HYDERABAD (SIND) NATIONAL COLLEGIATE BOARD

HSNC Board's
Smt. Chandibai Himathmal Mansukhani College
(Autonomous)
(Affiliated to the University of Mumbai)
University College Code : 217-JD Office : T14

Estd. 1965

Principal : Dr. Manju Lalwani Pathak

Ref. No: CHM (A) AC/02/2026-27
Date: 27th June, 2026

CIRCULAR

The immediate attention of all concerned is invited to this Office Circular No. CHM (A) AC 11/2026 dated 19th 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 Mathematics 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 Mathematics (SEM-I), S.Y.B.Sc in Mathematics (SEM-III) and F.Y.B.Sc in Mathematics (SEM-II) & S.Y.B.Sc in Mathematics (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 Mathematics coordinated by the Dean, Faculty of Pure Sciences in the meeting of Academic Council held on 20th 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 Mathematics, in continuation with syllabus of F.Y. B.Sc in Mathematics and S.Y.B.Sc in Mathematics of 2025-2026 (updated), and accordingly the same is attached for reference and is available on the College's website www.chmcollege.in

Ulhasnagar – 421003
27th 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 Pure Sciences
3. The Chairperson, Ad-hoc Board of Studies
4. The Controller of Examination
5. The Registrar

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science
(Mathematics)
(Aided)

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

PREAMBLE

Mathematics is often perceived as ‘calculations’ / ‘procedural’. This view, however, takes a turn when a learner enrolls in the undergraduate program. The most visible change being, emphasis on ‘proof based’ results.

Mathematics being pursued in this way for its intrinsic beauty and intellectual appeal leads to a strong conceptual understanding, critical reasoning skills and general problem-solving abilities which are valued in the industry too.

The three-year undergraduate program leading to a degree in BSc (Mathematics) offers a mix of courses in core areas of mathematics with abstract reasoning, with scope for the interplay between mathematics and its connections to related fields of statistics, computer science, IT, data science, finance etc.

The pedagogy involves balance between intuition and rigour, seeking meaning and insights behind formalism, exposure to applications, hands on math software tools etc. and aims to gently and gradually achieve a comfort level for the learner and open doors to pursue higher studies and diverse mathematical careers.

Faculty of Pure Sciences
Programme Outcomes
Upon completion of Bachelor of Science, learner will be able to :

PO1: **Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the chosen discipline, their concepts, theories, methods, and its interdisciplinary applications

PO2: **Critical Thinking and Analytical Reasoning:** Analyse issues critically, apply logical reasoning, and develop appropriate solutions

PO3: **Problem Solving and Scientific Skills:** Apply scientific methods to investigate and solve real life problems.

PO4: **Research Competence:** Formulate research questions, design and conduct investigations, collect and interpret data, apply appropriate statistical methods and communicate research findings effectively.

PO5: **Digital literacy:** Effectively use ICT, digital resources, computational tools, bioinformatics, artificial intelligence applications, and statistical software for scientific learning, research, and decision-making.

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 integrity, ethical conduct, biosafety, academic honesty, respect for intellectual property, and professional responsibility in scientific practice and research.

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 scientific knowledge, creativity, and entrepreneurial skills for employment and entrepreneurship.

Programme Specific Outcomes (PSOs)

Upon completion of the BSc (Mathematics) program, learners will be able to:

PSO1: Foundation in core Mathematical concepts

develop a sound foundation in core mathematical disciplines such as Single and Multivariable Calculus, Real and Complex Analysis, Linear Algebra, Abstract Algebra with both Group theory, Ring Theory and Topology of Metric Spaces with an emphasis on conceptual understanding, abstract reasoning, mathematical rigour and proof-based results.

PSO2: Application of Mathematical knowledge

build upon foundational mathematical principles and results to develop a deeper understanding of advanced mathematical concepts as well as apply mathematical, statistical framework to model and solve practical problems in interdisciplinary fields such as data analysis, network and graph theoretical optimization, machine learning, finance etc.

PSO3: Practical and computational Skills

use diverse computational platforms and programming languages such as Python, R, Java, and Excel to perform symbolic mathematical computing, data visualisation and data analysis.

PSO4: Enquiry based study

develop the skills for enquiry-based study and scientific investigation by exploring mathematical models through case studies and projects, validate AI findings wherever AI assistance is taken and communicate findings through structured reports and presentations.

PSO5: Career awareness and societal engagement

build readiness for higher education and gain the awareness and the initial background for potential careers in industry/ academics and research through case studies, projects, practical exposure etc including Community Engagement Projects (CEP) and On-Job Training (OJT).

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B.Sc.
(Mathematics)

