प्रश्न 2 : चार प्रश्नों में से किन्हीं दो प्रश्नों के उत्तर लिखिए ।	इकाई 2	15
	<b>कुल अंक</b>	<b>30</b>

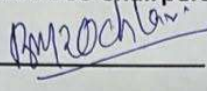
मूल्यांकन प्रारूप	अंक
<b>आंतरिक मूल्यांकन</b>	
<ul style="list-style-type: none"> <li>● AI की सहायता से हिंदी भाषा, राजभाषा हिंदी एवं उसके संवैधानिक महत्त्व पर शोध, सारांश एवं डिजिटल प्रस्तुति (Presentation) तैयार करना।</li> <li>● AI Grammar एवं Writing Tools का उपयोग करके वर्णमाला, शब्द-भेद, वाक्य-रचना, कारक, विराम-चिह्न तथा वर्तनी शुद्धता का अभ्यास करना एवं त्रुटियों का विश्लेषण करना।</li> <li>● AI की सहायता से हिंदी व्याकरण पर आधारित प्रश्नसंच (Question Bank), Quiz तथा Interactive अभ्यास-पत्र तैयार करना।</li> <li>● AI Writing Tools का उपयोग करके सामाजिक, आत्मकथात्मक एवं समसामयिक विषयों पर निबंध लेखन करना तथा AI द्वारा तैयार निबंध और विद्यार्थी द्वारा लिखे गए निबंध का तुलनात्मक विश्लेषण करना।</li> <li>● AI की सहायता से कठिन शब्दों के अर्थ, पर्यायवाची, विलोम, शब्दावली तथा सरल भाषा में व्याख्या तैयार करना।</li> <li>● AI Voice Tools का उपयोग करके शुद्ध उच्चारण, वाचन एवं मौखिक अभिव्यक्ति का अभ्यास करना तथा उच्चारण संबंधी Feedback प्राप्त करना।</li> </ul>	20
<b>कुल अंक</b>	<b>20</b>

<b>11.</b>	<b>संदर्भ ग्रंथ सूची –</b> <ol style="list-style-type: none"><li>1. बाबूराम सक्सेना – सामान्य भाषा विज्ञान, हिंदी साहित्य सम्मेलन, प्रयाग ।</li><li>2. कामताप्रसाद गुरू – हिंदी व्याकरण, लोकभारती प्रकाशन, इलाहाबाद ।</li><li>3. आचार्य देवेन्द्र नाथ शर्मा – भाषा विज्ञान की भूमिका, राधाकृष्ण प्रकाशन, दिल्ली ।</li><li>4. भाषा विज्ञान एवं भाषा शास्त्र – कपिलदेव द्विवेदी, विश्वविद्यालय प्रकाशन, वाराणसी ।</li><li>5. भोलानाथ तिवारी, भाषा विज्ञान, किताब महल, इलाहाबाद ।</li></ol>
------------	--

Bos in Hindi :

Sr No	Name of the Faculty	Designation and College
1.	Dr. Bhavna M.Rochlani	I/C HOD Asst. Professor CHM College Ulhasnagar
2.	Dr. Ajeet Kumar Rai	Associate Professor KC College Mumbai
3.	Dr. Santosh Motwani	Associate Professor RKT College Ulhasnagar

Name & Signature of the Ad-hoc BoS Chairperson -

Dr. Bhavna M. Rochlani : 

Name & Signature of the Dean -

Dr. Nitin Arekar : 



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year BA/BCom/BSc/SFC  
(Marathi)**

**Semester- IV**

**Vertical -5  
Ability Enhancement Course (AEC) -2 Credits**

**with effect from  
Academic Year 2026-2027**

Title: लेखन कौशल्ये - २ (महाजालावरील लेखन)

COURSE CODE: CHMAECMARIII

Sr. No.	Heading	Particulars
1	Description the Course:	<p>राष्ट्रीय शैक्षणिक धोरण - २०२० विद्यार्थ्यांच्या सर्वांगीण विकासावर (Wholistic Development) भर देते. या धोरणात सर्वांगीण विकासाचा भाग म्हणून क्षमता वर्धन अभ्यासक्रम (Ability Enhancement Course) या स्तंभांतर्गत भाषिक कौशल्य अभ्यासक्रमाचा समावेश करण्यात आला आहे. कला, वाणिज्य व विज्ञान या विद्याशाखांमध्ये अध्ययन करणाऱ्या विद्यार्थ्यांना तिसऱ्या सत्रामध्ये 'आधुनिक भारतीय भाषा'चे अध्ययन अनिवार्य करण्यात आले आहे. सदर क्षमता वर्धन अभ्यासक्रमाचे स्वरूप प्रामुख्याने भाषाकेंद्री असावे, असेही राष्ट्रीय शैक्षणिक धोरणात नमूद करण्यात आले आहे. विद्यार्थ्यांना विविध प्रकारच्या भाषिक कौशल्यांचा तपशीलवार परिचय करून देणे, तसेच ती कौशल्ये आत्मसात करण्याची संधी विद्यार्थ्यांना उपलब्ध करून देणे, ही या अभ्यासक्रमाची महत्त्वाची उद्दिष्टे आहेत. ही उद्दिष्टे लक्षात घेऊन 'लेखन कौशल्ये - २ (महाजालावरील लेखन)' (श्रेयांकने २) या अभ्यासपत्रिकेची आखणी करण्यात आली आहे.</p> <p>आंतरमहाजाल हे एकविसाव्या शतकातील अत्यंत प्रभावी साधन आहे. जगभरातील संगणक एकमेकांशी जोडले जाऊन त्यांचे जाळे तयार झाले आहे. विविध सामाजिक माध्यमस्थळांवर स्वतःचे खाते (अकाउंट) तयार करणे आणि त्यावर मराठी भाषा व देवनागरी लिपीतून लिहिणे, ही समकालीन संपर्क व्यवहारातील आवश्यक बाब झाली आहे. यास अनुसरून आपल्या अभिव्यक्तीला व्यासपीठ मिळवून देणारी अनुदिनी (ब्लॉग) तयार करणे, विकिपीडियावर भोवतालातील भाषा, साहित्य, संस्कृतीशी निगडित माहितीपर व विश्लेषणात्मक नोंदी लिहिणे, सामाजिक माध्यमस्थळांवरील आपल्या खात्यावर सातत्याने अभ्यासपूर्ण लेखन करणे, स्वक्षमतेशी निगडित समाजगट / आभासी कट्टे (कम्युनिटी ग्रुप) तयार करणे, या बाबींसाठी आवश्यक सामाजिक माध्यमस्थळ साक्षरता आणि मराठी भाषा व देवनागरी लिपीतून लिहिण्याची क्षमता 'लेखन कौशल्ये - २ (महाजालावरील लेखन)' (श्रेयांकने २) या अभ्यासपत्रिकेच्या अध्ययनातून विद्यार्थ्यांमध्ये निर्माण होईल.</p>
2	Vertical 5	Ability Enhancement Course
3	Type	Theory
4	Credit	2 Credits (1 Credit = 15 Hours for Theory or 30 Hours of Practical Work in a Semester)
5	Hours allotted	30 Hours
6	Marks allotted	50 Marks

7	<p><b>Course Objectives:</b></p> <p><b>CO1:</b> महाजालावरील लेखन कौशल्याचे स्वरूप समजावून सांगणे.</p> <p><b>CO2:</b> महाजालावर प्रभावी लेखन करण्यासाठी आवश्यक असणाऱ्या तंत्रांचा परिचय करून देणे.</p> <p><b>CO3:</b> नेहमीच्या पठडीतील लेखन व महाजालावरील लेखन यांमधील साम्य-भेद स्पष्ट करणे.</p> <p><b>CO4:</b> विविध सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित करणे.</p>
8	<p><b>Learning Outcomes:</b></p> <p>प्रस्तुत अभ्यासक्रम शिकल्यानंतर:</p> <p><b>LO1:</b> विद्यार्थ्यांना महाजालावरील लेखन कौशल्याचे स्वरूप समजेल.</p> <p><b>LO2:</b> विद्यार्थ्यांना महाजालावर प्रभावी लेखन करण्यासाठी आवश्यक तंत्रांचा परिचय होईल.</p> <p><b>LO3:</b> विद्यार्थ्यांना नेहमीच्या पठडीतील लेखन व महाजालावरील लेखन यांमधील साम्य-भेद स्पष्ट होईल.</p> <p><b>LO4:</b> विद्यार्थ्यांमध्ये विविध सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: सामाजिक माध्यमस्थळांवर मराठी भाषा व देवनागरी लिपीचा वापर करून लेखन (भाग - १)</b></p> <p>१. माध्यम साक्षरता</p> <p>२. अनुदिनी (ब्लॉग) लेखन</p> <p>३. विकिपीडियावरील लेखन</p> <p>(६० मिनिटांच्या १५ तासिका, श्रेयांकन १)</p> <p>(सूचना : विद्यार्थ्यांमध्ये उपरोक्त सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)</p> <p><b>UNIT II: सामाजिक माध्यमस्थळांवर मराठी भाषा व देवनागरी लिपीचा वापर करून लेखन (भाग - २)</b></p> <p>१. फेसबुक, इन्स्टाग्राम, एक्स यांवरील लेखन</p> <p>२. समाज गट (कम्युनिटी ग्रुप), आभासी कट्टे यांवरील लेखन</p> <p>(६० मिनिटांच्या १५ तासिका, श्रेयांकन-१)</p> <p>(सूचना : विद्यार्थ्यांमध्ये उपरोक्त सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)</p>

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00****hours**

Format of Question Paper

All questions are compulsory:

Q. No	Nature of Questions	Marks
Q1	Essay type question on Module 1	10
Q2	Essay type question on Module 2	10
Q6	MCQs 15 out of 20, 10 MCQs on each module	10
<b>Total</b>		<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Project and presentation / Viva	Marks
1.	<ul style="list-style-type: none"> <li>विकिपीडियासाठी माहिती संकलन, संदर्भ व्यवस्थापन, तथ्य पडताळणी <b>Fact Checking tool</b> तयार करणे आणि लेख तयार करणे.</li> <li><b>AI</b> साधने वापरून Facebook, Instagram आणि X (Twitter) साठी मराठीतील पोस्ट, Caption, Hashtags आणि Content Calendar तयार करणे.</li> <li><b>AI Copywriting Tools</b> चा वापर करून सामाजिक माध्यमांसाठी आकर्षक व लक्षित (Targeted) मजकूर तयार करणे.</li> <li><b>AI</b> साधनाच्या सहाय्याने Social Media Content चे भाषा विश्लेषण, शुद्धलेखन तपासणी आणि देवनागरी लिपीतील लेखन सुधारणा करणे.</li> <li><b>AI</b> साधनाच्या सहाय्याने Community Groups आणि Virtual Discussion Platforms साठी माहितीपूर्ण पोस्ट, जनजागृती मोहीम आणि संवादात्मक मजकूर तयार करणे.</li> <li><b>AI Image Generation</b> आणि Video Tools च्या सहाय्याने सामाजिक माध्यमांसाठी Creative Campaign तयार करणे.</li> <li><b>Blog, Wikipedia</b> आणि Social Media Content यांची AI-assisted comparative analysis करून प्रभावी डिजिटल लेखनाचा अभ्यास करणे.</li> </ul> <p>AI साधने: <a href="#">ChatGPT</a>, <a href="#">Google Gemini</a>, <a href="#">Claude</a>, <a href="#">Perplexity AI</a>, <a href="#">NotebookLM</a>, <a href="#">Canva</a>, <a href="#">CapCut</a>, <a href="#">InVideo</a>, <a href="#">Grammarly</a>, <a href="#">QuillBot</a>, <a href="#">Whisper</a>, <a href="#">ElevenLabs</a></p>	20
<b>Total</b>		<b>20</b>

11

**संदर्भ ग्रंथ (Reference Books) :**

१. मराठी व्याकरण आणि लेखन, विनायक गंधे व मीरा जोशी, निराली प्रकाशन, पुणे, २०१२.
२. उपयोजित मराठी, (संपा.) केतकी मोडक व अन्य, पद्मगंधा प्रकाशन, पुणे, २०१२.
३. मराठी भाषिक कौशल्य विकास, (संपा.) पृथ्वीराज तौर, अथर्व पब्लिकेशन्स, धुळे, २०१८.
४. व्यावहारिक मराठी, ल. रा. नसिराबादकर, भाषा विकास संशोधन संस्था, कोल्हापूर, २०२३.
५. *Aayushi International Interdisciplinary Research Journal* (ISSN 2349-638x) Peer Reviewed Journal [www.aiirjournal.com](http://www.aiirjournal.com)

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Second Year B. Sc.  
(Data Science)**

**Semester- IV**

**Title: Field Project**

**Vertical – 6**

**Field Project : 2 Credits**

**with effect from  
Academic Year 2025-2026**

## Title: Field Project

**Course Code: CHMDSIV9**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	Field projects offer students a practical learning experience by engaging them directly with real-world contexts. Students design questionnaires or interview schedules, interact with actual users or institutions, and gather first-hand data from the field. Through careful analysis of this data, they gain insights into real issues and challenges, helping them connect theory with practice. The project concludes with drawing meaningful conclusions and suggesting realistic improvements, thereby strengthening analytical skills, communication abilities, and professional awareness.
2	<b>Vertical 2</b>	Field Project
3	<b>Type</b>	Field Work + Survey + Discussion + Report Writing
4	<b>Credit</b>	2 credits
5	<b>Hours allotted</b>	30 hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p>CO(A) 1. To expose students to real-world data science applications through field-based projects.</p> <p>CO(A) 2. To apply data collection, analysis, and visualization techniques to practical problems.</p> <p>CO(A) 3. To develop analytical thinking and data-driven decision-making skills.</p> <p>CO(A) 4. To gain experience in working with real datasets and domain stakeholders.</p> <p>CO(A) 5. To promote ethical and responsible use of data in real-world contexts.</p>
8	<b>Course Outcomes:</b>	<p>Student will be able to</p> <p><b>CO1:</b> Identify real-world problems suitable for data-driven analysis.</p> <p><b>CO2:</b> Collect and prepare data from field and secondary sources.</p> <p><b>CO3:</b> Apply data science techniques to analyze and visualize data.</p> <p><b>CO4:</b> Interpret results and communicate insights effectively.</p> <p><b>CO5:</b> Practice ethical and professional standards in data handling and analysis.</p>

## Syllabus

Each student is required to select one topic from the given list. The topics are designed to help you explore the real-world application of Data Science concepts through data collection, analysis, and interpretation. Select a topic that truly interests you and can be realistically carried out, as you will be expected to work with real datasets, interact with stakeholders or data sources, apply analytical and statistical techniques, and derive data-driven insights. The chosen topic must be discussed and approved by the instructor to ensure it is clear, relevant, and not duplicated by other students.

Sr.No.	Name of the Topic
1.	Customer Purchase Behavior Analysis in Local Retail Stores
2.	Field Study on Effectiveness of Loyalty Programs in Supermarkets
3.	Price Sensitivity Analysis of Consumers in Local Markets
4.	Data Analysis of Online vs Offline Shopping Preferences in Urban Areas
5.	Inventory Demand Prediction for Small Retail Businesses
6.	Analysis of Social Media Usage Patterns Among College Students
7.	Influence of Social Media Marketing on Local Brand Awareness
8.	Trend Analysis of Hashtags Related to Local Events on Instagram
9.	Survey-Based Study on Digital Content Consumption Patterns
10.	Fake News Detection Trends in Social Media Discussions
11.	Study of Study Habits and Their Impact on Academic Performance
12.	Analysis of Student Preferences for Online Learning Platforms
13.	Field Survey on Effectiveness of Digital Learning Tools in Colleges
14.	Prediction of Student Dropout Risk Using Survey and Academic Data
15.	Analysis of Skill Development Trends Among Undergraduate Students
16.	Public Satisfaction Analysis of Local Municipal Services
17.	Data-Driven Study of Water Consumption Patterns in Residential Areas
18.	Streetlight Efficiency Monitoring Using Field Data Collection
19.	Public Park Usage Patterns and Community Engagement Analysis
20.	Noise Pollution Monitoring and Data Analysis in Urban Areas
21.	Spending Behavior Analysis of College Students Using Survey Data
22.	Adoption of Mobile Banking Services Among Young Adults
23.	Analysis of Online Payment Security Awareness Among Consumers
24.	Study of Micro-Entrepreneur Digital Payment Adoption
25.	Budgeting Habits and Financial Literacy Analysis Among Students

## Guidelines for Field Project

Following are the general guidelines for the conduct of Field Project (Semester III & IV)

### Head of the Department (HOD)/ Field Project Co-ordinator

1. To ensure that FP program aligns with departmental and academic objectives as per NEP Structure within syllabus framework.
2. Appointment of field project incharges from the faculty of the department for group of Students.
3. To conduct orientation of FP Supervisor and decide the time line of the project.
4. To support the student for Filed Project.

### FP Supervisor:

1. To give Guidelines for the field project.
2. To monitor student progress and provide guidance.

### Project (Dissertation) Report:

Students are required to submit a report of the field project at the end of the semester in following suggested format.

The project should be typed on A4 sheets

Font Size 12, Times New Roman, 1.5 line Spacing

The project report shall have student details with signature of Field Project Incharge and photographs if any and it should be of minimum of 10 pages.

10

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Nature of Evaluation	Marks
Field Project Report	30
<b>Total 30</b>	

### **Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Involvement of Survey of Field Project	05
2.	Field Visit Participation and Completion	10
3.	Overall Impression	05
<b>Total 20</b>		

11

**Appendix I**

**Attendance of the Student: Active Participation**

I, the undersigned Ms./Mr. \_\_\_\_\_ Roll No. \_\_\_\_\_ studying in the \_\_\_\_\_  
Year of \_\_\_\_\_ Full-time Course, is doing my project work under the  
guidance of Dr./Ms./Mr. \_\_\_\_\_. I wish to state that I  
have met my Internal guide on the following dates mentioned below for Project Guidance: -

Sr No	Date	Signature of the Internal Guide
-------	------	---------------------------------

Signature of the Candidate

Signature of Field Project Supervisor

**Appendix II**

**Name of the Department/College/Institute**

**Certificate**

I hereby certify that Mr./Ms. \_\_\_\_\_ Student of \_\_\_\_\_ studying in  
\_\_\_\_\_, has completed a project titled \_\_\_\_\_ in the area of  
\_\_\_\_\_ specialization for the academic year 2025–2026 to the best of my knowledge  
the work of the student is original and the information included in the project is correct.

Field Project Supervisor

Head of the Department

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**First Year**

**Semester- IV**

**Title: Cocurricular Course I**

**Vertical - 6  
Cocurricular Course - 2 Credits**

**with effect from  
Academic Year 2025-2026**

**Title: Cocurricular Course - I**

**Course Code: CHMCCI6**


Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>This student-friendly Co-Curricular Course is uniquely designed to promote holistic development through active participation in various college-based activities. Unlike traditional theory-based subjects, this course emphasizes hands-on involvement and experiential learning. Students are encouraged to explore their interests and talents by engaging in cultural, social, literary, sports, extension, or club-based events conducted by the college throughout the academic year.</p> <p>Participation will be recorded and assessed based on involvement, initiative, team spirit, creativity, and consistency. The aim is to nurture essential life skills such as leadership, communication, collaboration, and responsibility in a supportive, informal setting.</p> <p>This non-theory course offers students the opportunities and the freedom to learn beyond the classroom and grow into well-rounded individuals, contributing positively to campus life and society.</p>
2	<b>Vertical 6</b>	Cocurricular Course (Mandatory)
3	<b>Type Teaching Methods</b>	Non Theory Participation, Report Writing, Presentation etc.
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities.</li> <li>2. To enhance personal and interpersonal skills through real-life experiences and teamwork.</li> <li>3. To foster a sense of responsibility, leadership, and community engagement among students.</li> <li>4. To develop self-confidence and emotional well-being through creative expression and collaboration.</li> <li>5. To integrate classroom learning with experiential learning for holistic growth.</li> </ol>
8	<b>Learning Outcomes:</b>	<p>By the end of the course, students will be able to:</p> <p><b>LO1:</b> Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences.</p> <p><b>LO2:</b> Demonstrate improved communication, leadership, and teamwork skills.</p> <p><b>LO3:</b> Exhibit increased awareness of social responsibility and civic engagement.</p> <p><b>LO4:</b> Build confidence through creative, cultural, and intellectual expressions.</p> <p><b>LO5:</b> Maintain a portfolio or activity log to track participation and personal development.</p>

9	<b>Syllabus</b>															
	<b>Unit I - Suggested Areas of Participation in the activities:</b> <ul style="list-style-type: none"> <li>• <b>Cultural Events:</b> Drama, dance, music, literary events, debates, etc.</li> <li>• <b>Social Outreach:</b> Blood donation, awareness campaigns, cleanliness drives.</li> <li>• <b>Clubs &amp; Societies:</b> Photography, quiz, environment club, shram club, etc.</li> <li>• <b>Sports &amp; Fitness:</b> College tournaments, yoga, marathons, fitness challenges.</li> <li>• <b>Institutional Events:</b> Foundation Day, Annual Day, College Festivals, Intercollegiate events.</li> <li>• <b>National Festivals:</b> Independence Day, Republic Day etc.</li> </ul> <b>Unit II - Program Specific Topics</b> <ul style="list-style-type: none"> <li>• <b>Workshops/Seminars:</b> Report Writing, Personality Development, Soft Skills, Leadership Talks.</li> <li>• <b>Speak, Show, Shine:</b> Presentation / Poster Presentation / Viva and Learning Experience</li> </ul> <b>Mode of Evaluation:</b> <ul style="list-style-type: none"> <li>• <b>Faculty Coordinator:</b> To guide and evaluate student progress.</li> <li>• <b>Participation Proof:</b> Certificates, photos, attendance records.</li> <li>• <b>Reflective Journal:</b> Minimum 2-3 pages summarizing experiences, learning, and growth.</li> <li>• <b>Final Viva/Presentation:</b> 5-minute talk on poster presentation and on overall learning.</li> </ul>															
10	<b>Scheme of Examination and Assessment Pattern</b> <b>Based on 3 approved Activities</b> <b>Semester End External - 30 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Activity No</th> <th style="width: 65%;">Nature of Activities</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Title of Approved Activity - 1</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Title of Approved Activity - 2</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Title of Approved Activity - 3</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>30</b></td> </tr> </tbody> </table>	Activity No	Nature of Activities	Marks	1.	Title of Approved Activity - 1	10	2.	Title of Approved Activity - 2	10	3.	Title of Approved Activity - 3	10	<b>Total</b>		<b>30</b>
Activity No	Nature of Activities	Marks														
1.	Title of Approved Activity - 1	10														
2.	Title of Approved Activity - 2	10														
3.	Title of Approved Activity - 3	10														
<b>Total</b>		<b>30</b>														
	<b>Internal Examination: Continuous Evaluation – 20 marks</b>															
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Assessment / Evaluation</th> <th style="width: 10%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Reflective journal</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Presentation/ poster presentation/viva</td> <td style="text-align: center;">10</td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>Total</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </tbody> </table>		Assessment / Evaluation	Marks	1.	Reflective journal	10	2.	Presentation/ poster presentation/viva	10	<b>Total</b>		<b>20</b>			
	Assessment / Evaluation	Marks														
1.	Reflective journal	10														
2.	Presentation/ poster presentation/viva	10														
<b>Total</b>		<b>20</b>														

**Suggested Readings:**

- How to Win Friends and Influence People
- The 7 Habits of Highly Effective People
- Thinking, Fast and Slow
- Leaders Eat Last
- Talk Like Ted

Name & Signature of the Principal & Chairperson, Academic Council:

  
 Dr. Manju Lalwani Pathak





**HSNC Board's**  
**Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar**  
**(Autonomous)**  
**Affiliated to the University of Mumbai**

**Bachelor of Science**  
**(Data Science)**  
**(Self-Financing Course)**

**Semester – V**

**Choice Based and Credit Based syllabus**  
**as per NEP 2020 with effect from the Academic**  
**Year 2026-2027**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Deep Learning**

**Vertical - 1**

**Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

**Title: Deep Learning**  
**Course Code: CHMDSV1**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course introduces the fundamental concepts and techniques of deep learning used in modern artificial intelligence systems. It covers topics such as neural networks, activation functions, loss optimization, convolutional and recurrent networks, and training methods like backpropagation. The course also explores practical applications including image recognition, natural language processing, and speech analysis, enabling students to design, train, and deploy deep learning models for real- world problems.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> Understand the fundamental principles of deep learning, including neural network architectures, activation functions, and optimization techniques.</p> <p><b>CO(A) 2.</b> Design and implement deep learning models using feedforward, convolutional, and recurrent neural networks for various data types.</p> <p><b>CO(A) 3.</b> Apply training techniques such as backpropagation, regularization, and hyperparameter tuning to improve model performance.</p> <p><b>CO(A) 4.</b> Analyse and solve real- world problems using deep learning approaches in domains such as computer vision, natural language processing, and speech recognition.</p>

	<p><b>CO(A) 5.</b> Evaluate and deploy deep learning models using modern frameworks while considering performance, scalability, and ethical implications.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1.</b> Describe basics of mathematical foundation that will help the learner to understand the Concepts of Deep Learning.</p> <p><b>CO 2.</b> Understand and describe model of deep learning</p> <p><b>CO 3.</b> Understand various deep supervised learning architectures for text &amp; image data.</p> <p><b>CO 4.</b> Gain knowledge about various deep learning models and architectures.</p> <p><b>CO 5.</b> Familiarize various deep learning techniques to design efficient algorithms for real-world applications.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Introduction and Mathematical Basics for Deep Learning</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Deep learning:</b> What is Deep learning? Difference between Deep learning and Machine learning.</li> <li>• <b>Deep Networks:</b> Deep feed forward network, regularization for deep learning, Optimization for Training deep models.</li> <li>• <b>Linear Algebra:</b> Scalars, Vectors, Matrices and Tensors, Multiplying Matrices and Vectors, Identity and Inverse Matrices, Linear Dependence and Span, norms, special matrices and vectors, Eigen decompositions.</li> <li>• <b>Numerical Computation:</b> Overflow and under flow, poor conditioning, Gradient Based Optimization, Constraint optimization. What is Language AI and Natural Language Processing evolution?</li> </ul> <p><b>UNIT II: Deep Learning Models, Applications, and Research</b></p> <ul style="list-style-type: none"> <li>• <b>Convolution Applications:</b> Convolutional Networks, Sequence Modelling, Applications.</li> <li>• <b>Deep Learning Research:</b> Linear Factor Models, Auto encoders, representation learning.</li> <li>• <b>Generative Models:</b> What Is Generative Modelling? Generative Versus Discriminative Modelling, Generative Modelling and AI, The Generative Modelling Framework, Representation Learning, Core Probability Theory, Generative Model Taxonomy, Approximate Inference, Deep Generative Models.</li> </ul>

- **Applications:** Transformers, Advance GANs.

**10**

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Inside the Mind of AI: Exploring Deep Learning Models using Generative AI, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11**

**REFERENCES:**

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron An MIT Press book 1<sup>st</sup> 2016.
2. Generative Deep Learning David Foster O'Reilly 2nd 2023.
3. Fundamentals of Deep Learning Nikhil Buduma O'Reilly, 1<sup>st</sup> Edition, 2017.
4. Deep Learning: Methods and Applications Deng & Yu Now Publishers, 1<sup>st</sup> 2013.
5. Deep Learning CookBook Douwe Osinga O'Reilly 1st 2017.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Computer Vision**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Computer Vision

**Course Code: CHMDSV2**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Computer vision is a field of Artificial Intelligence (AI) that enables computers to interpret and understand images and videos. It uses algorithms and machine learning techniques to detect objects, recognize patterns, and extract meaningful information from visual data.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To build systems that automate visual tasks traditionally performed by humans.</p> <p><b>CO(A) 2.</b> To enable machines to interpret and understand visual data like humans do.</p> <p><b>CO(A) 3.</b> To master the extraction of actionable insights from the dominant form of data.</p> <p><b>CO(A) 4.</b> To contribute to and work on high-impact real-world applications across industries</p> <p><b>CO(A) 5.</b> To stay relevant in the evolving AI landscape, especially multimodal and embodied intelligence</p>
8	<b>Course Outcomes:</b>	<p>Student will be able to</p> <p><b>CO 1.</b> Understand and explain the fundamental principles of image formation, acquisition, and processing in computer vision.</p> <p><b>CO 2.</b> Apply classical and modern computer vision algorithms to solve basic visual perception tasks.</p> <p><b>CO 3.</b> Analyze and evaluate different approaches for object recognition, detection, and classification in images.</p>

	<p><b>CO 4.</b> Design and implement deep learning models for core computer vision applications using contemporary frameworks.</p> <p><b>CO 5.</b> Develop and demonstrate practical computer vision solutions for real-world problems, including ethical considerations.</p>
<p>9</p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Computer Vision:</b> What is computer vision?, Understanding human vision, Extracting information from images, Applications of computer vision.</li> <li>• <b>Color :</b> Physics of Color, Human Encoding of Color, Color Spaces.</li> <li>• <b>Pixels and Filters:</b> Image Sampling and Quantization, Image Histograms, Images as Functions, Linear Systems (Filters), Convolution and Correlation</li> <li>• <b>Edge Detection:</b> Edge Detection in Mammals, Edge Detection for Computer Vision, Simple Edge Detectors, Designing a Good Edge Detector, Hough Transforms,</li> <li>• <b>Features and Fitting:</b> Introduction, RANSAC, Local Invariant Features, Keypoint Localization</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Semantic Segmentation:</b> Introduction, Segmentation</li> <li>• <b>Clustering:</b> Clustering and Segmentation, Gestalt School and Factors, Agglomerative Clustering, K-Means Clustering, Mean-shift Clustering.</li> <li>• <b>Object recognition:</b> Mean-Shift, Object recognition, K-nearest neighbors.</li> <li>• <b>Face Identification:</b> Introduction to Facial Recognition, The Eigenfaces Algorithm, Linear Discriminant Analysis.</li> <li>• <b>Object Detection from Deformable Parts:</b> Introduction to Object Detection, Current Object Detection Benchmarks, Evaluating Object Detection, A Simple Sliding Window Detector, The Deformable Parts Model (DPM), The DPM Detection Pipeline, DPM Detection Results, DPM Summary.</li> </ul>

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Powered Movie Poster Analysis: Exploring Computer Vision Techniques for Object Recognition, Face Identification, and Genre Classification, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Computer Vision: Foundation and Application Ranjay Krishna published by stanford university.
2. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2022 (2nd Edition).
3. Computer Vision: Models, Learning, and Inference, Simon J. D. Prince, Cambridge University Press, 2012.
4. Deep Learning for Vision Systems, Mohamed Elgendy, Manning Publications, 2020.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Deep Learning and Computer Vision  
Practical**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Deep Learning and Computer Vision Practical

**Course Code: CHMDSV3**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This course provides hands-on practical training in Deep Learning and Computer Vision using modern AI frameworks such as TensorFlow. Students will learn to design, implement, train, and evaluate deep learning models, including neural networks, CNNs, RNNs, LSTMs, Autoencoders, GANs, and other advanced architectures for classification, prediction, feature learning, and data generation. The course also covers essential computer vision techniques such as image processing, object detection, face recognition, image stitching, OCR, image captioning, tracking, and 3D reconstruction. Through practical exercises and a mini project, students will develop AI-based solutions for real-world applications in image analysis, video processing, and intelligent vision systems.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To understand the fundamentals of deep learning, tensors, image processing, and computer vision techniques for analyzing visual data. <b>CO(A) 2.</b> To develop and apply deep neural network models for image and video-based problem solving and automated visual task execution. <b>CO(A) 3.</b> To perform data preprocessing, feature extraction, and visual data analysis to improve model accuracy and efficiency.	

	<p><b>CO(A) 4.</b> To analyze, optimize, evaluate, and visualize the performance of deep learning and computer vision models using appropriate techniques and hyperparameter tuning.</p> <p><b>CO(A) 5.</b> To explore real-world applications, emerging trends, and intelligent systems that integrate deep learning and computer vision technologies.</p>
8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1.</b> Use deep learning frameworks such as TensorFlow and PyTorch to build, train, evaluate, and deploy models for computer vision applications.</p> <p><b>CO 2.</b> Apply image processing, computer vision, and deep learning techniques to solve real-world visual perception and pattern recognition problems.</p> <p><b>CO 3.</b> Perform data preprocessing, augmentation, feature engineering, and image analysis to improve model accuracy, efficiency, and robustness.</p> <p><b>CO 4.</b> Analyze problems, select appropriate algorithms and architectures, evaluate model performance, and optimize solutions through troubleshooting and hyperparameter tuning.</p> <p><b>CO 5.</b> Design and implement intelligent computer vision systems for tasks such as object detection, recognition, and classification while considering practical applications and ethical aspects.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Deep Learning Practical</b></p> <ul style="list-style-type: none"> <li>• <b>Tensors and XOR problem using TensorFlow</b> <ol style="list-style-type: none"> <li>a) Create tensors with different shapes and data types.</li> <li>b) Perform basic operations like addition, subtraction, multiplication, and division on tensors.</li> <li>c) Reshape, slice, and index tensors to extract specific elements or sections.</li> <li>d) Performing matrix multiplication and finding eigenvectors and eigenvalues using TensorFlow</li> <li>e) Program to solve the XOR problem.</li> </ol> </li> <li>• <b>Linear and Logistic Regression</b> <ol style="list-style-type: none"> <li>a) To perform linear and logistic regression as shallow neural networks using the Breast Cancer / Iris or similar dataset and train the models using SGD and Adam optimizers.</li> </ol> </li> </ul>

- b) Implement a linear/Logistic regression model using TensorFlow's low-level API (or tf.keras).
- c) Train the model on a toy dataset (e.g., housing prices vs. square footage or any other relevant dataset).
- d) Visualize the loss function and the learned linear relationship.
- e) Make predictions on new data points.

- **Multilayer Perceptron (MLP)**

- a) Implement a Multilayer Perceptron (MLP) and study the effect of hidden layers, number of neurons, and activation functions on model performance.

- **Convolutional Neural Networks (Classification) Convolutional Neural Network (CNN) for Image Classification**

- a) To design and train a Convolutional Neural Network (CNN) for image classification using the MNIST or Fashion MNIST dataset
- b) Implementing deep neural network for performing binary classification task

- **Deep feed forward Network**

- a) Using a deep feed-forward network with two hidden layers for performing multiclass classification and predicting the class.
- b) Write a program to implement deep learning Techniques for image segmentation.

- **Autoencoders and Denoising Autoencoders**

- a) To implement autoencoders and denoising autoencoders for dimensionality reduction and feature learning using the MNIST dataset.
- b) Write a program to develop Autoencoders using MNIST Handwritten Digits.
- c) Applying the Autoencoder algorithms for encoding real-world data

- **Variational Autoencoder (VAE)**

- a) Design and train a Variational Autoencoder (VAE) for learning latent representations and generating new data samples.

- **Generative Adversarial Network (GAN)**

- a) Applying Generative Adversarial Networks for image generation and unsupervised tasks, implement a Generative Adversarial Network (GAN) for image generation using the MNIST or CIFAR 10 dataset.

- **Long Short Term Memory Network (LSTM)**
  - a) Write a program to predict a caption for a sample image using LSTM.
  - b) Design and train a Long Short Term Memory (LSTM) network to learn long term dependencies in sequential data.
- **Recurrent Neural Network (RNN)**
  - a) Demonstrate recurrent neural network that learns to perform sequence analysis for stock price.(google stock price).
  - b) Implement a Recurrent Neural Network (RNN) for sequence modeling tasks such as text classification or time-series prediction.
  - c) Write a program for character recognition using RNN and compare it with CNN
- **Regularization Techniques in Deep Learning**
  - a) Apply regularization techniques such as L2 weight decay, Dropout, and Early Stopping to reduce overfitting in neural networks using the Fashion MNIST dataset.
- **Boltzmann Machine (BM)**
  - a) To study and implement a Boltzmann Machine for modeling probability distributions over binary data.
- **Restricted Boltzmann Machine (RBM)**
  - a) To implement a Restricted Boltzmann Machine (RBM) for unsupervised feature learning using Contrastive Divergence.