Semester- I

Title: Algebra and Calculus – I

Vertical - 1
Major - 2 Credits

With effect from
Academic Year 2026-2027

Title: Algebra and Calculus – I
Course Code: CHMMTI1

<table>
<tr><th>Sr. No.</th><th>Heading</th><th>Particulars</th></tr>
<tr><td>1</td><td>Description of the Course</td><td>This course provides an introduction to fundamental concepts in discrete mathematics, mathematical analysis and elementary differential equations. Beginning with a study of functions, the course examines equivalence relations and their connection to partitions, divisibility, Euclidean algorithm, Fundamental Theorem of Arithmetic and polynomials. The second unit transitions to real analysis with a focus on the real number system, order properties, supremum/infimum, convergence of sequence, and differential equations.</td></tr>
<tr><td>2</td><td>Vertical 1</td><td>Major</td></tr>
<tr><td>3</td><td>Type
Teaching Method</td><td>Theory + Practicum
Lecture/group discussion/seminar/tech based learning etc.</td></tr>
<tr><td>4</td><td>Credit</td><td>2 Credits</td></tr>
<tr><td>5</td><td>Hours allotted</td><td>30 Hours</td></tr>
<tr><td>6</td><td>Marks allotted</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">Course Objectives:
CO(A) 1. To provide learners with an understanding of the basic concepts like relations and functions, direct and inverse images of sets, composition of functions, inverse of a function, equivalence relation.
CO(A) 2. To enable learners to understand and apply the concepts of integers and polynomials like division algorithm, Euclidean algorithm, roots of a polynomial and finite induction principles.
CO(A) 3. To impart knowledge about real number system among learners through its properties; the notion of sequences of real numbers, convergent sequences.
CO(A) 4. To develop learners’ ability to solve ordinary differential equations, their types and applications to the real world.</td></tr>
<tr><td>8</td><td colspan="2">Course Outcomes: Upon completion of the course, learner should be able to
CO 1 determine whether the given function is invertible; find range of a function, direct and inverse image of sets, composition of functions, inverse of a function (if exists), identify equivalence relation.
CO 2 apply Division and Euclidean algorithm to find gcd and lcm of two nonzero integers / polynomials; apply principle of finite induction to prove standard results; find roots of a polynomial with multiplicities.
CO 3 express a statement using quantifiers; state and prove properties of real number system, LUB property, absolute value; define and prove results about convergent sequence
CO 4 check the convergence of standard sequences and apply monotone convergence theorem; solve first order Ordinary Differential Equations using different techniques.</td></tr>
</table>

9	**Syllabus**

UNIT I: Relations, Functions, Integers and Polynomials

- Definition of relation and function, domain, codomain, range of a function, composition of functions, direct image$(\boldsymbol{f}(\boldsymbol{A}))$, inverse image $f^{-1}(B)$ for a function $f: X \to Y$, injective, surjective, bijective and invertible function.
- Equivalence relation and partition.
- Statements of well-ordering property of nonnegative integers, Principle of finite induction
- Divisibility in integers, Division algorithm, gcd of nonzero integers a and b, basic properties, Euclidean algorithm (examples only). Euclid's lemma, Fundamental Theorem of arithmetic (Statement only), infinitude of primes.
- Definition of polynomial, basic concepts and terminology of polynomial.
- Division algorithm in $\boldsymbol{F}[\boldsymbol{X}]$ (without proof), where $\boldsymbol{F} = \mathbb{Q}, \mathbb{R}, \mathbb{C}$, gcd of two polynomials, Euclidean algorithm (Statement and examples only)
- Roots of a polynomial function, relation between roots and coefficients, multiplicity of a root. Remainder theorem, Factor theorem. Rational Root Theorem and its Applications

UNIT II: Real Number System, Sequences and First Order Differential Equations

- Quantifiers, statements and their negations in terms of quantifiers. Real number system and order properties of $\mathbb{R}$, absolute value and its properties, intervals and neighbourhoods, Hausdorff property
- Bounded sets, supremum and infimum, characterization of supremum and infimum, statement of lub axiom and its consequences. Results about supremum, infimum. Archimedean property and its applications. Density of rationals (statement only)
- Definition of a sequence and examples, bounded sequences, convergence of sequences, results about convergent sequences. Monotone sequences, and monotone convergence theorem, examples.
- Order and degree of an ordinary differential equation, Homogeneous and Non-Homogeneous differential equations of first order and first degree. Linear ODE. Notion of partial derivatives
- Exact Differential Equations: General solution of exact differential equations of first order and first degree. Necessary and sufficient condition for $Mdx + Ndy = 0$ to be exact (statement only). Rules for finding integrating factors (without proof) for non-exact differential equations
- Applications of DEs through real life examples

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 References:

1. David M. Burton, ***Elementary Number Theory***, Seventh Edition, McGraw Hill Education (India) Private Ltd, 2023 - Chapters 1 (1.1), Chapter 2 (2.1, 2.2, 2.3), Chapter 3 (3.1), Chapter 4 (4.2)
2. Norman L. Biggs, ***Discrete Mathematics***, Revised Edition, Clarendon Press, Oxford 1989 – Chapter 1 (1.4, 1.5, 1.6, 1.7), Chapter 2 (2.1, 2.2), Chapter 5 (5.1, 5.2), Chapter 6 (6.1, 6.2, 6.3)
3. Ajit Kumar and S. Kumaresan, ***A Basic Course in Real Analysis***, CRC Press, 2014 – Chapters 1 and 2.
4. George F. Simmons, ***Differential Equations with Applications and Historical Notes***, Taylor's and Francis, Third Edition, 2017 – Chapters 1 and 2.
5. Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, ***A Foundation Course in Mathematics***, Narosa, 2018 – Chapter 1.
6. R. G. Bartle-D. R. Sherbert, ***Introduction to Real Analysis***, John Wiley & Sons, 1994
7. Sudhir Ghorpade and Balmohan Limaye, ***A course in Calculus and Real Analysis***, Springer International Ltd, 2000.
8. Richard R. Goldberg, ***Methods of Real Analysis***, Oxford & IBH Publishing, 2020.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

First Year B. Sc. (Mathematics)

Semester- I

Title: Practical based on Algebra and Calculus – I

Vertical - 1
Major - 2 Credits

With effect from
Academic Year 2026-2027

Title: Practical based on Algebra and Calculus – I
Course Code: CHMMTI2

Sr. No.	Heading	Particulars
1	**Description of the Course**	This practical course develops core skills in discrete Mathematics, real analysis and differential equations through problem-solving and applications. Learners will work with functions, equivalence classes, divisibility results and apply Euclidean algorithm to obtain gcd and lcm of non-negative integers and polynomials. Problems on properties of real number system, supremum/infimum and convergence of sequences will reinforce the concepts. Emphasis is placed on solving and interpreting differential equations in real-world contexts.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Group discussion/tech based learning/problem solving etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1.** To enable learners to understand and apply fundamental concepts of algebra such as relations, functions, equivalence relations, and divisibility in integers and polynomials. **CO(A) 2.** To develop skills among learners of using algorithmic methods like Euclidean algorithm, and to apply the theorems such as fundamental theorem of arithmetic and factor theorem to solve algebraic problems. **CO(A) 3.** To train learners to apply concepts in real analysis such as properties of real numbers, absolute value, boundedness, supremum, infimum, sequences and their properties for solving problems. **CO(A) 4.** To develop learners' ability to solve and analyze different types of differential equations.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** identify / prove properties of functions, relations, equivalence classes, and verify bijectivity and invertibility. **CO 2** apply Euclidean algorithms and theorems (like remainder and factor theorem) to solve problems involving integers and polynomials. **CO 3** find bounds, supremum, infimum of a set, state/prove results on bounded sets and properties of the subsets of real numbers; verify / find limit of a sequence and its properties.	