## UNIT II:

1. Perform Geometric Transformation
2. Perform Image Stitching.
3. Perform Camera Calibration.
4. Perform the following:
  - a. Face detection
  - b. Object detection
  - c. Pedestrian detection
  - d. Face recognition
5. Construct 3D model from images.
6. Implement object detection and tracking from video.
7. Perform Feature extraction using RANSAC

8. Perform Colorization
9. Perform Text detection and recognition
10. Perform Image matting and compositing
11. Design and perform following practical as mini project and submission with presentation.
  - Classifying traffic signs using a standard benchmark dataset
  - Multi-class classification application for detecting diseased plants based on images of their leaves
  - Optical Character Recognition (OCR) for Handwritten Text
  - Facial Emotion Recognition
  - Food Image Classification or Clothing Classifier
  - Multi-object Tracking in Video
  - Image Captioning
  - Gesture Recognition For Human-Computer Interaction
  - Visual Question Answering (VQA)
  - Face De-Aging/Aging
  - Human Pose Estimation And Action Recognition in Crowded Scenes
  - Unsupervised Anomaly Detection in Industrial Inspection

**10**

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

<b>Question</b>	<b>Based On</b>	<b>Marks</b>
Q1	Unit 1	13
Q2	Unit 2	12
Q3	Journal and Viva	05
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	Visualizing Deep Learning and Computer Vision: An AI-Powered Infographic Design Challenge, Project, Self-Learning Evaluation, Presentation, etc.	10
<b>Total:</b>		<b>20</b>

**11****REFERENCES:**

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron An MIT Press book 1st 2016
2. Generative Deep Learning David Foster O'Reilly 2nd 2023
3. Computer Vision : Foundation and Application Ranjay Krishna published by stanford university.
4. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2022 (2nd Edition).
5. Fundamentals of Deep Learning Nikhil Buduma O'Reilly 1<sup>st</sup> 2017.
6. Deep Learning: Methods and Applications Deng & Yu Now Publishers, 1st 2013
7. Deep Learning CookBook Douwe Osinga O'Reilly 1st 2017.
8. Computer Vision: Models, Learning, and Inference, Simon J. D. Prince, Cambridge University Press, 2012.
9. Deep Learning for Vision Systems, Mohamed Elgendy, Manning Publications, 2020.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Data Engineering**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## **Title: Data Engineering**

**Course Code: CHMDSV4**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	This course introduces the fundamentals of data engineering, including data architectures, data pipelines, data processing, analytics, and security concepts. It helps students understand how data is collected, transformed, and used for analysis. With the rapid growth of big data, cloud computing, and artificial intelligence, data engineering has become essential for building scalable and reliable systems. Students will learn to design efficient data pipelines, apply ETL/ELT processes, and handle large-scale data securely. The knowledge gained is useful across industries such as finance, healthcare, ecommerce, and social media. This course is closely connected with subjects like DBMS, Big Data, Cloud Computing, and Machine Learning, and prepares students for careers such as Data Engineer, Big Data Engineer, and Data Analyst.
<b>2</b>	<b>Vertical 1</b>	Major (Mandatory)
<b>3</b>	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	30 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks

7	<p><b>Course Objectives:</b></p> <p><b>CO(A) 1.</b> To explain the basic concepts, roles, and importance of Data Engineering in modern organizations.</p> <p><b>CO(A) 2.</b> To describe the data engineering lifecycle, including data pipelines and workflow management.</p> <p><b>CO(A) 3.</b> To identify different data architectures such as Data Warehouse, Data Lake, Lakehouse, and Data Mesh.</p> <p><b>CO(A) 4.</b> To apply techniques for data generation, ingestion, modeling, and transformation using batch and streaming pipelines.</p> <p><b>CO(A) 5.</b> To understand analytics serving, machine learning data pipelines, data security, privacy, and advanced storage techniques in data platforms.</p>
8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1.</b> Explain the concepts, lifecycle, and organizational role of Data Engineering in modern data systems.</p> <p><b>CO 2.</b> Design and analyze data architectures including Data Warehouses, Data Lakes, Lakehouses, and Data Mesh frameworks.</p> <p><b>CO 3.</b> Apply appropriate technology selection strategies and understand system design trade-offs such as build vs buy, monolithic vs modular, and serverless vs server-based architectures.</p> <p><b>CO 4.</b> Implement and evaluate data ingestion and transformation pipelines using ETL/ELT processes and data modelling techniques.</p> <p><b>CO 5.</b> Demonstrate understanding of data security, privacy, analytics serving, machine learning data workflows, and advanced data engineering techniques such as serialization and compression.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Foundations, Data Architecture, and Data Generation</b></p> <ul style="list-style-type: none"> <li>• <b>Foundations and Building Blocks:</b> Data Engineering Overview What is Data Engineering? Roles and Responsibilities of a Data Engineer Data Engineering Skills and Activities Data Engineers in an Organization.</li> <li>• <b>Data Engineering Lifecycle:</b> Concept of Data Engineering Lifecycle, Stages of the Data Engineering Lifecycle, Major Undercurrents Across the Lifecycle, Importance of</li> </ul>

Data Pipelines and Workflow Management.

- **Designing Good Data Architecture:** Definition of Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts, Types and Examples of Data Architecture. Data Warehouse, Data Lake, Data Lakehouse, Data Mesh Stakeholders in Designing Data Architecture.
- **Choosing Technologies in Data Engineering:** Factors for Technology Selection, Team Size and Capabilities. Speed to Market, Interoperability, Cost Optimization and Business Value, Build vs Buy, Monolithic vs Modular Architecture. Serverless vs Server-based Systems. Optimization and Performance Considerations.
- **Data Generation in Source Systems:** Sources of Data. Data Creation Methods, Source System Concepts, Practical Details of Source Systems, Collaboration with Data Producers.

## **UNIT II: Data Processing, Analytics Serving, and Advanced Concepts:**

- **Data Ingestion**  
Definition and Importance of Data Ingestion, Key Engineering Considerations, Batch Data Ingestion, Streaming and Message-based Ingestion, Methods and Tools for Data Ingestion, Collaboration with Data Platform Teams.
- **Queries, Data Modelling, and Transformation**  
Querying Data, Data Modelling Techniques, Relational Modelling, Dimensional Modelling, Data Transformation Processes, ETL and ELT Pipelines.
- **Serving Data for Analytics and Machine Learning**  
Serving Data for Business Analytics, Data for Machine Learning Workflows, Role of Data Engineers in ML Pipelines, Reverse ETL Concepts, Data Delivery Methods.
- **Security and Privacy**  
Data Security Concepts, Privacy and Compliance. People, Processes, and Technology in Data Protection.
- **Advanced Data Engineering Concepts**  
Serialization Formats, Columnar and Hybrid Serialization, Database Storage Engines. Data Compression Techniques: gzip, bzip2, Snappy.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Visualizing Data Engineering Lifecycle, Data Architecture, Data Ingestion, and Analytics Through AI-Powered Social Media Content Creation, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Fundamentals of Data Engineering, Joe Reis, Matt Housley, O'Reilly Media, 1st, 2022
2. Learning Spark: Lightning-Fast Data Analytics, Jules S. Damji, Brooke Wenig, O'Reilly Media, 2nd, 2020.
3. Kafka: The Definitive Guide, Neha Narkhede, Gwen Shapira, Todd Palino, O'Reilly Media, 1st, 2017
4. Data Pipelines Pocket Reference, James Densmore, O'Reilly Media, 1st, 2021.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Indian Knowledge Systems in Data Science**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Indian Knowledge Systems in Data Science

**Course Code: CHMDSV5**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Indian Knowledge Systems (IKS) explores India's interdisciplinary traditions integrating philosophy, mathematics, linguistics, medicine, and astronomy with data-centric thinking. It examines ancient concepts of observation, classification, algorithms, prediction, and ethics, linking classical texts and methods, such as zero, combinatorics, grammar, and astronomy to modern data science, artificial intelligence, knowledge organization, and responsible, value-driven research.
2	<b>Vertical 1</b>	Indian Knowledge Systems
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To Analyze the core methods of knowledge generation in Indian Knowledge System.</p> <p><b>CO(A) 2.</b> To Explore selected contributions from Nyāya, Vaiśeṣika, Vedic mathematics, and ancient computational traditions in modern data science.</p> <p><b>CO(A) 3.</b> To Integrate IKS-informed perspectives into data ethics and responsible AI.</p> <p><b>CO(A) 4.</b> To Leverage IKS domains for domain-specific data science innovation.</p> <p><b>CO(A) 5.</b> To Develop culturally rooted, multidisciplinary problem-solving competence.</p>
8	<b>Course Outcomes:</b>	Student will be able to <p><b>CO 1.</b> Apply classical Indian logical, mathematical, and algorithmic traditions</p> <p><b>CO 2.</b> Compare and contrast epistemological frameworks for reliable knowledge generation</p>

	<p>in data-intensive environments.</p> <p><b>CO 3.</b> Integrate ethical and value-based principles from Indian Knowledge Systems</p> <p><b>CO 4.</b> Analyze and adapt domain-specific insights from traditional Indian knowledge repositories.</p> <p><b>CO 5.</b> Design multidisciplinary, culturally grounded data science solutions for pressing Indian societal challenges.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p style="text-align: center;"><b>Project Themes/Research Areas</b></p> <p>Students shall under take one research project from any one of the following themes:</p> <ul style="list-style-type: none"> <li>• <b>Study of Zero and Decimal Number System: From Indian Gaṇita to Modern Computing</b> <ul style="list-style-type: none"> <li>▪ Topics: Development of decimal place-value system, contribution of Indian mathematicians, concept of zero in computation, numerical representation methods.</li> <li>▪ Modern Data Science Connection: Number representation in computers, binary data, numerical computing, importance of mathematical foundations in data processing.</li> </ul> </li> <li>• <b>Pattern Analysis of Sanskrit Ślokas Using Chandas (Poetic Meter)</b> <ul style="list-style-type: none"> <li>▪ Topics: Pingala’s Chandas Śāstra, poetic meter classification, combinatorics, binary patterns in poetic structures.</li> <li>▪ Modern Data Science Connection: Pattern recognition, sequence analysis, classification algorithms, data representation through patterns.</li> </ul> </li> <li>• <b>Classification of Medicinal Plants in Āyurveda and Its Relation with Data Organization</b> <ul style="list-style-type: none"> <li>▪ Topics: Āyurvedic classification of medicinal plants, properties of herbs, traditional knowledge organization, plant-based categorization.</li> <li>▪ Modern Data Science Connection: Taxonomy, data classification, database organization, knowledge representation systems.</li> </ul> </li> </ul>

	<ul style="list-style-type: none"><li>• <b>Exploring Nyāya Logic and Its Connection with Decision-Making Systems</b><ul style="list-style-type: none"><li>▪ Topics: Nyāya philosophy, inference (Anumāna), observation, reasoning methods, logical conclusions.</li><li>▪ Modern Data Science Connection: Rule-based systems, decision trees, logical reasoning models, explainable AI concepts.</li></ul></li> <li>• <b>Analysis of Astronomical Observations in Ancient Indian Jyotiṣa Texts</b><ul style="list-style-type: none"><li>▪ Topics: Jyotiṣa traditions, observation of celestial objects, planetary movements, time calculation methods.</li><li>▪ Modern Data Science Connection: Time-series analysis, prediction models, pattern detection from observational data.</li></ul></li> <li>• <b>Study of Panini's Vyākaraṇa: A Rule-Based Language System</b><ul style="list-style-type: none"><li>▪ Topics: Pāṇini's grammar framework, Sanskrit phonetics, linguistic rules, structured language analysis.</li><li>▪ Modern Data Science Connection: Natural Language Processing (NLP), grammar-based models, text analysis, language technologies.</li></ul></li> <li>• <b>Creating a Knowledge Map of Indian Knowledge Systems Using Concept Relationships</b><ul style="list-style-type: none"><li>▪ Topics: Interdisciplinary nature of IKS, relationships between philosophy, mathematics, medicine, astronomy, linguistics.</li><li>▪ Modern Data Science Connection: Knowledge graphs, semantic networks, information visualization, data modelling.</li></ul></li> <li>• <b>Comparative Study of Ancient Indian Mathematical Algorithms and Modern Algorithms</b><ul style="list-style-type: none"><li>▪ Topics: Algorithms of Āryabhaṭa, Brahmagupta, Bhāskara, mathematical procedures, iterative calculations.</li><li>▪ Modern Data Science Connection: Algorithmic thinking, computational procedures, problem-solving methods, programming logic.</li></ul></li></ul>
--	--

- **Data Visualization of Ancient Indian Calendrical Calculations**
  - Topics: Indian calendar systems, astronomical calculations, cycles of time, traditional measurement systems.
  - Modern Data Science Connection: Data visualization, temporal data analysis, dashboards, graphical representation of information.
  
- **Text Analysis of Sanskrit Literature Using Digital Tools**
  - Topics: Sanskrit manuscripts, structured text, linguistic features, classical literature analysis.
  - Modern Data Science Connection: Text mining, digital humanities, word frequency analysis, computational linguistics.
  
- **Study of Classification Systems in Vaiśeṣika Philosophy**
  - Topics: Vaiśeṣika categories (Padārtha), classification of objects, attributes and relationships.
  - Modern Data Science Connection: Ontologies, metadata, hierarchical classification, knowledge organization.
  
- **Pattern Recognition in Traditional Indian Art and Design**
  - Topics: Patterns in Indian architecture, Vāstu principles, traditional designs, symmetry and repetition.
  - Modern Data Science Connection: Image patterns, feature extraction, pattern recognition, visual data analysis.
  
- **Predictive Techniques in Ancient Indian Astronomy and Their Modern Interpretation**
  - Topics: Prediction of eclipses, planetary calculations, mathematical astronomy, observational methods.
  - Modern Data Science Connection: Predictive analytics, mathematical modelling, forecasting techniques.

- **Ethical Principles from Indian Philosophy and Responsible Data Science**
  - Topics: Dharma, balance with nature, ethical decision-making, responsibility in knowledge creation.
  - Modern Data Science Connection: Data ethics, responsible AI, privacy, fairness, sustainable technology practices.
  
- **Building a Mini Digital Archive of Indian Knowledge Sources**
  - Topics: Vedic literature, Āyurveda texts, Jyotiṣa works, mathematical texts, knowledge preservation
  - Modern Data Science Connection: Digital databases, data indexing, metadata creation, information retrieval systems.

Students may choose any one theme and formulate a specific research problem in consultation with the course instructor. The project may be theoretical, analytical, comparative, conceptual, computational, experimental, or prototype-based depending upon the nature of the selected topic. If required faculty members will allot Projects topics in addition to the above list that are relevant and important to the core Subject. The Project may be taken individually or in a group of students with proper guidance and prior sanction from the faculty.

### **Guidelines for Project Work**

Students shall undertake a research-based project on any one of the prescribed themes related to Indian Knowledge Systems and Data Science. The project should demonstrate the student's ability to explore, investigate, analyze, interpret, and present the computational, analytical, and knowledge representation aspects of Indian Knowledge Systems using appropriate research methods.

The project should focus on understanding traditional knowledge systems, identifying their underlying logical, mathematical, linguistic, or analytical principles, and establishing their relevance to contemporary data science concepts.

## **Suggested Approaches**

### **A. Literature-Based Research Study**

- Systematic study of classical texts, books, research papers, articles, and authentic sources related to Indian Knowledge Systems.
- Comparative analysis of traditional concepts and modern computational, analytical, or data-driven approaches.
- Identification of mathematical, logical, classification, linguistic, or predictive principles present in Indian Knowledge Systems.

### **B. Conceptual Modeling**

- Development of logical, mathematical, linguistic, or computational models based on selected Indian Knowledge Systems concepts.
- Creation of flowcharts, frameworks, classification models, ontologies, knowledge graphs, decision models, or process representations.
- Mapping of traditional knowledge structures, classification methods, and reasoning systems to modern Computer Science and Data Science concepts.

### **C. Experimental or Computational Study**

- Implementation of simple simulations, algorithmic demonstrations, data analysis, computational verification, or prototype models wherever applicable.
- Development of small software demonstrations, visualization models, analytical tools, or proof-of-concept applications based on the selected theme.
- Use of appropriate computational tools for analyzing patterns, classifications, predictions, or structured knowledge representations.

### **D. Case Study and Comparative Analysis**

- Investigation of selected texts, mathematical methods, classification systems, linguistic frameworks, astronomical models, or traditional knowledge practices.
- Comparative study between Indian Knowledge Systems approaches and contemporary computational techniques.
- Analysis of similarities, differences, and relevance of traditional methods in modern

data-driven applications.

### **Nature of Deliverables**

The project deliverable may consist of one or more of the following:

- Research Report
- Review Paper
- Comparative Study
- Conceptual Framework
- Knowledge Representation Model
- Ontology or Knowledge Graph
- Classification or Taxonomy Model
- Algorithm Design
- Flowchart-Based Model
- Data Analysis Report
- Visualization-Based Study
- Computational Analysis
- Software Prototype
- Simulation Study
- Case Study Report

**Note:** Since the course encompasses diverse themes within Indian Knowledge Systems, not all projects are expected to result in software development or programming-based outcomes. Therefore, for evaluation purposes, the term “Prototype Development / Experimental Implementation / Conceptual Model Demonstration” shall include software prototypes, algorithmic demonstrations, simulations, analytical studies, conceptual frameworks, ontologies, knowledge graphs, decision models, visual representations, formal models, or any other research artifact appropriate to the chosen topic.

The emphasis of the course is on originality, systematic investigation, analytical understanding, interdisciplinary learning, and the ability to connect Indian Knowledge Systems with modern computational sciences and data-driven methodologies.

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End**

**External - 30 marks**

The External Assessment shall evaluate the final research work, outcomes, findings, report quality, and viva voce examination.