	CO 4 check and prove the behavior of sequences including monotonic sequences and Cauchy sequences; solve and apply Ordinary Differential Equations in real life problems related to physical and social sciences.
9	**Syllabus** **UNIT I: Practical based on Algebra** 1. Relations, functions, range of a function, direct and inverse image of a set 2. Injective, Surjective, Bijective and Invertible functions. 3. Equivalence relations and partitions 4. Principle of finite induction, Division algorithm, Euclidean algorithm in $\mathbb{Z}$ 5. Prime numbers, Fundamental theorem of Arithmetic 6. Division algorithm, Euclidean algorithm in $F[x]$ where $F = \mathbb{Q}, \mathbb{R}, \mathbb{C}$ 7. Relation between roots and coefficients, Applications of Rational root theorem. **UNIT II: Practical based on Calculus** 1. Quantifiers, properties of real numbers 2. Absolute value, intervals, neighborhood of a point 3. Bounded sets, supremum and infimum of a set, LUB property of $\mathbb{R}$; homogeneous DE 4. Archimedean property, density theorem; non-homogeneous DE 5. Sequences, examples of convergent, bounded sequences, Results on sequences, exact DE 6. Sandwich theorem, Monotone convergence theorem, Linear DE, non-exact DE 7. Cauchy sequences, subsequences; applications of DE **Case Study 1: Recommendation System using Relations and Functions** (1) Application: Recommendation System in Digital Platforms like YouTube, Netflix, Amazon or Spotify. (2) Mathematics Used: Relations, Functions, Domain, Codomain and Range, Direct and Inverse Image of a Function, Composition of Functions, Bijective/Invertible Functions (basic idea) **Case Study 2: Polynomial-based Prediction using Pattern Recognition** (1) Application: Prediction and Pattern Recognition in Intelligent Systems (2) Mathematics Used: Polynomial Functions, Algebra of Polynomials, Relation between Roots and Coefficients (basic idea), Polynomial Pattern Recognition, Rational Root Theorem (where applicable) **AI Tools Used:** AI chatbot tools (e.g., ChatGPT, Claude, Gemini or any other), AI-assisted learning tools (e.g.,NotebookLM) for conceptual understanding, and Python (Pandas/NumPy) for computational illustration.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks Time: 3 hours** Structure of Evaluation
11	**References:**

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 References:

1. David M. Burton, ***Elementary Number Theory***, Seventh Edition, McGraw Hill Education (India) Private Ltd, 2023- Chapters 1 (1.1), Chapter 2 (2.1, 2.2, 2.3), Chapter 3 (3.1), Chapter 4 (4.2)
2. Norman L. Biggs, ***Discrete Mathematics***, Revised Edition, Clarendon Press, Oxford 1989 – Chapter 1 (1.4, 1.5, 1.6, 1.7), Chapter 2 (2.1, 2.2), Chapter 5 (5.1, 5.2), Chapter 6 (6.1, 6.2, 6.3)
3. Ajit Kumar and S. Kumaresan, ***A Basic Course in Real Analysis***, CRC Press, 2014 – Chapters 1 and 2.
4. George F. Simmons, ***Differential Equations with Applications and Historical Notes***, Taylor's and Francis, Third Edition, 2017 – Chapters 1 and 2.
5. Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, ***A Foundation Course in Mathematics***, Narosa, 2018 – Chapter 1.
6. R. G. Bartle-D. R. Sherbert, ***Introduction to Real Analysis***, John Wiley & Sons, 1994
7. Sudhir Ghorpade and Balmohan Limaye, ***A course in Calculus and Real Analysis***, Springer International Ltd, 2000.
8. Deisenroth, Marc Peter; Faisal, A. Aldo; Ong, Cheng Soon, ***Mathematics for Machine Learning***, Cambridge University Press, 1st Edition, 2020.

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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, Ulhasnagar
CHM
(Autonomous)

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Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B.Com.
(Mathematics)

Semester- I

Title: Practical Statistics for Business - I

Vertical - 3
Open Elective - 2 Credits
Mandatory

With effect from
Academic Year 2026-2027

Title: Practical Statistics for Business – I
Course Code: CHMMTI3

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces foundational statistical concepts and data visualization techniques. Learners learn to classify and summarize various data types, construct visual representations, and apply descriptive statistics including measures of central tendency, dispersion, skewness, and kurtosis. Through real-world case studies, learners gain hands-on experience in data collection, analysis, and graphical interpretation using tools like bar diagrams, histograms, and box plots.
2	**Vertical 3**	Open Elective
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech based learning/problem solving etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: CO(A) 1. To introduce learners to fundamental statistical concepts and techniques applicable to business contexts. CO(A) 2. To develop skills in collecting, organizing, analysing, and graphically presenting data using statistical methods such as histograms and bar diagrams. CO(A) 3. To familiarize learners with statistical tools such as mean, median, mode, variance, and standard deviation, along with their applications in business. CO(A) 4. To facilitate analytical thinking through the interpretation of real-world datasets using statistical tools for decision-making.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain the fundamental statistical concepts and techniques used in business decision-making. **CO 2** apply statistical methods to collect, organize, analyze, and present business data using appropriate tabular and graphical tools. **CO 3** compute and analyze measures of central tendency and dispersion to interpret data variability. **CO 4** evaluate and interpret statistical measures from real-world datasets to support decision-making and justify conclusions.	