	<b>Assessment Component</b>	Marks
1.	Prototype Development / Experimental Implementation / Conceptual Model Demonstration	10
2.	Analysis, Interpretation, and Discussion of Results / Findings	10
3.	Final Research Report / Research Paper	05
4.	Viva Voce Examination	05
	Total	30

**Guidelines for External Assessment**

**Prototype Development / Experimental Implementation / Conceptual Model Demonstration (10 Marks)**

- Development of software prototype, simulation, algorithm, conceptual framework, ontology, knowledge graph, decision model, comparative model, or other project artifact appropriate to the selected theme.
- Originality and relevance of the work
- Technical and conceptual quality

**Analysis, Interpretation, and Discussion of Results / Findings (10 Marks)**

- Quality of analysis
- Interpretation of observations and findings
- Computational relevance and insights
- Critical discussion and conclusions

**Final Research Report / Research Paper (5 Marks)**

The report should include:

- Title and Abstract

- Objectives
- Literature Review
- Methodology
- Analysis and Findings
- Conclusion
- References

**Viva Voce Examination (5 Marks)**

- Understanding of the selected topic
- Knowledge of research methodology
- Ability to explain findings and conclusions
- Response to questions from examiner

**Internal Examination: Continuous Evaluation- 20 marks**

The Internal Assessment shall evaluate the student's ability to identify a research problem, conduct literature review, plan the project, and communicate progress during the semester.

	<b>Assessment Component</b>	<b>Marks</b>
1.	Research Problem Identification, Objectives Formulation, and Literature Review	<b>10</b>
2.	Internal Seminar / Progress Review (Problem Understanding, Methodology, Presentation Skills, Communication and Discussion)	<b>10</b>
	Total	<b>20</b>

**Guidelines for Internal Assessment**

**Research Problem Identification and Literature Review (10 Marks)**

- Selection and justification of research topic
- Clarity of research objectives
- Identification of research gap/problem statement
- Review of relevant literature and sources
- Understanding of IKS and computational perspectives

	<p><b>Internal Seminar / Progress Review (10 Marks)</b></p> <ul style="list-style-type: none"> <li>• Project planning and methodology</li> <li>• Progress made during the semester</li> <li>• Presentation skills and communication</li> <li>• Ability to answer questions and justify approach</li> <li>• Active participation in review discussions</li> </ul>
<p><b>11</b></p>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. The Wonder That Was India, Basham, A. L., Revised Ed., Picador / Rupa Publications, 2004.</li> <li>2. A Critical Survey of Indian Philosophy, Sharma, C., Revised Ed., Motilal Banarsidass, 2016.</li> <li>3. Classical Indian Philosophy, Mohanty, J. N., 1st Ed., Rowman &amp; Littlefield, 2000.</li> <li>4. Mahadevan, B., Bhat, Vinayak Rajat, and Nagendra Pavana R. Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning, 2022.</li> <li>5. Kapil Kapoor and Avadesh Kumar Singh. Indian Knowledge Systems. D.K. Printworld.</li> <li>6. Kak, Subhash and Rao, T. R. N. Computing Science in Ancient India. Center for Advanced Computer Studies, University of Southwestern Louisiana, 1998.</li> <li>7. Bhanu Murthy, T. S. A Modern Introduction to Ancient Indian Mathematics. New Age International, 1992.</li> <li>8. Kim Plofker. Mathematics in India. Princeton University Press, 2009.</li> <li>9. C. K. Raju. Cultural Foundations of Mathematics. Pearson Education.</li> <li>10. Briggs, Rick. Knowledge Representation in Sanskrit and Artificial Intelligence. AI Magazine, 1985.</li> </ol>

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Data Security and Privacy**

**Vertical - 1  
Major (Elective) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Data Security and Privacy

**Course Code: CHMDSV6**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	<p>This course introduces the fundamentals of information security, including the CIA triad (Confidentiality, Integrity, Availability), authentication, access control, and cryptographic techniques such as AES and RSA. It also covers digital certificates, secure authentication systems like Kerberos, and key aspects of web security including vulnerabilities, server protection, and secure communication. The course helps students understand how to protect digital systems and data from increasing cyber threats.</p> <p>The course is highly relevant for modern IT applications such as online banking, e-commerce, cloud computing, and network security. It builds a strong foundation in identifying and preventing cyber attacks and is closely related to subjects like Computer Networks, Operating Systems, and DBMS. With growing industry demand, students can pursue careers as Cyber Security Analysts, Ethical Hackers, Security Engineers, SOC Analysts, and other security professionals.</p>
2	<b>Vertical 1</b>	Major (Elective)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks

7	<p><b>Course Objectives:</b></p> <p><b>CO(A) 1.</b> To understand the fundamental principles of information security, including the CIA Triad, authentication, authorization, access control, and security mechanisms used to protect computer systems and networks.</p> <p><b>CO(A) 2.</b> To identify and analyze common security threats and attacks, such as malware, phishing, ransomware, and other cyber risks, along with appropriate defense strategies.</p> <p><b>CO(A) 3.</b> To introduce cryptographic concepts and techniques, including encryption, decryption, substitution and transposition ciphers, and symmetric and asymmetric cryptography.</p> <p><b>CO(A) 4.</b> To study modern cryptographic algorithms and their applications in secure communication, data protection, digital signatures, and authentication systems.</p> <p><b>CO(A) 5.</b> To understand web and application security, including browser vulnerabilities, privacy concerns, server-side security management, secure configurations, and access control mechanisms for web applications and servers.</p>
8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1.</b> Explain the principles of information security, including the CIA Triad, and apply authentication, authorization, and access control mechanisms to protect information systems.</p> <p><b>CO 2.</b> Identify and analyze common cyber-attacks such as malware, phishing, and ransomware, and apply basic network security concepts and defense techniques.</p> <p><b>CO 3.</b> Describe cryptographic fundamentals, including plaintext, ciphertext, encryption, decryption, substitution and transposition techniques, and distinguish between symmetric and asymmetric cryptography.</p> <p><b>CO 4.</b> Explain modern cryptographic algorithms such as AES, DES, and RSA, and demonstrate the use of digital signatures, digital certificates, PKIX, and Kerberos for secure communication and authentication.</p> <p><b>CO 5.</b> Analyze web security challenges, including browser vulnerabilities, privacy concerns, and web server security, and implement access control strategies to secure web resources and applications.</p>

## Syllabus

### UNIT I:

- Information security principles (CIA Triad), Authentication, authorization, and access control
- Need for Security, Security approaches, security principles, Types Of Attacks, Network security basics, Malware, phishing, ransomware, Multi-factor authentication (MFA)
- Cryptography concept and Techniques: Plain text, Cipher Text, Substitution, Techniques, Transposition Techniques, Encryption, Decryption, Symmetric and asymmetric cryptography, Steganography.
- Symmetric key algorithms(AES,DES), Assyemtric key algorithms(RSA, Digital Signature).
- Digital Certificates, PKIX Model, User Authentication and Kerberos.

### UNIT II:

- The Web Security Landscape: Web Security in a Nutshell, The Web Security Problem, Credit Cards, Encryption, and the Web, Firewalls: Part of the Solution, Risk Management.
- The Buggy Browser: Browser History, Data-Driven Attacks, Implementation Flaws, Privacy: Log Files, Cookies, Personally Identifiable Information, Anonymizers, Unanticipated Disclosure.
- Host and Site Security, Historically Unsecure Hosts, Current Major Host Security Problems, Minimizing Risk by Minimizing Services, Secure Content Updating, Back-End Databases, Physical Security.
- Controlling Access to Your Web Server, Access Control Strategies, Implementing Access Controls with <Limit> Blocks, A Simple User Management System.

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15

2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	AI-Assisted Cybersecurity Investigation: Analyzing Threats, Cryptography, Authentication, and Web Security, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11**

**REFERENCES:**

1. William Stallings – Cryptography and Network Security
2. Atul Kahate, “Cryptography and Network Security”, Tata McGraw-Hill.
3. Web Security and Commerce by Simson Garfinkel, Gene Spafford.
4. DATA PRIVACY Principles and Practice by Nataraj Venkataramanan Ashwin Shriram
5. Introduction to Modern Cryptography, Katz, J., Lindell, Y., CRC Press, 2020.
6. Understanding Cryptography: A Textbook for Students and Practitioners, Paar, C., Pelzl, J., Springer, 2010.
7. Web Security for Developers: Real Threats, Practical Defense, Malcolm McDonald, 1st Ed., No Starch Press, 2017.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Business Forecasting Practical**

**Vertical - 1  
Major (Elective) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## **Title: Business Forecasting Practical**

**Course Code: CHMDSV7**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description the Course:</b>	This course provides practical knowledge of business forecasting using statistical and quantitative techniques. Students will learn to analyze past data, apply forecasting methods such as moving averages, trend analysis, regression, and time series, and use spreadsheet / statistical software for business decision making.
<b>2</b>	<b>Vertical 1</b>	Major (Elective)
<b>3</b>	<b>Type &amp; Teaching Method</b>	Practical
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	60 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b> <b>CO(A) 1.</b> To understand the role of forecasting in business planning. <b>CO(A) 2.</b> To apply statistical methods for forecasting. <b>CO(A) 3.</b> To develop practical skills using Excel / R / SPSS. <b>CO(A) 4.</b> To interpret forecasting results for decision making.	
<b>8</b>	<b>Course Outcomes:</b> Student will be able to <b>CO 1.</b> Students will be able to collect and present business data. <b>CO 2.</b> Students will be able to apply moving average, trend and regression methods. <b>CO 3.</b> Students will be able to perform forecasting using software tools. <b>CO 4.</b> Students will be able to analyze results for business decisions.	

9

## Syllabus

### UNIT I: Fundamentals of Forecasting and Time Series

1. Types of forecasting – Qualitative and Quantitative
2. Data collection, classification and presentation
3. Introduction to Excel / Statistical software for forecasting
4. Components of Time Series
5. Moving averages – Simple and Weighted
6. Trend analysis – Linear trend method
7. Seasonal variation – Simple method
8. Practical problems using spreadsheet / software

### UNIT II: Regression and Business Forecasting Applications

1. Concept of correlation
2. Karl Pearson correlation coefficient
3. Linear regression method
4. Forecasting using regression equation
5. Demand forecasting
6. Sales forecasting
7. Index numbers – basics and applications
8. Forecasting using real business data
9. Case study / Practical assignments using software.

10

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	13
Q2	Unit 2	12
Q3	Journal and Viva	05
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	AI-Powered Sales Forecasting and Business Analytics Challenge: From Data to Business Decisions, Project, Self-Learning Evaluation, Presentation, etc.	10
<b>Total:</b>		<b>20</b>

**11****REFERENCES:**

1. Gupta S.C. & Kapoor V.K. – Fundamentals of Applied Statistics.
2. Anderson, Sweeney & Williams – Statistics for Business and Economics.
3. Makridakis, S., Wheelwright, S.C., Hyndman, R.J., Forecasting Methods and Applications, 3rd Edition, Wiley, 1998.
4. Levin, R.I., Rubin, D.S., Statistics for Management, 7th Edition, Pearson Education, 2017

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year  
(Mathematics)**

**Semester- V**

**Title: Basics of Mathematics in Real Life – IV**

**Vertical - 2  
Minor - 2 Credits**

**with effect from  
Academic Year 2026-2027**

**Title: Basics of Mathematics in Real Life – IV**

**Course Code: CHMMATHV10**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	This course gives introduction to natural numbers, integers, rational numbers, real numbers and complex numbers in detail. Basic concepts like primes and congruences are introduced.
<b>2</b>	<b>Vertical 2</b>	Minor
<b>3</b>	<b>Type</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	30 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b>	<b>CO(A) 1.</b> To develop the notions of limits and continuity <b>CO(A) 2.</b> To identify the properties of congruences <b>CO(A) 3.</b> To associate diagrams based on equalities and inequalities of complex numbers <b>CO(A) 4.</b> To recognize various properties of functions and their use in basic counting
<b>8</b>	<b>Course Outcomes:</b>	Student will be able to: <b>CO 1:</b> Understand and remember basic concepts of numbers, sets, functions, sequences, and counting principles. <b>CO 2:</b> Apply mathematical techniques to solve routine and real-life problems. <b>CO 3:</b> Analyze patterns, relationships, and structures in numbers, functions, and sequences. <b>CO 4:</b> Justify/check mathematical results using logical reasoning and proof methods. <b>CO 5:</b> Construct simple mathematical models, proofs, and examples for real-life situations.

## Syllabus

### UNIT I: Basics of integers, real numbers and complex numbers (15 Hours)

- Natural numbers, Integers, Rational numbers and Irrational numbers
- Introduction to induction in natural numbers via proofs of sums of first  $n$  natural numbers and sums of squares and cubes of the first  $n$  natural numbers.
- Further applications of induction through problem solving.
- Operations on integers and rational numbers like addition, multiplication and subtraction. Equivalence of two rational numbers.
- Divisibility in integers and basic properties of divisibility
- Definition of prime numbers and statement of fundamental theorem of arithmetic (without proof).
- Greatest common divisor, least common multiple and relation to the product of numbers, Euclid's algorithm (without proof)
- Infinitude of primes (with proof) and existence of irrational numbers (Square-root two is irrational with proof).
- Congruences and their basic properties like solution of linear congruence
- Real number line and properties of real numbers.
- Order on real numbers and relation to the operation on real numbers.
- Definition of a complex number and visualization in the plane. Plotting of complex numbers.
- Operations on complex numbers like addition and multiplication and polar form of complex numbers. DeMoivre's theorem and its proof via induction.
- Plotting of regions in the complex plane defined by equalities and inequalities.
- Definition of a sequence and examples of sequences of natural numbers, integers and real numbers and analyzing the behaviour of sequences pictorially and introduction to the idea of convergence.

### UNIT II: Introduction to basic counting and basics of functions (15 Hours)

- Permutations and combinations of distinct objects.
- Examples based on permutations: digits, license plates etc.

- Examples based on combinations: digits, bit strings etc.
- Addition and multiplication principles for counting and illustrations
- Permutations with repetitions (only formula) and examples
- Combinations with repetitions (only formula) and examples
- De Morgan's laws for sets and introduction to functions between sets
- Injective and surjective functions
- Bijective functions, examples and their properties
- Inverse images of sets and their properties
- Limit of a function at a point
- Properties of limits: uniqueness (with proof)
- Computations of limits in various examples
- Definition and examples of continuous functions
- Properties of continuous functions: sums, products and ratios

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Q. No.	Structure of the Questions	Marks
1	Attempt ANY THREE (out of five/Six). (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE (out of five/Six). (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Note:**

- **Certified Journal** is **compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

**Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)

Sr. No.	Particulars	Marks	
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10	
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05	
3	Seminar/ group presentation on any one topic related to the syllabus.	05	

**Paper pattern of the Test (Offline Mode with One hour duration):**

Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1).

Q2: Attempt any 2 from 3 Descriptive questions. (06 marks: 2 x 3)

**11**

**REFERENCES:**

1. Burton, D. M/. Elementary Number Theory, McGraw Hill Education
2. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons.
3. Niven, Ivan, Zuckerman H. S., Montgomery, H. L., An Introduction to the theory of numbers, Wiley, 1972.
4. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year  
(Mathematics)**

**Semester- V**

**Title: Practical Based on Basics of Mathematics  
in Real Life – IV**

**Vertical - 2  
Minor - 2 Credits**

**with effect from  
Academic Year 2026-2027**

**Title: Practical Based on Basics of Mathematics in Real Life – IV**

**Course Code: CHMMATHV11**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
<b>1</b>	<b>Description of the Course:</b>	This course is based on problem-solving which is a fundamental aspect of any mathematics course. While advanced courses often emphasize the theoretical nature of the subject, engaging in problem-solving reinforces concepts and enhances learners' ability to analyze existing problems and devise solutions. This activity not only motivates learners but also empowers them to formulate new results, propose conjectures, and develop innovative theories.
<b>2</b>	<b>Vertical 2</b>	Minor
<b>3</b>	<b>Type</b>	Practical
<b>4</b>	<b>Credit</b>	2 Credits
<b>5</b>	<b>Hours allotted</b>	60 Hours
<b>6</b>	<b>Marks allotted</b>	50 Marks
<b>7</b>	<b>Course Objectives:</b> CO(A) 1. To develop the notions of limits and continuity CO(A) 2. To identify the properties of congruences CO(A) 3. To associate diagrams based on equalities and inequalities of complex numbers CO(A) 4. To recognize various properties of functions and their use in basic counting	

8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Apply mathematical techniques to solve routine and real-life problems.</p> <p><b>CO 2:</b> Analyze patterns, relationships, and structures in numbers, functions, and sequences.</p> <p><b>CO 3:</b> Justify/check mathematical results using logical reasoning and proof methods.</p> <p><b>CO 4:</b> Construct simple mathematical models, proofs, and examples for real-life situations.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Practical based on basics of integers, real numbers and complex numbers (30 Hours)</b></p> <ul style="list-style-type: none"> <li>• Integers and divisibility</li> <li>• Computation of greatest common divisor using Euclid’s algorithm</li> <li>• Properties of congruences</li> <li>• Solutions of linear congruences</li> <li>• Plotting of regions in the complex numbers and conversion to polar form</li> <li>• Applications of DeMoivre’s theorem</li> <li>• Sequences and their plotting, Convergence of sequences based on plotting</li> </ul> <p><b>UNIT II: Practical based on Introduction to basic counting and basics of functions (30 Hours)</b></p> <ul style="list-style-type: none"> <li>• Permutations of distinct objects</li> <li>• Combinations of distinct objects</li> <li>• Permutations and combinations of multisets</li> <li>• Injective, bijective, surjective functions</li> <li>• Inverse images of sets under functions</li> <li>• Limit of a function and examples</li> <li>• Continuity of a function</li> <li>• Arithmetic of continuous functions</li> </ul>

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Five out of Eight multiple choice questions (four from Unit 1 and four from Unit 2) (LO1 to LO3)	(3 × 5 = 15 Marks)
Q2	Attempt any Two out of Four (Two from Unit 1 and two From Unit 2). (LO 3 and LO 4)	(5 × 2 = 10 Marks)
Q3	Journal	5 (2.5 marks for each Unit 1 & Unit 2)
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

**Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)

	Assessment / Evaluation	Marks
1.	Objective question test	10
2.	Overall performance	5
3.	Viva	5
		<b>Total: 20</b>