9	**Syllabus**

UNIT I: Types of Data and Visualization of Data

- Definition and scope of Statistics, Data, primary data, secondary data.
- Quantitative and qualitative data, Discrete and Continuous data.
- Frequency distribution, Inclusive and Exclusive types of frequency distribution.
- Graphical representation: Histogram, Frequency polygon, Frequency curve and Ogives.
- Diagrammatic representation: Bar diagram, Pie diagram.
- Case studies such as
  - To collect data about number of people watching different web channels such as Amazon-Prime, Netflix, Zee-5, Hotstar etc. and present the same in Bar Diagram or Pie Chart
  - To collect data about price of hotel rooms in ten cities in tourist seasons, off seasons and present the same in histogram.
    (Learners can take the help of AI (such as Copilot or Datawrapper) for drawing charts / plotting graphs)

Unit II: **Descriptive Measures and Data Summary**

- Measures of central tendency:
  - Mathematical averages: Arithmetic mean and its properties, weighted mean, combined mean and their merits and demerits.
  - Positional Averages: Median, Mode, and their merits and demerits.
- Measures of Dispersion:
  - Concept of dispersion. Standard deviation and Variance.
- Case Studies such as
  - To collect data about the runs scored by a particular player and wickets taken by a particular player in the recent IPL season, finding the mean, standard deviation and the coefficient of variation of each, and identifying more/less-consistent player between the two selected ones.
  - To collect a real-world data set of interest for you such as
    - Compensation – salary + bonus received by CEOs of major technology companies
    - Airline ticket prices
    - Expenditure on advertising by companies in different media – print, television, social media etc.
    - Salaries of MBAs in different fields like health management, hotel administration, sales management etc.
      Learners can take the help of AI (such as Juilius AI or Perplexity AI) for calculating mean / standard deviation, and for deriving conclusions.

Recommended that data be collected on different variables related to the area chosen by the learner, summarize the data and variability in it using the techniques covered in Unit 1, 2, represent the data measures on a histogram, and comment on the observations. Also, state with reason the measures that you would recommend for your data set and the purpose of study.

Technology integration: Use of spreadsheet like EXCEL is encouraged while doing case studies

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks

A. External Examination: Semester End External - 30 marks   Time: 1 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
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

Format of Question Paper

Sr. No.	Particulars	Marks
1	Test – MCQs /Answer in one sentence / Problems / Match the pairs / Puzzles etc.	10
2	Mini-project / Case study / Presentation / Open book test / Flipped classroom etc.	10
	Total	**20**

11

References:

1. Prem Mann: Introductory Statistics (7th Ed), JOHN WILEY & SONS, INC
2. Gupta S. P.: Statistical Methods, S. Chand and Sons
3. Goon A.M., Gupta M.K., Dasgupta B.: Fundamentals of Statistics, Volume II: The World Press Private Limited, Calcutta (1968).
4. Kothari C.R.: Research Methodology, Wiley Eastern Limited, Second Edition. (2004)
5. Agarwal B.L. : Basic Statistics, New Age International Ltd.
6. Spiegel M.R. : Theory and Problems of Statistics, Schaum' s Publications series. Tata McGraw-Hill.
7. Elhance D. N, Elhance V, Aggarwal B. M, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi, 2018.
8. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

First Year

Semester- I

Title: Data Analysis with Excel

Vertical - 3
Open Elective - 2 Credits
Choice Based

with effect from
Academic Year 2026-2027

Title: Data Analysis with Excel

Course Code: CHMMTI4

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course offers opportunity to the learners to get acquainted with various tools of Microsoft Excel to analyse the data. It introduces learners to various functions and formulae in Excel and further equips them to learn how to perform statistical analysis of data using Excel. By integrating concepts with real-life examples and through a project, the course equips the learners with relevant industry skills for data analysis. The course also touches upon few AI tools in Excel.
2	**Vertical 3**	Open Elective Choice Based
3	**Type** **Teaching Method**	Theory + Practical Lecture/Hands on lab sessions /mini case study / tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** Get introduced with Microsoft Excel, different data types in Excel, creating and navigating worksheet. **CO(A) 2** Learn various functions and formulae in Excel **CO(A) 3** Understand how to use Excel tools for data analysis **CO(A) 4** Use certain AI tools available in Excel to work with the data	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** perform basic spreadsheet tasks including navigation, filling data in different formats, web scraping **CO 2** use functions such as XLOOKUP, IF, FILTER, SUMIF and construct formulae in Excel **CO 3** analyze the data using tools in Excel such as pivot tables, slicers, interactive charts **CO 4** apply certain AI tools like FlashFill, PowerQuery in Excel to enhance efficiency.	

9	**Syllabus** **UNIT I: Excel functions and formulae** Basic spreadsheet tasks including navigation, types of data, web scraping; Quick ways to add data using Auto complete, Auto correct, Auto fill, Autosum; conditional formatting, data cleaning ▪ Formulae in excel, relative and absolute reference ▪ Functions in Excel: VLOOKUP, XLOOKUP, CHOOSECOLS, INDEX, IFERROR, SQRT, UNIQUE, FILTER **UNIT II: Excel tools for Data Analysis** Statistical Functions in Excel: COUNTIFS, SUMIFS, AVERAGEIFS, SMALL, LARGE ▪ Introduction to Pivot table, Slicers, Timelines, Interactive Charts, Pivot Charts, KPIs, DAX ▪ AI tools in Excel such as FlashFill, PowerQuery.
10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks Time: 1 hour** (see table A below) **B. Internal Examination: Continuous Evaluation - 20 marks** (see table B below)
11	**References:** (see list below)

A. External Examination: Semester End External - 30 marks   Time: 1 hour

Q. No.	Pattern of the Practical exam	Marks
1	Perform any ONE from Q1, Q2	8
2	Perform any ONE from Q3, Q4	10
3	Objectives / MCQs	12
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