	<p><b>Paper pattern of the Test (Offline Mode):</b></p> <p>Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: <math>5 \times 2</math>) Duration: 1Hrs</p> <p>While setting question paper four MCQ on unit I and four MCQ on unit II both.</p>
<p><b>11</b></p>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Niven H. Zuckerman and H. Montogomery. An Introduction to the Theory of Numbers. John Wiley &amp; Sons. Inc.</li> <li>2. David M. Burton. An Introduction to the Theory of Numbers. Tata McGraw-Hill Edition.</li> <li>3. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons.</li> <li>4. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons.</li> <li>5. Thomas and Finney, Calculus and Analytical Geometry, Pearson</li> <li>6. Ajit Kumar and S. Kumaresan, A basic course in real analysis, Chapman and Hall</li> <li>7. B. V. Limaye and Sudhir Ghorpade, A course in calculus and real analysis, Springer Nature.</li> </ol>


**HSNC Board's**  
**Smt. Chandibai Himathmal Mansukhani College**  
**(Autonomous)**  
**(Affiliated to the University of Mumbai)**

**Board of Studies (BoS) Mathematics**

<b>Sr. No.</b>	<b>Name of the Faculty</b>	<b>Designation and College</b>
1.	Ms. Urmila Pillay	Head and Associate Professor, Department of Mathematics, Smt. CHM College (Autonomous)
2.	Mr. Amish Thakker	Associate Professor, Smt. CHM College (Autonomous)
3.	Ms. Asha Chugh	Associate Professor, Smt. CHM College (Autonomous)
4.	Mr. Mandar Khasnis	Associate Professor, Smt. CHM College (Autonomous)
5.	Dr. Dipak Jadhav	Associate Professor, Smt. CHM College (Autonomous)
6.	Ms. Pooja Rajani	Assistant Professor, Smt. CHM College (Autonomous)
7.	Mr. Salil Sawarkar	Assistant Professor, Smt. CHM College (Autonomous)
8.	Mrs. Usha Hemasundar	Outside University nominee Head and Associate Professor, K.C. College, Churchgate
9.	Dr. Pankit Gandhi	Outside University nominee Professor, K.C. College, Churchgate
10.	Ms. Minal Wankhede	Vice Chancellor Nominee Head and Associate Professor, B.N. Bandodkar College, Thane
11.	Mr. Mandar Dongare	Industry Representative Senior Manager, Customer Success, Teradata India Pvt. Ltd.
12.	Ms. Supriya Bhagat	Alumni Representative Senior Product Data Scientist, Project pro

Name and Signature of the Ad hoc BoS Chairperson: Ms. Urmila Pillay 

Name and Signature of the Dean:

Dr. Neena Anand 

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Data Visualization Practical**

**Vertical - 4  
Vocational Skill Course (VSC) - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Data Visualization Practical

**Course Code: CHMDSV8**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Data Visualisation Practical is a hands-on course that teaches students how to represent data using charts, graphs, dashboards, and visual tools for clear understanding. It focuses on using software and analytical techniques to transform raw data into meaningful visual insights for decision-making and communication.
2	<b>Vertical 4</b>	Vocational Skill Course (VSC)
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To understand the basic concepts and importance of data visualization in analyzing information.</p> <p><b>CO(A) 2.</b> To learn how to represent data using charts, graphs, and other visual tools effectively.</p> <p><b>CO(A) 3.</b> To develop practical skills in using data visualization software and tools..</p> <p><b>CO(A) 4.</b> To interpret and communicate data insights clearly through visual presentations.</p> <p><b>CO(A) 5.</b> To enhance analytical thinking by transforming raw data into meaningful visual information.</p>
8	<b>Course Outcomes:</b>	<p>Student will be able to</p> <p><b>CO 1:</b> Students will be able to understand and explain the basic principles of data visualization.</p> <p><b>CO 2:</b> Choose appropriate data sources and analytical tools to assess business decision for improving performance.</p> <p><b>CO 3:</b> Apply analytics tools to a variety of data collected.</p>

**CO 4:** Translate the results of quantitative analyses into managerial insights for decision making.

**CO 5:** Explain and illustrate how visual data is used in an integrated manner to solve strategic problems.

9

## Syllabus

### UNIT I:

- **Getting Started with Tableau and Building Basic Visualizations**
  - a) Connect to a CSV dataset and explore the Tableau interface
  - b) Identify and differentiate Measures and Dimensions
  - c) Convert fields between discrete and continuous and observe changes
  - d) Create and customize a basic bar chart
  - e) Build a line chart for time-series analysis
  - f) Create a geographic map visualization
  - g) Combine multiple charts into a simple interactive dashboard
- **Working with Data Sources and Data Preparation in Tableau**
  - a) Connect to different data sources (Excel, CSV, Database)
  - b) Create and use data extracts vs live connections
  - c) Manage metadata (rename, hide, change data types)
  - d) Perform joins (inner, left, right) on multiple tables
  - e) Apply data blending between two sources
  - f) Implement different types of filters (dimension, measure, date)
  - g) Optimize performance using extracts and filtering
- **Creating Advanced Visualizations in Tableau**
  - a) Create stacked and grouped bar charts for comparison
  - b) Build treemaps and pie charts for part-to-whole analysis
  - c) Design scatter plots to identify relationships
  - d) Create dual-axis and combination charts
  - e) Develop histograms for distribution analysis
  - f) Build box-and-whisker plots
  - g) Use Gantt charts and advanced date visualizations

- **Performing Data Analysis using Calculations in Tableau**
  - a) Create basic calculated fields using formulas
  - b) Perform row-level calculations
  - c) Perform aggregate-level calculations
  - d) Implement FIXED Level of Detail (LOD) calculations
  - e) Use INCLUDE and EXCLUDE LOD expressions
  - f) Create and use parameters for dynamic analysis
  - g) Apply calculations to fix data issues and enhance insights
- **Analyzing Data using Table Calculations in Tableau**
  - a) Apply quick table calculations (running total, percent of total)
  - b) Create moving averages and cumulative metrics
  - c) Perform year-over-year growth analysis
  - d) Use ranking functions (Top N, Bottom N)
  - e) Implement window functions (WINDOW\_SUM, WINDOW\_AVG)
  - f) Customize addressing and partitioning
  - g) Create dynamic titles and labels using table calculations
- **Designing Effective and Visually Appealing Dashboards**
  - a) Apply worksheet-level and workbook-level formatting
  - b) Customize number, date, and null value formatting
  - c) Design effective color schemes and layouts
  - d) Create informative tooltips
  - e) Implement “Viz in Tooltip”
  - f) Improve readability and user experience
  - g) Apply best practices for visual storytelling
- **Creating Interactive Dashboards and Data Stories**
  - a) Design a basic dashboard layout using sheets
  - b) Add filters and interactive controls
  - c) Implement highlight and filter actions
  - d) Use URL and set actions for interactivity
  - e) Create dynamic dashboards using parameters
  - f) Design dashboards for multiple devices

g) Build a complete data story using Story feature

## **UNIT II:**

### **• Performing Advanced Analytics using Trends, Clustering, and Forecasting**

- a) Add and interpret trend lines (linear, exponential)
- b) Customize and analyze trend models
- c) Perform clustering on datasets
- d) Analyze distributions using built-in tools
- e) Apply forecasting techniques
- f) Compare different statistical models
- g) Export and interpret statistical results

### **• Cleaning and Structuring Data for Analysis**

- a) Identify and handle missing or inconsistent data
- b) Convert wide data into tall format
- c) Perform union of multiple files
- d) Execute cross-database joins
- e) Restructure data for better visualization
- f) Handle different levels of detail in datasets
- g) Apply advanced data cleaning techniques

### **• Data Preparation and Transformation using Tableau Prep**

- a) Connect and load data into Tableau Prep
- b) Clean and profile data
- c) Group and standardize values
- d) Merge mismatched fields
- e) Perform aggregations in Prep
- f) Apply filters and transformations
- g) Create and automate data preparation flows

### **• Implementing Advanced Visualization Techniques and Customizations**

- a) Create slope charts and lollipop charts
- b) Design waterfall charts
- c) Build sparklines for trend analysis
- d) Implement sheet swapping for dynamic dashboards

- e) Create custom geographic territories
- f) Use background images in dashboards
- g) Apply animation and transparency techniques

- **Sharing, Publishing, and Presenting Data Visualizations**

- a) Export dashboards as PDF/Image
- b) Use presentation mode in Tableau
- c) Publish dashboards to Tableau Public
- d) Share dashboards via Tableau Server/Online
- e) Enable user interaction on shared dashboards
- f) Manage permissions and access control
- g) Evaluate and optimize sharing strategies

- **Retail Sales & Profitability Dashboard**

Analyze sales, profit, and discount impact across regions.

- Build bar, line, and map visualizations
- Use calculated fields (Profit Ratio)
- Apply filters (Region, Category)
- Create interactive dashboard

- **Customer Segmentation & Behavior Analysis**

Identify customer segments based on purchasing patterns.

- Use clustering
- Analyze frequency, recency, and monetary value
- Create scatter plots and segmentation dashboards
- Highlight high-value customers

- **Sales Forecasting and Trend Analysis**

Predict future sales using historical data.

- Build time-series charts
- Apply forecasting
- Compare seasonal trends
- Use moving averages

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	13
Q2	Unit 2	12
Q3	Journal and Viva	05
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / Evaluation	Marks
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	Self-Directed Learning Using AI Tools and Resources, Project, Self-Learning Evaluation, Presentation, etc.	10
		<b>Total: 20</b>

**REFERENCES:**

1. Learning Tableau 2019 Tools for Business Intelligence, data prep, and visual analytics, Packt Publication.
2. Microsoft Power BI Dashboards Errin O'Connor Microsoft Corporation by Pearson Education, Inc.
3. Power BI for the Excel Analyst, Wyn Hopkins, Holy Macro Books, PO Box 541731, Merritt Island FL 32953, USA 2022.
4. <https://learn.microsoft.com/en-us/training/modules/explore-data-power-bi/>
5. <https://www.tableau.com/learn/training>
6. <https://public.tableau.com/en-us/s/resources>

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- V**

**Title: Community Engagement  
Project (CEP)**

**Vertical - 6  
CEP - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## **Title: Community Engagement Project (CEP)**

**Course Code: CHMDSV9**

**Duration :-** 30 hrs (Field Work+ Survey) + 15hrs (Discussion + Report Writing) : Total - 45 hrs

### **Indicative Topics for CEP**

<b>Sr. No.</b>	<b>Name of the Topic</b>
1.	Community Health Data Analysis for Disease Pattern Identification
2.	Nutrition Deficiency Analysis Using Local Health Survey Data
3.	Predictive Analysis of Seasonal Diseases in Rural/Urban Areas
4.	Maternal & Child Health Data Dashboard for Local Clinics
5.	Analyzing Vaccination Coverage and Dropout Rates
6.	Mental Health Awareness Insights Using Survey & Sentiment Data
7.	Analyzing Healthcare Access Inequality Using Open Data
8.	Data-Driven Health Awareness Campaign Planning
9.	Lifestyle Disease Risk Analysis Using Community Data
10.	COVID/Post-Pandemic Health Impact Analysis at Community Level
11.	School Dropout Rate Analysis Using Socioeconomic Data
12.	Learning Outcome Analytics for Government Schools
13.	Digital Literacy Impact Assessment Using Data Science
14.	Career Aspiration & Skill Gap Analysis for Youth
15.	Attendance & Performance Pattern Analysis in Schools
16.	Education Resource Optimization Using Data Insights
17.	Gender Gap Analysis in Education Using Census Data
18.	Data-Driven Scholarship Allocation Recommendations
19.	Early Warning System for At-Risk Students
20.	Learning Analytics Dashboard for Community Learning Centers
21.	Air Quality Trend Analysis Using Open Environmental Data
22.	Water Quality Data Analysis for Community Awareness
23.	Solid Waste Generation & Segregation Data Analytics
24.	Climate Change Impact Analysis at Local Level

Sr. No.	Name of the Topic
25.	Urban Heat Island Effect Analysis Using Public Data
26.	Rainfall & Flood Risk Prediction Using Historical Data
27.	Energy Consumption Pattern Analysis for Households
28.	Biodiversity Data Analysis for Conservation Awareness
29.	Noise Pollution Pattern Detection in Urban Areas
30.	Environmental Awareness Campaign Based on Data Insights
31.	Crop Yield Prediction Using Historical Agricultural Data
32.	Soil Health Data Analysis for Farmers' Awareness
33.	Market Price Trend Analysis for Agricultural Produce
34.	Weather Pattern Analytics for Farming Advisory
35.	Farm Input Optimization Using Data Analytics
36.	Pest & Disease Occurrence Pattern Analysis
37.	Water Usage Efficiency Analysis in Agriculture
38.	Data-Driven Crop Diversification Recommendations
39.	Agricultural Supply Chain Bottleneck Analysis
40.	Farmer Feedback & Satisfaction Analysis Using Surveys
41.	Analysis of Public Grievance Redressal Data
42.	Welfare Scheme Utilization & Gap Analysis
43.	Data-Based Assessment of Smart City Initiatives
44.	Citizen Satisfaction Analytics for Local Governance
45.	Budget Allocation vs Outcome Analysis for Local Bodies
46.	Urban Infrastructure Usage Pattern Analysis
47.	Data Visualization of Local Development Indicators
48.	Electoral Participation Data Analysis (Non-Political)
49.	Public Transport Usage & Optimization Analysis
50.	Crime Pattern Analysis for Community Safety Awareness
51.	Gender Inequality Analysis Using Employment Data
52.	Accessibility Gap Analysis for Persons with Disabilities
53.	Bias Detection in Public Datasets
54.	Socioeconomic Inequality Mapping Using Census Data

<b>Sr. No.</b>	<b>Name of the Topic</b>
55.	Migration Pattern Analysis for Urban Planning
56.	Ethical Data Collection Framework for Communities
57.	Digital Divide Measurement Using Survey Data
58.	Sentiment Analysis of Community Issues from Public Feedback
59.	Data Storytelling for Social Change
60.	Community-Centric Open Data Platform Development

The topics are indicative and the faculty members should allot Community Engagement Project that are relevant and important as per core Subject. The Community Engagement Project may be taken individual or in a group up to 4 students with proper guidance from Faculty.

## Evaluation Pattern:-

Evaluation during CEP Program involves two key components :-

External Evaluation 60%

Internal Evaluation 40%

## Evaluation Chart

### (i) External Evaluation (Marks 30)

Criteria	Marks
Objectives, Literature Review, Methodology, Data Analysis, Conclusion and Recommendations	15
Overall Project Report Structure and Style	5
Presentation Skills & Communication	10
Total	30

### (ii) Internal Evaluation by Guide (Marks 20)

Criteria	Marks
Attendance, Community interactions completion and interaction with Supervisor	10
Overall Report quality	10
Total	20



**HSNC Board's**  
**Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar**  
**(Autonomous)**  
**Affiliated to the University of Mumbai**

**Bachelor of Science**  
**(Data Science)**  
**(Self-Financing Course)**

**Semester – VI**

**Choice Based and Credit Based syllabus**  
**as per NEP 2020 with effect from the Academic**  
**Year 2026-2027**

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Natural Language Processing**

**Vertical - 1**

**Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Natural Language Processing

**Course Code: CHMDSVI1**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course introduces the fundamental concepts and techniques of Natural Language Processing (NLP), focusing on the processing and analysis of textual data using computational methods. The course covers key stages of the NLP pipeline including text preprocessing, feature extraction, and text representation techniques such as Bag-of-Words and TF-IDF. It also introduces machine learning approaches for text classification and clustering, along with important NLP applications such as topic modeling, sentiment analysis, and text summarization. Through a combination of theoretical concepts and practical exercises, students gain hands-on experience in developing basic NLP solutions for real-world text analytics problems.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>  <b>CO(A) 1.</b> To introduce students to the fundamental concepts, history, and applications of Natural Language Processing and its role in text analytics.  <b>CO(A) 2.</b> To develop understanding of NLP preprocessing techniques such as tokenization, POS tagging, stop-word removal, stemming, and lemmatization.	