Sr. No.	Pattern of the exam	Marks
1	Mini case study	10
2	Practical exam (hands-on) in the lab OR Test	10
	Total	**20**

References:

1. M. L. Humphrey, Excel 2024 for Beginners, 2025
2. Ian Lamont, Excel Basics In 30 Minutes, 3rd Edition, i30 media corp, 2015
3. Michael McDonald, 200+ Excel Formulas and Functions, BPB publication, 2023
4. Paul McFedries, Microsoft Excel: Formulas and Functions (Office 2021 and Microsoft 365), Pearson Education, 2022
5. Wayne L. Winston, Microsoft Excel Data Analysis and Business Modeling (Office 2021 and Microsoft 365), 7th Edition, PHI, 2024
6. George Mount, Modern Data Analytics in Excel, O'Reilly Media, Inc., 2024
7. Simon Johnson, AI in Excel for Beginner: A Comprehensive Steps-by-Steps Guide, Kindle Edition

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Mathematics)

Semester- I

Title: **Basics in Python Programming**

VSC
(As per NEP 2020)
2 Credits

with effect from
Academic Year 2026-2027

Title: **Basics in Python Programming**

(Course Code : CHMMTI5)

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces learners to the fundamentals of Python programming and the basic concepts of Artificial Intelligence (AI). Learners will learn essential programming constructs such as variables, data types, operators, control structures, strings, lists, and file handling. The course also provides hands-on experience with Python libraries such as NumPy and Pandas and demonstrates simple AI applications through rule-based systems and practical case studies. Ethical aspects and responsible use of AI are also discussed.
2	**Vertical**	VSC
3	**Type** **Teaching Method**	Practical Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1.** To introduce the fundamental concepts of Python programming, including variables, data types, operators, control structures, strings, lists, and file handling. **CO(A) 2.** To develop learners' programming skills for designing and implementing Python programs to solve basic computational problems. **CO(A) 3.** To enable learners to understand the fundamentals of Artificial Intelligence, AI ethics, and the use of Python libraries for AI applications. **CO(A) 4.** To facilitate the application of Python programming and AI concepts in developing simple intelligent systems through practical case studies.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** Remember the fundamental concepts of Python programming, including data types, operators, control structures, strings, lists, and file handling. **CO 2** Apply Python programming constructs to develop programs involving decision-making, looping, file operations, and basic data processing. **CO 3** Explain the concepts of Artificial Intelligence, AI ethics, and the role of Python libraries such as NumPy and Pandas in AI applications. **CO 4** Analyze simple real-world problems and develop rule-based AI solutions using Python, NumPy, Pandas, and basic decision-making techniques.	

9	**Syllabus**
	Unit I: Basics of Python Programming (30 Hours) **1. Introduction to Python** Features of Python, Applications of Python, Installing Python, Writing and executing Python programs, Python IDEs **2. Variables and Data Types** Variables and constants, Numeric, string, and boolean data types, Type conversion, Input and output functions **3. Operators and Expressions** Arithmetic operators, Relational operators, Logical operators, Assignment operators **4. Decision Making and Looping** if, if-else, nested if, for loop, while loop, break and continue **5. Strings and Lists** String operations, List creation and manipulation, List methods, Basic list processing **6. File Handling** Opening and closing files, Reading and writing text files **Practicals** 1. Basic Input/Output Programs 2. Programs using operators and expressions 3. Programs using conditional statements 4. Loop-based programs 5. String manipulation programs 6. List processing programs 7. File handling programs **Unit II: Introduction to AI using Python (30 Hours)** **1. Introduction to Artificial Intelligence** Meaning of AI, Applications of AI in daily life, AI vs Machine Learning, Advantages and limitations of AI **2. Introduction to Ethics in AI** Responsible use of AI, Limitations of AI systems, Social impact of AI **3. Python Libraries for AI** Introduction to: NumPy, Pandas; Installing libraries, Basic array and data handling concepts **4. Decision Making in AI** Rule-based systems, Intelligent decision systems, Simple prediction logic **5. Case Studies** **Case Study i: Learner Marks Prediction** Predict learner performance based on study hours, Use of conditions and

	functions **Case Study ii: Spam Message Checker** Detect spam words using string operations **Case Study iii: Weather Suggestion System** Suggest actions based on temperature input **Practicals** 1. Installation of AI libraries 2. Basic array operations using NumPy 3. Data handling using Pandas 4. Simple rule-based AI programs 5. Spam checker program
10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks, Time: 3 hour**

Structure of Evaluation

Sr. No.	Structure of the Questions	Marks
1.	Practical Exam Attempt any four out of six questions (three questions from each unit)	20
2.	In semester participation (Active participation)	05
3.	Journal	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Quiz (MCQs/ Match the Pairs/ short answers/ Puzzles)	05
2	Hands-on test of problems/programs	10
3	Project / Seminar / Quiz / case study/ presentation	05
	Total	**20**

11 **References:**

1. Mark Lutz, *Learning Python*, O'Reilly Media, 2013.
2. E. Balagurusamy, *Python Programming*, McGraw Hill Education, 2017.
3. Wes McKinney, *Python for Data Analysis*, O'Reilly Media, 2022.
4. Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2013.
5. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media, 2016.
6. John V. Guttag, *Introduction to Computation and Programming Using Python*, MIT Press, 2021.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Mathematics)

Semester- I

Title: Data Analytics I

Vertical - 4
SEC - 2 Credits

with effect from
Academic Year 2026-2027

Title: Data Analytics I
(Course Code : CHMMTI6)