	<p><b>CO(A) 3.</b> To enable students to apply feature extraction and text representation methods including n-grams, Bag-of-Words, and TF-IDF.</p> <p><b>CO(A) 4.</b> To familiarize students with machine learning techniques used in NLP such as classification, clustering, dimensionality reduction, and model evaluation.</p> <p><b>CO(A) 5.</b> To provide knowledge of major NLP applications including topic modeling, text summarization, vector representations, and sentiment analysis.</p>
8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Apply fundamental NLP preprocessing techniques to convert raw textual data into structured formats suitable for analysis.</p> <p><b>CO 2:</b> Implement feature extraction and representation methods for transforming textual data into numerical vectors for machine learning models.</p> <p><b>CO 3:</b> Analyze textual datasets using machine learning algorithms for tasks such as classification, clustering, and dimensionality reduction.</p> <p><b>CO 4:</b> Develop and evaluate NLP models using appropriate pipelines, performance metrics, and data processing techniques.</p> <p><b>CO 5:</b> Apply NLP methods to solve real-world problems including sentiment analysis, topic modeling, and automated text summarization.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Foundations of Natural Language Processing</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Natural Language Processing</b> <ol style="list-style-type: none"> <li>a) Overview of NLP</li> <li>b) History and evolution of NLP</li> <li>c) Relationship between Text Analytics and NLP</li> <li>d) Applications of NLP</li> </ol> </li> <li>• <b>NLP Processing Pipeline</b> <ol style="list-style-type: none"> <li>a) Steps in an NLP system</li> <li>b) Data collection and preprocessing</li> <li>c) Feature extraction</li> <li>d) Model development, evaluation, and deployment</li> </ol> </li> <li>• <b>Text Preprocessing Techniques</b> <ol style="list-style-type: none"> <li>a) Tokenization</li> </ol> </li> </ul>

- b) Part-of-Speech (POS) tagging
- c) Stop-word removal
- d) Text normalization
- e) Spelling correction
- f) Stemming and Lemmatization
- g) Sentence boundary detection
- h) Named Entity Recognition
- i) Word Sense Disambiguation

- **Feature Extraction from Text**

- a) Types of textual data and text cleaning
- b) N-grams and tokenization methods
- c) Bag of Words model
- d) Zipf's Law
- e) TF-IDF representation
- f) Feature engineering and text similarity
- g) Text visualization techniques (word clouds, dependency trees)

## **UNIT II: Machine Learning and Applications in NLP**

- **Machine Learning for NLP**

- a) Supervised and unsupervised learning
- b) Hierarchical clustering and K-means clustering
- c) Classification algorithms
  - Logistic Regression
  - Naïve Bayes
  - K-Nearest Neighbors

- **Advanced Machine Learning Models**

- a) Regression with textual data
- b) Tree-based models
  - Decision Trees
  - Random Forest
  - Gradient Boosting

- XGBoost

- c) Sampling techniques
- d) Dimensionality reduction (PCA)
- e) Model evaluation and performance metrics
- f) NLP pipelines and model persistence

- **Text Data Collection and Processing**

- a) Web scraping
- b) Extracting data from HTML
- c) Working with JSON and XML data
- d) Using APIs for real-time data collection
- e) Extracting text from local files

- **Applications of NLP**

- a) Topic modeling
  - Latent Semantic Analysis (LSA)
  - Latent Dirichlet Allocation (LDA)
- b) Text summarization
  - Extractive and abstractive summarization
  - TextRank algorithm
- c) Text generation using Markov chains
- d) Vector representations of text
  - One-hot encoding
  - Word embeddings and Word2Vec
  - Document vectors
- e) Sentiment analysis
  - Sentiment analysis concepts and applications
  - Tools and libraries for sentiment analysis
  - Training sentiment classification models

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Exploring AI and NLP Solutions for Real-World Problems, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Natural Language Processing Fundamentals, Sohom Ghosh and Dwight Gunning Published by Packt Publishing Ltd. March 2019.
2. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit Sebastopol, CA: O'Reilly Media.2009.
3. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models (3rd ed.). Online manuscript. Stanford University.
4. Foundations of Statistical Natural Language Processing. Cambridge, MA: MIT Press. 1999.
5. Introduction to Natural Language Processing. Cambridge, MA: MIT Press. 2019.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Sports Analytics**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Sports Analytics

**Course Code: CHMDSVI2**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course introduces the principles and applications of sports data analytics, focusing on performance evaluation, predictive modelling, athlete management systems, and injury risk analysis. It explores artificial intelligence techniques for game strategy and opponent analysis, along with fan engagement analytics and emerging trends shaping the future of data-driven sports management.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>  <b>CO(A) 1.</b> Develop a fundamental understanding of sports data analytics, including data collection, preprocessing, athlete management systems, and the use of statistical methods and Key Performance Indicators (KPIs) for performance evaluation.  <b>CO(A) 2.</b> Enable students to analyze and interpret athlete and team performance data using analytical techniques and predictive models to support performance assessment and forecasting.  <b>CO(A) 3.</b> Apply sports analytics for injury prevention, workload monitoring, and performance optimization to enhance athlete health, safety, and competitive outcomes.	

	<p><b>CO(A) 4.</b> Explore the applications of Artificial Intelligence and Machine Learning in sports, including performance analysis, talent identification, and opponent strategy evaluation.</p> <p><b>CO(A) 5.</b> Understand fan engagement analytics, business and commercial applications of sports data science, along with ethical considerations, emerging technologies, and future trends in the sports industry.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Explain the fundamental concepts of sports analytics, data management, athlete monitoring systems, and their role in sports performance evaluation.</p> <p><b>CO 2:</b> Analyze, interpret, and visualize sports performance data using appropriate statistical techniques and analytical tools.</p> <p><b>CO 3:</b> Design and implement predictive models to evaluate athlete and team performance, analyze match outcomes, and support strategic decision-making.</p> <p><b>CO 4:</b> Apply data-driven methods, including AI and machine learning techniques, for injury risk assessment, workload management, and performance optimization.</p> <p><b>CO 5:</b> Evaluate fan engagement and business strategies using sports analytics while considering ethical issues, technological advancements, and future trends in the sports industry.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Foundations and Predictive Performance Analytics</b></p> <ul style="list-style-type: none"> <li>• <b>Foundations of Sports Data Analytics and Athlete Management Systems</b> <ol style="list-style-type: none"> <li>a) Evolution and scope of sports analytics</li> <li>b) Data collection methods: manual, optical tracking, wearables, video analytics</li> <li>c) Data preprocessing: cleaning, normalization, encoding, validation</li> <li>d) Athlete Management Systems (AMS): design principles and architecture</li> <li>e) Ethical considerations, data privacy, and governance</li> <li>f) Integration of performance and health data</li> </ol> </li> <li>• <b>Statistical Assessment and Performance Evaluation in Sports</b> <ol style="list-style-type: none"> <li>a) Key Performance Indicators (KPIs) in sports</li> <li>b) Descriptive and inferential statistics in sports science</li> <li>c) Data interpretation and visualization</li> </ol> </li> </ul>

- d) Performance benchmarking
- e) Contextual analysis of player and team performance
- f) Evidence-based decision-making in sports

- **Predictive Modelling and Game Performance Analytics**

- a) Analytical frameworks for sports performance modelling
- b) Regression, classification, and machine learning basics
- c) Game outcome prediction models
- d) Tactical and strategic analytics
- e) Model validation and performance metrics
- f) Applications in team selection and match strategy

## **UNIT II: Advanced Applications, AI, and Sports Business Analytics**

- **Injury Analytics and Load Management Technologies**

- a) Athlete workload monitoring concepts
- b) Injury risk modelling and mitigation strategies
- c) Biomechanical and physiological data integration
- d) Wearable technology applications
- e) Data-driven rehabilitation and return-to-play decisions

- **Artificial Intelligence Applications in Sports Performance**

- a) AI-driven performance analysis (Badminton case study model)
- b) Computer vision in sports analytics
- c) Machine learning algorithms for opponent analysis
- d) Explainable AI in sports
- e) Challenges and limitations of ML in sports environments

- **Fan Engagement Analytics and Future Trends in Sports Data Science**

- a) Fan behavior analytics and engagement modelling
- b) Social media and digital analytics in sports marketing
- c) Revenue optimization using data analytics
- d) Emerging technologies in sports (AI integration trends)
- e) Ethical challenges and future research directions

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Future of AI in Sports: Emerging Technologies and Innovations in Sports Data Science, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Sports Data Analytics: Techniques, Applications, and Innovations, edited by Mehul S. Raval, Tolga Kaya, N. Sertac Artan, and Christopher Taber, published by Springer Nature (Studies in Big Data Series), 2026, First Edition.
2. Machine Learning and Data Mining for Sports Analytics: 9th International Workshop, MLSA 2022 Proceedings, edited volume (workshop proceedings), published by Springer, 2022, First Edition.
3. Football Analytics with Python & R: Learning Data Science Through the Lens of Sports, by Eric A. Eager and Richard A. Erickson, published by O'Reilly Media, 2023,

First Edition.

4. *Game of Edges: The Analytics Revolution and the Future of Professional Sports*, by Bruce Schoenfeld, published by Grand Central Publishing, 2023, First Edition.
5. *Sports Performance Analytics: Data-Driven Approaches for Athlete Optimization*, by Carlos Lago-Peñas and Jaime Sampaio, published by Routledge (Taylor & Francis), 2022, First Edition.
6. *Handbook of Statistical Methods and Analyses in Sports*, by Jim Albert, Mark E. Glickman, Tim B. Swartz, and Ruud H. Koning, published by Chapman & Hall/CRC Press, 2017, First Edition.
7. *Analyzing Baseball Data with R*, by Max Marchi, Jim Albert, and Benjamin S. Baumer, published by Chapman & Hall/CRC Press, 2019, Second Edition.
8. *Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers*, by Benjamin C. Alamar, published by Columbia University Press, 2013, Updated Edition.
9. *The Data Game: Controversies in Social Science Statistics and Sports Analytics*, by Mark P. Taylor, published by Princeton University Press, 2022, First Edition.
10. *Data Analytics in Sport: Concepts and Cases*, by Craig Williams and Mark Hughes, published by Routledge, 2021, First Edition.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Natural Language Processing and Sports  
Analytics Practical**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Natural Language Processing and Sports Analytics Practical

**Course Code: CHMDSVI3**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	This practical course provides hands-on experience in Natural Language Processing (NLP) and Sports Analytics, focusing on the implementation of data preprocessing, statistical analysis, and machine learning techniques. Students work with textual and sports performance datasets to perform tasks such as sentiment analysis, classification, predictive modelling, injury risk analysis, and performance evaluation. The course emphasizes real-world applications using Python-based tools to support data-driven decision making in sports management and intelligent text analytics systems.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To introduce students to the fundamental concepts of Natural Language Processing (NLP) and Sports Data Analytics, including data collection, preprocessing, normalization, linguistic analysis, performance evaluation, and athlete management systems. <b>CO(A) 2.</b> To develop practical skills in transforming textual and sports data into machine-processable representations using feature extraction, statistical analysis, visualization techniques, and Python-based analytical tools. <b>CO(A) 3.</b> To enable students to design and implement data-driven solutions such as text classification, sentiment analysis, topic modeling, text summarization, sports	

	<p>performance evaluation, and athlete monitoring using real-world datasets.</p> <p><b>CO(A) 4.</b> To apply statistical, machine learning, and predictive modelling techniques for text analytics, sports performance forecasting, match outcome prediction, and injury risk assessment.</p> <p><b>CO(A) 5.</b> To explore Artificial Intelligence applications in NLP and sports analytics, including intelligent decision-making systems, fan engagement analytics, and emerging AI technologies in modern data-driven environments.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Apply text preprocessing and normalization techniques, including tokenization, POS tagging, stop-word removal, stemming, and lemmatization, to prepare textual data for analysis.</p> <p><b>CO 2:</b> Implement feature extraction and machine learning techniques for NLP applications such as text classification, topic modeling, sentiment analysis, and other text analytics tasks.</p> <p><b>CO 3:</b> Develop, evaluate, and deploy complete data analytics pipelines involving data collection, preprocessing, feature engineering, model training, visualization, and performance assessment for real-world NLP and sports analytics problems.</p> <p><b>CO 4:</b> Analyze and preprocess sports datasets to extract meaningful insights, evaluate athlete and team performance, and support evidence-based decision-making.</p> <p><b>CO 5:</b> Design and implement predictive models using statistical, machine learning, and AI techniques for performance forecasting, match outcome prediction, injury risk assessment, and fan engagement analytics.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Natural Language Processing Practical</b></p> <ul style="list-style-type: none"> <li>• <b>Python Basics for NLP:</b> Introduction to Python for text processing, String operations (split, join, replace), File handling (read/write text files), Simple text cleaning using Python.</li> <li>• <b>NLP Setup &amp; Tokenization:</b> Install NLP libraries (NLTK/TextBlob/Scikit learn), perform basic text analytics, tokenize sentences and paragraphs, and inspect tokens using Python scripts.</li> </ul>

- **Regular Expressions for Text Processing:** Pattern matching using re, Extract emails, phone numbers, URLs, Cleaning text using regex
- **NLP Preprocessing:** Perform POS tagging, remove stop words, detect sentence boundaries, and extract named entities from sample text datasets.
- **Text Normalization:** Implement text normalization, perform spelling correction, apply stemming (Porter/Regex), and perform lemmatization while comparing results.
- **Feature Extraction:** Generate n-grams (bi-grams and tri-grams), tokenize text using different libraries, remove noise from text, and extract basic statistical text features.
- **Text Representation:** Implement Bag-of-Words models, generate TF-IDF vectors, and compute similarity between text documents using vector representations.
- **Text Visualization:** Generate word clouds, analyze word frequency distribution using Zipf's Law, and visualize dependency parse trees and named entities.
- **Machine Learning for NLP:** Build text classification models using Logistic Regression, Naive Bayes, and K-Nearest Neighbors; split datasets into training and testing sets; and compare model performance.
- **Advanced ML Models:** Train Decision Tree and Random Forest classifiers, implement Gradient Boosting/XGBoost for text classification, and compare model accuracy and performance metrics.
- **Dimensionality Reduction:** PCA for text features, Feature reduction visualization, Compare performance before & after PCA
- **NLP Pipeline Development:** Build an end-to-end NLP pipeline including preprocessing, feature extraction, dimensionality reduction (PCA), model training, and model evaluation.
- **Web Data Collection:** Scrape textual data from HTML pages, extract content using Python requests and BeautifulSoup, retrieve data using APIs, and parse JSON datasets.
- **Topic Modeling:** Perform topic modeling using Latent Semantic Analysis (LSA) and Latent Dirichlet Allocation (LDA), analyze document clusters, and visualize topic distributions across documents.
- **Sentiment Analysis & Text Summarization:** Perform sentiment analysis using TextBlob, train a sentiment classification model, and implement automatic text

summarization using Gensim or frequency-based techniques.

## **UNIT II: Sports Data Analytics Practical's**

- **Data Collection, Cleaning and Preprocessing in Sports Analytics**

- a) Sports Dataset Import and Data Cleaning( Import match or player dataset, Identify missing values, Remove duplicate records, Standardize player names and date formats)
- b) Data Transformation and Feature Engineering( Normalize performance metrics, Apply Min-Max scaling and standardization, Encode categorical variables (team, position). Create derived features (performance index, workload ratio))
- c) Exploratory Data Analysis in Sports Performance( Generate summary statistics, Correlation analysis, Boxplot and histogram, visualization, Detect and treat outliers)

- **Performance Metrics and Statistical Evaluation**

- a) Calculation of Key Performance Indicators (KPIs) (Compute scoring averages, Calculate efficiency ratings, Create composite, performance score, Compare multiple players,
- b) Statistical Comparison of Team Performance (Perform hypothesis testing (t-test), Analyze variance in team performance, Study match-by-match performance trends)
- c) Sports Performance Visualization Dashboard (Create player comparison charts, Plot seasonal performance trends, Visualize team efficiency metrics, Design simple analytical dashboard)

- **Predictive Modelling and Game Analytics**

- a) Match Outcome Prediction using Classification(Train Logistic Regression model, Predict win/loss outcome, evaluate model using accuracy and confusion matrix)
- b) Player Performance Prediction using Regression(Apply Linear Regression model, Predict future player performance, Compute RMSE and  $R^2$  score)
- c) Player Profiling using Clustering( Apply K-Means clustering, Group players based on performance statistics, Visualize clusters and interpret results)

- **Injury Risk and Workload Analytics**

- a) Athlete Workload Monitoring Analysis( Analyze training load dataset, Calculate

Acute: Chronic Workload Ratio, Identify high-risk workload levels

b) Injury Risk Prediction Model( Train Random Forest classifier, Predict injury probability, Evaluate precision, recall and F1-score)

c) Anomaly Detection in Athlete Health Data( Use Isolation Forest or One-Class SVM, Detect abnormal performance or fatigue levels, Visualize anomaly patterns

• **AI Applications and Fan Engagement Analytics**

a) Opponent Performance Pattern Analysis( Analyze match event dataset, Identify scoring patterns, Predict likely scoring zones using ML model)

b) Social Media Fan Engagement Analytics( Analyze engagement dataset, Compute engagement rate, Perform basic sentiment analysis)

c) Comparative Evaluation of Machine Learning Models( Compare Logistic Regression, Random Forest and SVM, Evaluate using accuracy, precision and F1-score, Select optimal model for sports prediction)

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	13
Q2	Unit 2	12
Q3	Journal and Viva	05
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / Evaluation</b>	<b>Marks</b>
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	Case Study on AI-Driven Sports Performance Analysis and Fan Sentiment Evaluation, Project, Self-Learning Evaluation, Presentation, etc.	10
<b>Total:</b>		<b>20</b>

**11**

**REFERENCES:**

1. Natural Language Processing Fundamentals, Sohom Ghosh and Dwight Gunning Published by Packt Publishing Ltd. March 2019
2. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit Sebastopol, CA: O'Reilly Media.2009
3. Sports Data Analytics: Techniques, Applications, and Innovations, edited by Mehul S. Raval, Tolga Kaya, N. Sertac Artan, and Christopher Taber, published by Springer Nature (Studies in Big Data Series), 2026, First Edition.
4. Machine Learning and Data Mining for Sports Analytics: 9th International Workshop, MLSA 2022 Proceedings, edited volume (workshop proceedings), published by Springer, 2022, First Edition.
5. Foundations of Statistical Natural Language Processing. Cambridge, MA: MIT Press. 1999
6. Introduction to Natural Language Processing. Cambridge, MA: MIT Press. 2019 Handbook of Statistical Methods and Analyses in Sports, by Jim Albert, Mark E.
7. Glickman, Tim B. Swartz, and Ruud H. Koning, published by Chapman & Hall/CRC Press, 2017, First Edition.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Large Language Models**

**Vertical - 1**

**Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Large Language Models

**Course Code: CHMDSVI4**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course introduces the concepts and techniques behind Large Language Models (LLMs) used in modern AI systems. It covers topics such as tokenization, embeddings, transformer architectures, and prompt engineering, along with applications like semantic search and Retrieval-Augmented Generation (RAG). The course also explores methods for fine-tuning pretrained language models for tasks such as classification and text generation, enabling students to build and adapt LLM-based solutions for real-world applications.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To introduce the fundamental concepts of Large Language Models (LLMs) and their role in modern Natural Language Processing systems. <b>CO(A) 2.</b> To develop understanding of tokenization, embeddings, and transformer architectures <b>CO(A) 3.</b> that form the foundation of LLMs. <b>CO(A) 4.</b> To enable students to apply prompt engineering techniques for effective interaction with generative language models. <b>CO(A) 5.</b> To familiarize students with advanced LLM applications such as semantic search and Retrieval-Augmented Generation (RAG).	