Sr. No.	Heading	Particulars
1	**Description the Course:**	This course offers a foundational understanding of Statistics through data visualization, summarization, and probability distributions. Topics include descriptive and inferential statistics, graphical representation, measures of central tendency and measures of dispersion, and probability concepts. Learners will explore discrete and continuous variables, analyze real-world data, and apply binomial and normal distributions to solve problems using statistical reasoning and interpretations.
2	**Vertical**	SEC
3	**Type**	Practical Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1.** To provide learners with an understanding of fundamental statistical concepts, terminology, data types, and methods of organizing, visualizing, and summarizing data. **CO(A) 2.** To develop learners' ability to use descriptive statistical measures and graphical techniques for analyzing and interpreting qualitative and quantitative data. **CO(A) 3.** To introduce learners to the concepts of probability, random variables, and probability distributions as tools for modeling uncertainty and real-world phenomena. **CO(A) 4.** To equip learners with practical skills in applying probability distributions and statistical techniques using Microsoft Excel and/or R for data analysis and interpretation.	
8	**Course Outcomes**: Upon completion of the course, learners should be able to **CO 1** classify and organize different types of data, and construct and interpret appropriate graphical representations for qualitative and quantitative variables. **CO 2** calculate and analyze measures of central tendency, dispersion, and position to summarize and interpret datasets. **CO 3** apply probability rules, conditional probability, and Bayes' theorem to solve problems involving uncertainty and random events. **CO 4** analyze and interpret discrete and continuous probability distributions, including Binomial and Normal distributions, using statistical software such as Excel and/or R.	

9	**Syllabus**

UNIT I: Data visualization and summarization

- Introduction to statistics, different terminologies: experimental unit, variable, population, sample, sampling, statistic, parameter, statistical inference. Concept of descriptive statistics and inferential statistics.
- Qualitative and quantitative variables, types of quantitative variable i.e. discrete and continuous, cross section data and time series data.
  Problems based on
  - identifying key terms
  - identifying the variable and the nature of the variable (qualitative or quantitative and for quantitative variable, such as discrete or continuous.).
  - identifying the data as cross section or time series.
- Organization and graphical representation of data: Bar graphs and pie charts for qualitative data and histogram, frequency polygon, frequency curve for quantitative data.
  Problems based on
  - understanding the Bar graphs, Pie charts, and interpretation of the data.
  - working with histogram, frequency polygon, frequency curve, and interpretation of the data.
- Data summarization with measures of descriptive statistics such as:
  Measures of central tendency: mean, median, mode
  Measures of dispersion: range, standard deviation
  Problems based on
  - Mean, median, mode, range, standard deviation, variance and coefficient of variation for ungrouped data and grouped data.
  - To decide appropriate use of different measures of central tendency.
  - Measures of Position – quartiles, interquartile range, percentile, percentile rank.
  - Box-and-Whisker Plot.

UNIT II: Random Variables and their Probability Distributions

- Review of basic concepts of probability: Random experiment, sample space, events, addition rule and multiplication rule, independent events, conditional probability
  Problems based on
  - Finding probability using definition and applying fundamental rules.
  - Conditional probability and Baye's theorem.
- Discrete Random Variables and their Probability Distributions:
  Problems based on
  - Random variables and probability mass function.
  - Mean and Standard deviation of a discrete random variable
  - The Binomial probability distribution
- Continuous Random Variables and probability density function.
  Problems based on
  - Continuous probability distribution and the normal probability distribution.
  - Standardizing a normal distribution.
  - Applications of the normal distribution.

	• Determining the z and x values, when an area under the normal distribution curve is known. Use of real data published in newspapers or from different sources on internet for the above-mentioned problems and case studies is recommended. **Technology integration** – Microsoft Excel software / R to be used for practicals. **Case Study 1: Online Shopping Trends Analysis:** **A retail company wants to understand customer buying behavior during festive sales.** **The dataset contains:** Age of customers, Monthly income, Number of purchases, Preferred payment mode, Time spent on the shopping app **Learners need to:** Identify qualitative and quantitative variables, create bar charts, pie charts, and histograms, calculate mean, median, mode, and standard deviation, interpret customer trends and purchasing patterns **AI Tools That Can Be Used:** ChatGPT for data interpretation and formula guidance, Microsoft Excel for graphs and statistical calculations, Google Colab with Python/R for visualization **Data Sources for Case Study 1: Online Shopping Trends Analysis** **Recommended Sources** • Kaggle – E-commerce Datasets: Search keywords: “online shopping dataset”, “customer purchasing behavior”, “e-commerce sales data” • UCI Machine Learning Repository: Useful dataset: “Online Shoppers Purchasing Intention Dataset” • Data.gov.in : Indian public datasets related to digital economy and online commerce. • Easy Classroom Option: Learners can also create a small survey using: Google Forms: Collect responses from classmates about shopping habits. **Case Study 2: Learner Performance and Attendance Study** **A college collects data on:** Learner attendance percentage, Internal assessment marks, Study hours per week, Participation in extracurricular activities **Learners need to:** Classify variables as discrete/continuous, prepare frequency distribution tables, Construct histograms and frequency polygons, find quartiles, percentile rank, and Box-and-Whisker plots, analyze whether attendance impacts academic performance **AI Tools That Can Be Used:** ChatGPT for statistical explanation and interpretation, Canva Charts for visual representation, R Project for statistical analysis **Recommended Sources** • Kaggle – Learner Performance Dataset : Search keywords: “learner performance”, “attendance and marks”, “education analytics” • UCI Machine Learning Repository: Useful dataset: “Learner Performance Data Set” • UNESCO Data: Educational statistics and learner-related indicators. **Case Study 3: Probability Analysis of Rainfall and Traffic** **A city traffic department studies how rainfall affects traffic congestion. Data includes:** Daily rainfall levels, Traffic volume, Number of accidents, Travel time during peak hours **Learners need to:** Use probability concepts, analyze whether heavy rainfall increases accident probability, apply normal distribution to travel-time data, calculate z-scores and interpret probabilities **AI Tools That Can Be Used:** ChatGPT for solving probability problems step-by-step,

Microsoft Excel for normal distribution functions, Tableau Public for interactive dashboards