	<p><b>CO(A) 6.</b> To provide knowledge of fine-tuning techniques for adapting pretrained language models to specific tasks such as classification and text generation.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Explain the working principles and architecture of Large Language Models.</p> <p><b>CO 2:</b> Apply tokenization and embedding techniques to represent textual data for language models.</p> <p><b>CO 3:</b> Design effective prompts to control and guide the output of generative language models.</p> <p><b>CO 4:</b> Implement LLM-based solutions such as semantic search and retrieval-augmented generation systems.</p> <p><b>CO 5:</b> Fine-tune pretrained language models for specific NLP tasks including classification and text generation.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Foundations of Large Language Models</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction to Large Language Models</b> <ol style="list-style-type: none"> <li>a) What is Language AI and Natural Language Processing evolution</li> <li>b) Historical development of Language AI and the emergence of Generative AI</li> <li>c) Representing language: Bag-of-Words and dense vector embeddings</li> <li>d) Types of embeddings and contextual representations</li> <li>e) Attention mechanism and transformer foundations</li> <li>f) Encoder-only vs Decoder-only models</li> <li>g) Training paradigm of Large Language Models</li> <li>h) Applications of LLMs and responsible development</li> <li>i) Interfacing with LLMs and generating initial outputs</li> </ol> </li> <li>• <b>Tokens and Embeddings</b> <ol style="list-style-type: none"> <li>a) LLM tokenization concepts</li> <li>b) Preparing input text for language models</li> <li>c) Tokenization methods: word, subword, character, and byte tokens</li> <li>d) Comparison of trained LLM tokenizers</li> <li>e) Token embeddings and contextual word embeddings</li> <li>f) Sentence and document embeddings</li> </ol> </li> </ul>

- g) Word embeddings beyond LLMs
- h) Word2Vec and contrastive training approaches
- i) Embeddings in recommendation systems

- **Architecture of Large Language Models**

- a) Overview of transformer architecture
- b) Inputs and outputs of transformer-based LLMs
- c) Components of the forward pass
- d) Sampling and decoding strategies
- e) Parallel token processing and context windows
- f) Key–value caching for faster generation
- g) Internal structure of transformer blocks
- h) Positional embeddings (RoPE) and architectural improvements

- **Prompt Engineering**

- a) Using text generation models
- b) Model selection and loading techniques
- c) Controlling model output
- d) Fundamentals of prompt engineering
- e) Structure and components of effective prompts
- f) Instruction-based prompting
- g) Advanced prompting strategies
- h) In-context learning and few-shot prompting
- i) Chain-of-thought reasoning
- j) Self-consistency and tree-of-thought prompting
- k) Output verification and constrained generation

## **UNIT II: LLM Applications and Fine-Tuning**

- **Advanced Text Generation and LLM Systems**

- a) Model I/O and loading quantized models using frameworks
- b) Chains and prompt templates for LLM workflows
- c) Multi-prompt chains and pipeline design
- d) Conversation memory in LLM applications

- e) Buffer memory and windowed conversation memory
- f) Conversation summarization methods
- g) LLM agents and multi-step reasoning systems
- h) ReAct-based agent workflows

- **Semantic Search and Retrieval-Augmented Generation**

- a) Overview of semantic search and retrieval systems
- b) Semantic search using language models
- c) Dense retrieval techniques
- d) Reranking strategies for search results
- e) Retrieval evaluation metrics
- f) Retrieval-Augmented Generation (RAG) architecture
- g) Transition from traditional search to RAG
- h) Grounded generation with LLM APIs
- i) RAG implementation with local models
- j) Advanced RAG techniques and evaluation

- **Fine-Tuning Representation Models**

- a) Supervised classification with transformer models
- b) Fine-tuning pretrained BERT models
- c) Freezing layers and transfer learning strategies
- d) Few-shot classification methods
- e) SetFit framework for efficient fine-tuning
- f) Continued pretraining with masked language modeling
- g) Named Entity Recognition tasks
- h) Dataset preparation for NER
- i) Fine-tuning models for NER applications

- **Fine-Tuning Generation Models**

- a) LLM training pipeline: pretraining, supervised fine-tuning, preference tuning
- b) Supervised fine-tuning (SFT) methods
- c) Full fine-tuning vs parameter-efficient fine-tuning (PEFT)
- d) Instruction tuning using QLoRA
- e) Instruction dataset preparation and templating

- f) Model quantization techniques
- g) LoRA configuration and training setup
- h) Training and merging model weights
- i) Evaluation of generative models
- j) Word-level metrics and benchmark evaluation
- k) Human and automated evaluation approaches
- l) Alignment techniques and RLHF
- m) Reward models for preference learning
- n) Direct Preference Optimization (DPO)

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / Evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Generative AI Revolution: Case Studies of Large Language Model Applications, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**REFERENCES:**

1. Hands-On Large Language Models Language Understanding and Generation by Jay Alammar and Maarten Grootendorst, Oreilly Publication , Edition 01 , 2024
2. LLM Engineer's Handbook by Paul Iusztin and Maxime Labonne, Pakt Publications,2024.
3. Natural Language Processing with Transformers Building Language Applications with Hugging Face, Oreilly, 2022
4. Building LLMs for Production by LOUIS-FRANÇOIS BOUCHARD et.al. 2024

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Social Media Analytics**

**Vertical - 1  
Major (Mandatory) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Social Media Analytics

**Course Code: CHMDSVI5**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Social Media Analytics introduces concepts and techniques for analyzing social media data and online social networks. The course covers graph theory, network measures, network models, and data mining essentials, followed by community analysis, information diffusion, influence, recommendation systems, and behavior analytics. Students learn to understand, model, and analyze individual and collective behavior in social media using data-driven approaches.
2	<b>Vertical 1</b>	Major (Mandatory)
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To introduce students to the fundamental concepts, challenges, and techniques involved in mining and analyzing social media and networked data. <b>CO(A) 2.</b> To develop students' ability to model, analyze, and interpret social networks and communities using network measures, network models, and data mining methods. <b>CO(A) 3.</b> To enable students to understand how information spreads in social media and how influence, homophily, and social interactions shape user behavior. <b>CO(A) 4.</b> To equip students with analytical techniques for building and evaluating recommendation systems and for analyzing individual and collective behavior in social platforms.	

8	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Analyze social networks using appropriate network measures, models, and data mining techniques to understand structure, behavior, and interactions.</p> <p><b>CO 2:</b> Apply community detection and evaluation methods to identify, analyze, and interpret communities and their evolution in social media data.</p> <p><b>CO 3:</b> Analyze information diffusion processes, influence patterns, and homophily effects in social media using appropriate analytical models.</p> <p><b>CO 4:</b> Design and evaluate social media recommendation and behavior analytics solutions by applying data-driven and social-context-based methods.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I:</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction:</b> Social Media Mining, Challenges for Mining</li> <li>• <b>Network Measures:</b> Centrality, Transitivity and Reciprocity, Balance and Status, Similarity</li> <li>• <b>Network Models:</b> Properties of Real-World Networks, Random graphs, Small-World Model, Preferential Attachment Model</li> <li>• <b>Data Mining Essentials:</b> Data, Data Processing, Data Mining Algorithms, Supervised Learning, Unsupervised Learning</li> <li>• <b>Community Analysis:</b> Community Detection, Community Evolution, Community Evaluation</li> </ul> <p><b>UNIT II:</b></p> <ul style="list-style-type: none"> <li>• <b>Information Diffusion in Social Media:</b> Herd Behaviour, Information Cascades, Diffusion of Innovations, Epidemics</li> <li>• <b>Influence and Homophily:</b> Measuring Assortativity, Influence, Distinguishing Influence and Homophily</li> <li>• <b>Recommendation in Social Media:</b> Challenges, Classical Recommendation Algorithms, Recommendation Using Social Context</li> <li>• <b>Behaviour Analytics:</b> Individual Behaviour, Collective Behaviour</li> </ul>

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No	Structure of the Questions	Marks
1	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 1)	15
2	Answer ANY THREE out of SIX. (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / evaluation	Marks
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Exploring AI Tools for Social Media Analytics, Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

11

**REFERENCES:**

1. Liu, H., Abbasi, M. A., & Zafarani, R. (2014). Social media mining: An introduction. Cambridge University Press.
2. Easley, D., & Kleinberg, J. (2017). Networks, crowds, and markets: Reasoning about a highly connected world (3rd ed.). Cambridge University Press.
3. Hansen, D., Shneiderman, B., Smith, M., & Himelboim, I. (2019). Analysing social media networks with NodeXL (2nd ed.). Morgan Kaufmann.
4. Choudhury, M. D., & De Choudhury, M. (2018). Social media analysis: Techniques and applications. Springer.

- |  |  |
|--|--|
|  | <ol style="list-style-type: none"><li>5. Barabási, A.-L. (2016). Network science. Cambridge University Press.</li><li>6. Aggarwal, C. C. (2016). Social network data analytics. Springer.</li><li>7. Feldman, R., &amp; Sanger, J. (2007). The text mining handbook: Advanced approaches in analyzing unstructured data. Cambridge University Press.</li></ol> |
|--|--|

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Robotics Process Automation Practical**

**Vertical - 1  
Major (Elective) Course - 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Robotics Process Automation Practical

**Course Code: CHMDSVI6**

Sr. No.	Heading	Particulars
1	<b>Description the Course:</b>	<p>The course introduces the principles of Robotic Process Automation (RPA) and focuses on building automation workflows that mimic human interactions with digital systems. Students learn to analyze business processes, identify automation opportunities, and develop software robots that automate repetitive and rule-based tasks across desktop, web, and enterprise applications.</p> <p>The curriculum covers essential RPA development concepts such as workflow design, variables and arguments, control flow, data manipulation, UI automation, Excel and email automation, and file handling. It also emphasizes advanced topics including exception handling, debugging, logging, and best practices for developing scalable and maintainable automation solutions.</p>
2	<b>Vertical 1</b>	Major (Elective)
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b> <b>CO(A) 1.</b> To introduce the fundamental concepts of Robotic Process Automation (RPA), its architecture, and its role in improving organizational efficiency through the automation of rule-based business processes. <b>CO(A) 2.</b> To develop the ability to analyze business processes, identify automation opportunities, and design suitable automation solutions using RPA technologies. <b>CO(A) 3.</b> To enable students to design, develop, and implement automation workflows using	

	<p>UiPath Studio and its activities for business process automation.</p> <p><b>CO(A) 4.</b> To provide practical skills in automating web, desktop, file, and spreadsheet-based tasks while integrating automation workflows with enterprise systems and applications.</p> <p><b>CO(A) 5.</b> To equip students with techniques for debugging, exception handling, logging, deployment, and centralized management of automation workflows using tools such as UiPath Orchestrator.</p>
<p><b>8</b></p>	<p><b>Course Outcomes:</b> Student will be able to</p> <p><b>CO 1:</b> Explain the fundamental concepts, architecture, applications, and business benefits of Robotic Process Automation (RPA).</p> <p><b>CO 2:</b> Analyze business workflows, identify automation opportunities, and design appropriate automation strategies for process improvement.</p> <p><b>CO 3:</b> Develop and implement automation workflows using UiPath Studio activities and components for business process automation.</p> <p><b>CO 4:</b> Apply automation techniques for data manipulation, web automation, file handling, spreadsheet operations, and integration with enterprise applications.</p> <p><b>CO 5:</b> Utilize debugging, exception handling, logging, deployment, scheduling, and monitoring techniques to build, manage, and maintain reliable automation solutions using tools such as UiPath Orchestrator.</p>
<p><b>9</b></p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Introduction to RPA</b></p> <ul style="list-style-type: none"> <li>• <b>RPA Basics and Workflow Creation</b> <ol style="list-style-type: none"> <li>a) Create a Sequence workflow that displays the message “Welcome to RPA Automation”.</li> <li>b) Create a Flowchart workflow that prints numbers from 1 to 5 using WriteLine activity.</li> <li>c) Create a workflow using State Machine.</li> <li>d) Create variables of types String, Integer, Boolean, and DateTime and display their values.</li> <li>e) Create variables to store two numbers and calculate their sum, difference, product, and quotient.</li> </ol> </li> </ul>

- f) Use Input Dialog activity to accept a number from the user and display the square of that number.
- g) Create a workflow that stores user input in variables and displays formatted output using Message Box.

- **Variables, Arguments and Data Types**

- a) Demonstrate the use of Array and List variables.
- b) Create and use DataTable variable.
- c) Create an array containing at least 10 names and count how many names start with the letter "A".
- d) Demonstrate variable scope in workflows.
- e) Pass values between workflows using Arguments.
- f) Perform data type conversion using Assign activity.

- **Control Flow Activities**

- a) Create a Switch activity that takes a number (1–7) as input and displays the
- b) corresponding day of the week.
- c) Create a loop that prints numbers from 1 to 10, but stops execution after number 5 using Break.
- d) Create an automation using Do While activity to print numbers from 5 down to 1.
- e) Create two WriteLine activities separated by a Delay activity of 5 seconds.
- f) Create an automation that takes a number as input and checks whether the number is even or odd using an If condition.
- g) Demonstrate nested loops for data processing.

- **Recording Automation**

- a) Use "Use Application/Browser" to open Notepad and type text.
- b) Use Indicate Target on Screen to automate button clicks.
- c) Automate a web search using Modern UI Automation activities.
- d) Extract text from a webpage using Get Text activity.
- e) Use Data Scraping wizard to extract tabular data from a website.
- f) Open a news website. Extract the headline of the first news article. Extract the publication date. Extract the author name if available. Display extracted

information using Message Box.

- **Excel Automation**

- a) Read data from an Excel sheet containing student marks and store it in a DataTable.
- b) Write the value “Automation Completed” into a specific Excel cell (e.g., B5).
- c) Read the value of a specific Excel cell and display it using Message Box.
- d) Append a new row containing student details into the Excel sheet.
- e) Count rows and columns in Excel sheet.
- f) Display extracted data using Message Box.

- **UI Automation Controls**

- a) Use Attach Window activity to automate typing text inside Notepad and display the typed text.
- b) Use Attach Browser activity to open a website containing a registration form and automatically enter user details such as name, email, etc.
- c) Use Element Exists activity to check whether the confirmation message or submit button appears after form submission and display the result.
- d) Use Find Children activity to retrieve all UI elements from a selected webpage or application window and count the number of elements detected. Also, display these elements in Output panel.
- e) Automate a data-entry task to the RPA Challenge ([www.rpachallenge.com](http://www.rpachallenge.com)), where field positions change, by identifying input fields using Anchor Base activity.
- f) Use Get Ancestor activity to identify the parent container of a selected UI element on a webpage.

- **Excel Automation – Advanced**

- a) Sort the Excel table based on marks column in descending order.
- b) Filter the Excel table to display only students whose marks are greater than 60.
- c) Extract specific rows using DataTable filtering.
- d) Create automation to calculate totals in Excel.
- e) Read multiple sheets from Excel file.

- f) Export processed data into a new Excel file.

## **UNIT II: Modern Design – RPA**

- **Data Manipulation in UiPath**

- a) Create an automation that creates a DataTable with columns (Name, Age, City) and programmatically adds at least five rows of data, then displays the table content using a loop.
- b) Create an automation that reads student data from an Excel file into a DataTable and displays each row using For Each Row activity.
- c) Create an automation that filters employees whose salary is greater than 50,000 from a DataTable and stores the filtered results in another DataTable.
- d) Create an automation that reads employee data into a DataTable, increases the salary of all employees by 10%, and updates the values in the table.
- e) Create an automation that compares two DataTables (Old Employee List and Updated Employee List) and identifies newly added records.
- f) Create an automation that converts a DataTable containing product names and prices into a dictionary where the product name is the key and price is the value.
- g) Create an automation that groups sales data by region and calculates total sales for each region, then writes the summary to Excel.

- **Keyboard and Mouse Events**

- a) Create automation that performs Click, Double Click, and Hover actions on an application.
- b) Use Type Into activity to enter text automatically into a text editor.
- c) Use Type Secure Text activity to enter a password field.
- d) Use Send Hotkey activity to perform Ctrl+C and Ctrl+V operations.
- e) Create automation that triggers when a specific UI element appears on screen using Element Trigger.
- f) Create automation that triggers when a specific image appears using Image Trigger.

- **Screen Scraping and Web Scraping**

- a) Extract text from desktop application: Create an automation that opens Notepad, types a paragraph, and then uses Get Text activity to extract the displayed text and show it in a Message Box.
- b) Extracting Full Text from a Desktop Window: Create an automation that opens a desktop application (e.g., Calculator or Notepad) and uses Get Full Text activity to extract all visible text from the application window and display it.
- c) Extracting Text Using OCR: Create an automation that opens an image file containing text and uses Get OCR Text activity to extract the text and display the extracted result.
- d) Web Scraping of Product Information: Create an automation that opens an e-commerce website using Use Application/Browser activity, extracts product names and prices, and stores the extracted data in an Excel file.
- e) Extracting News Headlines from a Website: Create an automation that opens a news website, extracts the top five news headlines using Get Text activity, and displays them using WriteLine.
- f) Extracting Tabular Data from a Website: Create an automation that opens a webpage containing tabular data, uses the Data Scraping wizard, and stores the extracted table in an Excel sheet.

- **PDF Automation**

- a) Read text from a Scanned PDF document using OCR activity.
- b) Merge three PDF files into a single PDF document.
- c) Extract invoice number and date from a PDF and store them in Excel.
- d) Create automation to count the number of pages in a PDF using Count Pages activity.
- e) Create automation to extract all invoice numbers from a PDF document using Regular Expression activity.
- f) Split PDF into individual pages.

- **Exception Handling**

- a) Create an automation that divides two numbers entered by the user. Use a Try-Catch activity to handle the situation when the denominator is zero and

display an appropriate error message.

- b) Create an automation that reads data from a text file. If the file does not exist, catch the exception and display the message “File not found”.
- c) Create an automation that converts a string to an integer. Use exception handling to manage the case when the string contains non-numeric characters.
- d) Create an automation that reads data from an Excel file. If the Excel file is already open or inaccessible, handle the exception and log an error message.
- e) Create an automation that clicks a button on a webpage. If the UI element is not found, catch the exception and display a message indicating the element was not detected.
- f) Create an automation where a custom exception is thrown when the entered age is less than 18, and display a message stating that the user is not eligible.
- g) Create an automation that opens a file and reads its content. Ensure that the Finally block closes the file or performs cleanup operations regardless of whether an exception occurs.
- h) Create an automation that performs a series of operations (file read, data processing, and output) and logs any exception details using Log Message activity.

- **Email Automation**

- a) Configure email account in UiPath.
- b) Read unread emails from inbox.
- c) Send email with attachment.
- d) Save email attachments to folder.
- e) Reply to received emails automatically.
- f) Filter emails based on subject line.

- **File and Folder Automation**

- a) Create new folders automatically.
- b) Move files between folders.
- c) Rename files automatically.
- d) Delete unwanted files.
- e) Monitor folder for new files.

f) Organize files based on file type.

- **Orchestrator Fundamentals**

- a) Publish automation project to UiPath Orchestrator.
- b) Create process in Orchestrator.
- c) Run jobs from Orchestrator.
- d) Monitor bot execution.
- e) Schedule automation jobs.
- f) View logs and job results.
- g) Queue Management in Orchestrator

- **Mini Project (Any 1): Academic / Education Automation**

- a) Student Result Processing and Report Generation Bot
- b) Automated Attendance Data Processing System
- c) Student Admission Form Automation Bot
- d) Academic Notice Web Scraper and Notification Bot

- **Web Automation Projects:**

- a) Automated Job Portal Data Extraction Bot
- b) Online Product Price Monitoring and Comparison Bot
- c) News Headlines Web Scraping and Daily Email Report Bot
- d) Automated Website Form Filling Bot

- **Business Process Automation**

- a) Invoice Processing and Excel Report Generation Bot
- b) Purchase Order Data Extraction and Processing Bot
- c) Customer Feedback Data Collection and Summary Bot
- d) Sales Data Consolidation and Reporting Automation

- **Document Processing Projects**

- a) PDF Invoice Data Extraction and Validation Bot
- b) Automated Resume Screening and Candidate Data Extraction Tool
- c) Document Data Extraction and Excel Database Update Bot

- **Email and File Automation**

- a) Automated Email Attachment Downloader and File Organizer
- b) Email Notification Monitoring and Response Bot

- **UI Automation Projects**

- Automated Data Entry Bot for Desktop Applications
- Dynamic Web Data Entry Bot (RPA Challenge Automation)
- System Log Monitoring and Alert Notification Bot

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Unit 1	13
Q2	Unit 2	12
Q3	Journal and Viva	05
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

	Assessment / Evaluation	Marks
1.	The internal evaluation will be determined by the completion of practical tasks and the submission of corresponding write-ups for each session. Each practical exercise holds a maximum value of 5 marks. The total evaluation, out of 100 marks, should be scaled down to a final score of <b>10 marks</b> .	10
2.	Integrated AI-Based Business Process Automation System using RPA and Data Analytics, Project, Self-Learning Evaluation, Presentation, etc.	10
		<b>Total: 20</b>

**REFERENCES:**

1. Learning Robotic Process Automation – Alok Mani Tripathi
2. Robotic Process Automation using UiPath StudioX – Adeel Javed
3. Robotic Process Automation Projects – Nandan Mullakara

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B. Sc.  
(Data Science)**

**Semester- VI**

**Title: Management Information Systems Practical**

**Vertical - 1  
Major (Elective) Course- 2 Credits**

**with effect from  
Academic Year 2026-2027**

## Title: Management Information Systems Practical

**Course Code: CHMDSVI7**

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	Management Information Systems (MIS) is an academic discipline and course of study that explores the intersection of business, people, organizations, and information technology. It focuses on how to effectively use data, systems, and technology to support managerial decision-making, improve business processes, and create competitive advantages for organizations.
2	<b>Vertical 1</b>	Major (Elective)
3	<b>Type &amp; Teaching Method</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To understand the role of Management Information Systems (MIS) in supporting organizational decision-making.</p> <p><b>CO(A) 2.</b> To learn how information systems collect, process, and manage business data effectively.</p> <p><b>CO(A) 3.</b> To develop the ability to use MIS tools for improving business operations and management control.</p> <p><b>CO(A) 4.</b> To understand the integration of technology, people, and processes in organizational information systems.</p> <p><b>CO(A) 5.</b> To analyze how MIS supports strategic planning and competitive advantage in organizations.</p>
8	<b>Course Outcomes:</b>	<p>Student will be able to</p> <p><b>CO 1:</b> To understand the basic concepts and importance of Management Information Systems (MIS) in organizations.</p> <p><b>CO 2:</b> To develop knowledge of how information systems support managerial decision-making.</p> <p><b>CO 3:</b> To learn the process of collecting, processing, and managing business information.</p>

**CO 4:** To understand the role of technology in improving business operations and management control.

**CO 5:** To analyze the use of MIS for effective planning, coordination, and organizational performance.

9

### Syllabus

**UNIT I:**

- Understanding Management Information System and its functional subsystem
- Identification of physical and conceptual structure of MIS.
- Understanding of Functional and Non-Functional Requirements Identification System Requirements and Design.
- System Design (ERD, DFD, Use case, Sequence Diagram, etc)
- Identify Information System, Its Types and Modules Identify Decision Support System, Its Users And Characteristics

**UNIT II:**

- Data Collections
- Data Cleaning, Processing and Integration
- Data Analysis (insights, trends, patterns, KPIs calculation)
- Report Dashboard.
- Recommendations / Suggestions base on analysis.

10

#### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks**

Format of Question Paper

Sr. No	Criteria	Marks
1.	System Study (Functional and Non-Functional Requirement)	5
2.	System Design	5
3.	Organization of Report	5
4.	Data Analysis and KPI study	5
5.	Presentation	5
6.	Viva	5

**Internal Examination: Continuous Evaluation - 20 marks**

	<b>Assessment / evaluation</b>	<b>Marks</b>
1.	Class Test- It should be conducted using any Learning Management System such as MOODLE. The test should have 10 MCQs which should be solved in a time duration of 20 minutes.	10
2.	Project, Self-Learning Evaluation, Presentation, etc.	10
	<b>Total</b>	<b>20</b>

**11****REFERENCES:**

1. Management Information Systems: Managing the Digital Firm, Kenneth C. Laudon, Jane P. Laudon, Pearson Education, 2016, 16th Edition
2. Management Information Systems, James A. O'Brien, George M. Marakas, McGraw-Hill Education, 2017, 10th Edition.
3. Management Information Systems. Robert Schultheis, Mary Sumner, McGraw-Hill Education, 2010, 20th Reprint.
4. Management Information Systems, V. M. Prasad, Pearson Education, 2005, 9th Edition
5. Introduction to Management Information Systems, J. R. Claggett, Robert G. Murdick, J. E. Ross, Prentice-Hall India, 2007, 3rd Edition
6. Essentials of Management Information Systems, Kenneth C. Laudon, Jane P. Laudon, Carol G. Traver, Pearson Education, 2023, 15th Edition.

## BOARD OF STUDIES (BOS) DATA SCIENCE

Sr No	Name of the Faculty	Designation
1.	Dr. Shiji Johnson	Assistant Professor, Smt. CHM College, Ulhasnagar
2.	Ms.Razia Khan	Assistant Professor, Smt. CHM College, Ulhasnagar
3.	Ms.Kalyani Patil	Assistant Professor, Smt. CHM College, Ulhasnagar
4.	Ms. Shailaja Rane	Assistant Professor, K.C College, HSNCB University, Churchgate
5.	Mr. Vinod Rajput	Assistant Professor, Birla College ,Kalyan
6.	Dr. Manoj Kavedia	Founder, Kaizen Futuretech

Name & Signature of the Ad-hoc BoS Chairperson: Dr.Shiji Johnson



Name & Signature of the Dean: Mr.Agi Thomas



**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year  
(Mathematics)**

**Semester- VI**

**Title: Basics of Mathematics in Real Life – V**

**Vertical - 2**

**Minor - 2 Credits**

**with effect from  
Academic Year 2026-2027**

### Course Code: CHMMATHVI12

Sr. No.	Heading	Particulars
1	<b>Description of the Course:</b>	This course gives a gentle introduction to one variable calculus, which is very helpful to students across various disciplines. Important concepts like convergence and recurrence relations are introduced. The linearization process that plays a vital role all across mathematics is introduced through the definition of differentiability. Important theorems based on this concept are presented. A quick flavour of integration, a key concept of mathematics, with extremely important applications is also given.
2	<b>Vertical 2</b>	Minor
3	<b>Type &amp; Teaching Method</b>	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	30 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<p><b>CO(A) 1.</b> To develop the notion of recurrence</p> <p><b>CO(A) 2.</b> To identify sequences that are convergent</p> <p><b>CO(A) 3.</b> To associate a Taylor series expansion to differentiable functions</p> <p><b>CO(A) 4.</b> To recognize the importance of continuity and differentiability in locating zeroes of functions.</p>
8	<b>Course Outcomes:</b> Student will be able to:	<p><b>CO 1:</b> Understand and remember definitions and examples of sequences, convergence, differentiability, derivatives, and integration.</p>

	<p><b>CO 2:</b> Apply rules of sequences, recurrence relations, differentiation, and integration to solve standard and real-life problems.</p> <p><b>CO 3:</b> Analyze the behavior of sequences and functions, including convergence, differentiability, and extrema. OC4: to outline methods to find zeroes of functions</p> <p><b>CO 4:</b> Justify/check results using logical reasoning, limit arguments, and standard theorems of calculus.</p> <p><b>CO 5:</b> Construct recurrence relations, Taylor expansions, and mathematical models for real-life applications.</p>
<p>9</p>	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I</b></p> <ul style="list-style-type: none"> <li>• Sequences of real numbers and examples</li> <li>• Convergence of a sequence of real numbers: definition</li> <li>• Examples of convergent sequences</li> <li>• Examples of non-convergent (divergent) sequences</li> <li>• Sums and products of sequences (convergent sequences)</li> <li>• Sums and products of sequences (not necessarily convergent)</li> <li>• Sandwich theorem for sequences and applications</li> <li>• Sequences defined by recurrence relation: definition and examples</li> <li>• Statement for existence of solution of homogeneous recurrence relation (without proof)</li> <li>• Examples of solving homogeneous recurrence relations: linear and quadratic</li> <li>• Examples of solving homogeneous recurrence relations: cubic and quartic</li> <li>• Examples of non-homogeneous recurrence relations and statement for existence of solution.</li> <li>• Non homogeneous recurrence relation examples (root does not match with root of the associated characteristic polynomial)</li> <li>• Non homogeneous recurrence relation examples (root matches with a root of the associated characteristic polynomial)</li> <li>• Setting up recurrence relations in simple examples</li> </ul> <p><b>UNIT II</b></p> <ul style="list-style-type: none"> <li>• Definition of differentiability of a function</li> </ul>

- Examples of differentiable and non-differentiable functions
- Calculation of the derivative using first principles: simple examples
- Sums, products of differentiable functions are differentiable (with proofs)
- Ratios of differentiable functions are differentiable (with proof)
- Applications of the above rules in various examples and intermediate value property
- Examples of functions which are differentiable finitely many times and those which are differentiable infinitely many times.
- Rolle's theorem (only statement) and applications
- Cauchy and Lagrange's mean value theorems and applications (only statements)
- Derivative of the inverse of a function and examples
- Taylor expansion of a function at a point: definition and remainder term
- Examples for computation of Taylor series of functions
- Applications of derivatives in real life problems (finding maxima, minima)
- Definition of (Riemann) integration and examples
- Basic properties of Riemann integration and easy examples

10

**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 1:00 hour**

Format of Question Paper

Q. No.	Structure of the Questions	Marks
1	Attempt ANY THREE (out of five/Six). (Each question of 5 marks, based on unit 1)	15
2	Attempt ANY THREE (out of five/Six). (Each question of 5 marks, based on unit 2)	15
	<b>Total</b>	<b>30</b>

**Internal Examination: Continuous Evaluation - 20 marks**

**Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)

	Sr.No.	Particulars	Marks
	1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
	2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
	3	Seminar/ group presentation on any one topic related to the syllabus.	05
	<p><b>Paper pattern of the Test (Offline Mode with One hour duration):</b></p>		
	<p>Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1).</p>		
	<p>Q2: Attempt any 2 from 3 Descriptive questions. (06 marks: 2 × 3)</p>		
<p><b>11</b></p>	<p><b>REFERENCES:</b></p>		
	<ol style="list-style-type: none"> <li>1. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons.</li> <li>2. Kenneth Rosen, Discrete Mathematics and its applications, McGraw Hill.</li> <li>3. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons.</li> <li>4. Brualdi, Richard A., Introductory Combinatorics, Pearson Education.</li> </ol>		

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year  
(Mathematics)**

**Semester- VI**

**Title: Practical Based on Basics of Mathematics  
in Real Life – V**

**Vertical - 2  
Minor - 2 Credits**

**with effect from  
Academic Year 2026-2027**

**Title: Practical Based on Basics of Mathematics in Real Life – V**

**Course Code: CHMMATHVI13**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
1	<b>Description of the Course:</b>	This course is based on problem-solving which is a fundamental aspect of any Mathematics course. While advanced courses often emphasize the theoretical nature of the subject, engaging in problem-solving reinforces concepts and enhances learners' ability to analyze existing problems and devise solutions. This activity not only motivates learners but also empowers them to formulate new results, propose conjectures, and develop innovative theories.
2	<b>Vertical 1</b>	Minor
3	<b>Type</b>	Practical
4	<b>Credit</b>	2 Credits
5	<b>Hours allotted</b>	60 Hours
6	<b>Marks allotted</b>	50 Marks
7	<b>Course Objectives:</b>	<b>CO(A) 1.</b> To develop the notion of recurrence <b>CO(A) 2.</b> To identify sequences that are convergent <b>CO(A) 3.</b> To associate a Taylor series expansion to differentiable functions <b>CO(A) 4.</b> To recognize the importance of continuity and differentiability in locating zeroes of functions

8	<p><b>Course Outcomes:</b> Student will be able to:</p> <p><b>CO 1:</b> Apply rules of sequences, recurrence relations, differentiation, and integration to solve standard and real-life problems.</p> <p><b>CO 2:</b> Analyze the behavior of sequences and functions, including convergence, differentiability, and extrema.OC4: to outline methods to find zeroes of functions</p> <p><b>CO 3:</b> Justify/check results using logical reasoning, limit arguments, and standard theorems of calculus.</p> <p><b>CO 4:</b> Construct recurrence relations, Taylor expansions, and mathematical models for real-life applications.</p>
9	<p style="text-align: center;"><b>Syllabus</b></p> <p><b>UNIT I: Practical based on sequences and recurrence relations (30 Hours)</b></p> <ul style="list-style-type: none"> <li>• Convergence of sequences of real numbers</li> <li>• Arithmetic of convergent sequences</li> <li>• Applications of sandwich theorem and divergent sequences</li> <li>• Homogeneous recurrence relations: degree one and two</li> <li>• Homogeneous recurrence relations: degree three and four</li> <li>• Non homogeneous recurrence relations</li> <li>• Examples of setting up recurrence relations</li> </ul> <p><b>UNIT II: Practical based on Differentiability and Integrability of functions (30 Hours)</b></p> <ul style="list-style-type: none"> <li>• Differentiability: examples from first principles</li> <li>• Arithmetic of differentiable functions</li> <li>• Derivate of the inverse of a function</li> <li>• Applications of Rolle’s theorem and Mean value theorems</li> <li>• Taylor expansion of functions at a point</li> <li>• Applications of derivatives: maxima and minima</li> <li>• Applications of derivatives: further examples</li> <li>• Computations of simple integrals</li> </ul>

### Scheme of Examination and Assessment Pattern

Paper – 50 Marks

**External Examination: Semester End External - 30 marks Time: 2:00 hour**

Format of Question Paper

Question	Based On	Marks
Q1	Five out of Eight multiple choice questions (four from Unit 1 and four from Unit 2) (LO1 to LO3)	(3 × 5 = 15 Marks)
Q2	Attempt any Two out of Four (Two from Unit 1 and two From Unit 2). (LO 3 and LO 4)	(5 × 2 = 10 Marks)
Q3	Journal	5 (2.5 marks for each Unit 1 & Unit 2)
		<b>Total: 30</b>

**Note:**

- **Certified Journal is compulsory** for appearing at the time of Practical Exam, failing which they will not be allowed to appear for the examination.
- Students are required to perform 75% of the Practicals for the journal to be duly certified. The journal serves as a record of their practical work and is essential component of the evaluation process.

**Internal Examination: Continuous Evaluation - 20 marks**

**Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)

	Assessment / Evaluation	Marks
1.	Objective question test	10
2.	Overall performance	5
3.	Viva	5
		<b>Total: 20</b>

	<p><b>Paper pattern of the Test (Offline Mode):</b></p> <p>Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: <math>5 \times 2</math>)</p> <p>Duration: 1Hrs</p> <p>While setting question paper four MCQ on module 1 and four MCQ on module 2 both.</p>
<b>11</b>	<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"><li>1. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons.</li><li>2. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons.</li><li>3. Thomas and Finney, Calculus and Analytical Geometry, Pearson</li><li>4. Ajit Kumar and S. Kumaresan, A basic course in real analysis, Chapman and Hall</li><li>5. B. V. Limaye and Sudhir Ghorpade, A course in calculus and real analysis, Springer Nature</li></ol>

**HSNC Board's  
Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)  
(Affiliated to the University of Mumbai)**

**Board of Studies (BoS) Mathematics**

<b>Sr. No.</b>	<b>Name of the Faculty</b>	<b>Designation and College</b>
1.	Ms. Urmila Pillay	Head and Associate Professor, Department of Mathematics, Smt. CHM College (Autonomous)
2.	Mr. Amish Thakker	Associate Professor, Smt. CHM College (Autonomous)
3.	Ms. Asha Chugh	Associate Professor, Smt. CHM College (Autonomous)
4.	Mr. Mandar Khasnis	Associate Professor, Smt. CHM College (Autonomous)
5.	Dr. Dipak Jadhav	Associate Professor, Smt. CHM College (Autonomous)
6.	Ms. Pooja Rajani	Assistant Professor, Smt. CHM College (Autonomous)
7.	Mr. Salil Sawarkar	Assistant Professor, Smt. CHM College (Autonomous)
8.	Mrs. Usha Hemasundar	Outside University nominee Head and Associate Professor, K.C. College, Churchgate
9.	Dr. Pankit Gandhi	Outside University nominee Professor, K.C. College, Churchgate
10.	Ms. Minal Wankhede	Vice Chancellor Nominee Head and Associate Professor, B.N. Bandodkar College, Thane
11.	Mr. Mandar Dongare	Industry Representative Senior Manager, Customer Success, Teradata India Pvt. Ltd.
12.	Ms. Supriya Bhagat	Alumni Representative Senior Product Data Scientist, Project pro

Name and Signature of the Ad hoc BoS Chairperson: Ms. Urmila Pillay



Name and Signature of the Dean:

Dr. Neena Anand