Recommended Sources

- India Meteorological Department (IMD): Rainfall and weather records.
- Open Government Data Platform India: Traffic, accident, and weather datasets.
- Kaggle – Traffic and Weather Datasets: Search keywords: “traffic accident dataset”, “weather and traffic”, “rainfall analysis”
- World Bank Open Data: Transport and environmental indicators.
- Easy Classroom Option: Learners can manually collect: Daily rainfall data from weather apps, Travel time observations, Local traffic conditions over 2–3 weeks

Case Study 4: IPL Cricket Statistics Analysis

A sports analyst studies IPL player and match performance data: Runs scored, Strike rate, Wickets taken, Match attendance, Win/loss records

Learners need to: Classify variables and identify data types, create bar graphs and pie charts for team performance, Compute averages and variability measures, use probability concepts to estimate match outcomes, analyze player consistency using standard deviation

AI Tools That Can Be Used: ChatGPT, Microsoft copilot, Google Gemini, Google colab

Suggested Data Sources

- Kaggle – IPL Datasets
- ESPN Cricinfo Statsguru
- BCCI Official Website

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No	Title	Marks
1.	Problems / Programs (**four** out of **six**) (three from each unit)	20
2.	Journal	05
3.	In semester participation (Active participation)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Quiz (MCQs/ Match the Pairs/ short answers/ Puzzles)	05
2	Hands-on test of problems/programs	10
3	Project / Seminar / Quiz / case study/ presentation	05
	Total	**20**

11	**References:** 1. Mann, P. S., *Introductory Statistics*, 8th Edition, John Wiley & Sons, Inc., 2013. 2. Anderson, D. R., Sweeney, D. J., and Williams, T. A., *Statistics for Business and Economics*, 11th Edition, Cengage Learning, 2011. 3. Gupta, S. C. and Kapoor, V. K., *Fundamentals of Mathematical Statistics*, 12th Edition, Sultan Chand & Sons, 2020. 4. Gupta, S. C. and Gupta, I., *Business Statistics*, 6th Edition, Himalaya Publishing House, 2013. 5. Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., and Cochran, J. J., *Essentials of Modern Business Statistics with Microsoft Excel*, 7th Edition, Cengage Learning, 2022. 6. Panneerselvam, R., *Business Statistics Using Excel: A Complete Course in Data Analytics*, Routledge (Taylor & Francis), 2024. 7. McClave, J. T. and Sincich, T., *A First Course in Statistics*, 12th Edition, Pearson Education Limited, 2018. 8. Illowsky, B., Dean, S., and Chiappetta, L., *Introductory Statistics*, OpenStax, 2013. 9. Grolemund, G., *Hands-On Programming with R*, O'Reilly Media, 2014.

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	**Description the Course:**	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. 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.
2	**Vertical 4**	Ability Enhancement Course
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 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.
8	**Course Outcomes**: 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.

9	**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	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - **Unit 2** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 2**	15
	Total	**30**

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 **OR** Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	Total	**20**

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

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar
(Autonomous)
Affiliated to the University of Mumbai

Bachelor of Commerce/ Arts/Science/ SFC
(Sindhi)
(AEC – Ability Enhancement Course)
(Aided Course)

Semester – I

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

PREAMBLE

The Bachelor of Commerce (B.Com.) in Sindhi is a comprehensive program designed to develop Sindhi language. Language is the soul of Literature. Sindhi is medium of Communication, Education and Cultural exchange. Curriculum is designed specially in digital age.

Language enriches literature. This curriculum is prepared according to Social, Cultural and Academic needs. The B.Com. Sindhi subject offers students a unique opportunity to explore and widened Sindhi Culture through a wide range of literary programs. The curriculum not only emphasizes literary appreciation and analysis but also fosters ethical awareness, intercultural sensitivity and social responsibility.

The program is committed to developing critical thinking, ethical reasoning and inclusive perspectives. It encourages students to reflect and engage with communication in Sindhi, expertise in Business and Employment Creative work, meditation and listening, use of visual tails, expertise of asking questions, knowledge of different languages through communication.

Language allows us to share our ideas, thoughts, feelings and emotions with others through communication. There is a special contribution of the ideal citizen in nation building. It plays crucial role in creating civilized society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1 Students will understand the communication skills and role of language in communication.

PSO-2 Students will be able to talk effectively in Sindhi language with friends, relatives and Business customers.

PSO-3 Students will understand aspects of language.

PSO-4 Students will be able to understand the Importance of communication, and they will communicate in different ways i.e. verbal, non-verbal, written and Digital methods.

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	**Description the Course:**	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	**Vertical 1**	AEC – Ability Enhancement Course
3	**Type**	Theory + Practicum (Teaching Method: Lecture/ Discussion/Reading)
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**	50Marks
7	**Course Objectives**: After successful completion of this course: **CO(A) 1:** The learner will get understanding of communication skills. **CO(A) 2:** The learner will understand how to accurate the pronunciation of special words in Sindhi **CO(A) 3:** The learner will improve the conversation skill in Sindhi. **CO(A) 4:** The learner will become best communicator in Sindhi language	
8	**Course Outcomes**: Student will be able to **CO1**: Know the basic special features of Sindhi language. **CO2**: Understand communication skills. **CO3**: Knowing the conversation with businessmen and customers **CO4**: Know the etiquettes with parents, relatives, friends and others in effective way	

9	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 अहिमियत
- भाषा जा बुनियादी पहलू

  १) किस्म, २) भाषा जो किरदार, ३) भाषा मे तबदीलियूं, ४) भाषा जा अहिसासाती पहलू ५) बोली ऐ नई पीढ़ी 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 गुफ्तगू
- कारोबार में सिंधी गालाइण

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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
Total		**30**
		Total 30

Internal Examination: Continuous Evolution - 20 marks

	Assessment / evaluation	Marks
1.	**Written assignment on any one of the following topics** 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
	Total	**20**

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.	Mrs. Kajal Ramchandani	**H.O.D. of Jai Hind College**	
2.	Mrs. Komal Totani	**Assistant Teacher, Smt. CHM College**	

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

Name & Signature of the Dean: (Dr. Nitin 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	**Description the Course:**	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. 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. 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.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9

Syllabus

Unit I - Suggested Areas of Participation in the activities:

- **Cultural Events:** Drama, dance, music, literary events, debates, etc.
- **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives.
- **Clubs & Societies:** Photography, quiz, environment club, shram club, etc.
- **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges.
- **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events.
- **National Festivals:** Independence Day, Republic Day etc.

Unit II - Program Specific Topics

- **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks.
- **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience

Mode of Evaluation:

- **Faculty Coordinator:** To guide and evaluate student progress.
- **Participation Proof:** Certificates, photos, attendance records.
- **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth.
- **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.

10

Scheme of Examination and Assessment Pattern
Based on 3 approved Activities
Semester End External - 30 marks

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
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

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

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	**Description the Course:**	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	**Vertical 5**	IKS
3	**Type & Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To sensitize the students about context in which they are embedded i.e. Indian culture and civilization including its Knowledge System and Tradition. **CO(A)2:** To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system. **CO(A)3:** To help to study the enriched scientific Indian heritage. **CO(A)4:** To introduce the contribution from Ancient Indian system & tradition to modern science & Technology.	
8	**Course Outcomes**: Student will be able to **CO1:** Understand and appreciate the rich Indian Knowledge Tradition. **CO2:** Understand the contribution of Indians in various fields. **CO3:** Experience increase subject-awareness and self-esteem. **CO4:** Develop a comprehensive understanding of how all knowledge is ultimately intertwined.	

9	**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

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 all questions.**

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
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	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
TOTAL		**20**

11

REFERENCES:

1. Concise history of science in India- D.M. Bose, S.N Sen, B.V. Subbarayappa.
2. Positive sciences of the Ancient Hindus- Brajendranatha seal, Motilal Banrasidas, Delhi 1958.
3. History of Chemistry in Ancient India & Medieval India, P. Ray- Indian Chemicals Society, Calcutta 1956.
4. Charaka Samhita- a scientific synopsis, P. Ray & H.N Gupta National Institute of Sciences of India, New Delhi 1965.
5. MacDonnell A.A- History of Sanskrit literature.
6. Winternitz M- History of Indian Literature Vol. I, II.
7. Dasgupta S.N & De S.K- History of Sanskrit literature Vol' I.
8. Ramkrishna Mission- cultural heritage of India Vol' I, II.
9. Majumdar R. C & Pushalkar A.D- History & culture of the Indian people, Vol. I, II & III.
10. Keith A.B- History of Sanskrit literature.

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

(Dr. Nitin Arekar)

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

First Year

Semester - III

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	**Description the Course:**	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	**Vertical 5**	VEC
3	**Type &** **Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To introduce about ecosystems, biodiversity and to make aware for the need of conservation. **CO(A)2:** To sensitize students towards environmental concerns, issues, and impacts of human population. **CO(A)3:** To analyze the impact of human population growth and development activities on the environment, including issues related to displacement, disaster response, and rehabilitation. **CO(A)4:** To foster awareness of environmental ethics and the role of cultural and social movements in shaping sustainable environmental practices through communication, policy, and activism.	
8	**Course Outcomes**: Student will be able to **CO1:** Explain the interrelationships within ecosystems and analyze energy flow and succession, using examples from various ecological zones. **CO2:** Critically evaluate biodiversity levels and conservation strategies, applying knowledge of endemic species, threats, and ecological services to real-world scenarios. **CO3:** Assess the socio-environmental implications of population growth, displacement, and disasters, incorporating case studies to understand sustainable development challenges. **CO4:** Demonstrate an understanding of environmental ethics and advocacy, by interpreting the influence of cultural values, environmental movements, and communication strategies on sustainability.	

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
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
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
TOTAL		**20**

11 **REFERENCES:**

1. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press.
3. Gleeson, B., & Low, N. (Eds.). (1999). *Global Ethics and Environment*. Routledge.
4. Gleick, P. H. (1993). *Water in Crisis*. Pacific Institute for Studies in Development, Environment & Security; Stockholm Environment Institute; Oxford University Press.
5. Sodhi, N. S., Gibson, L., & Raven, P. H. (Eds.). (2013). *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
6. Thapar, V. (1998). *Land of the Tiger: A Natural History of the Indian Subcontinent*.
7. Warren, C. E. (1971). *Biology and Water Pollution Control*. W. B. Saunders.
8. Wilson, E. O. (2006). *The Creation: An Appeal to Save Life on Earth*. W. W. Norton.
9. Harper, Charles L. (2017). *Environment and Society: Human Perspectives on Environmental Issues* (6th Edition). Routledge.
10. Rajagopalan, R. (2011). *Environmental Studies: From Crisis to Cure*. Oxford University Press.
11. Harris, Frances (2012). *Global Environmental Issues* (2nd Edition). Wiley-Blackwell.

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

Dr. Nitin Arekar

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science (Mathematics)

(Aided)

Semester – II

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

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B.Sc.
(Mathematics)

Semester- II

Title: Discrete Mathematics and Calculus – II

Vertical - 1
Major - 2 Credits

With effect from
Academic Year 2026-2027

Title: Discrete Mathematics and Calculus – II

Course Code: CHMMTII1

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course provides an introduction to fundamental concepts in combinatorics and one variable calculus. The first unit introduces preliminary and advanced counting principles**,** including permutations, combinations, recurrence relations, and the inclusion–exclusion principle. Learners learn to solve discrete problems involving arrangements, selections, and distributions, while exploring key combinatorial identities and functions such as Stirling numbers**,** Euler's φ-function**,** and derangements. The second unit develops the theory of limits, continuity, and differentiability of real-valued functions using rigorous ε–δ definitions. Learners study standard functions**,** mean value theorems**,** and applications of derivatives in determining monotonicity, extrema, and function approximation using Taylor's theorem.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech-based learning/flipped classroom etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1.** To provide learners with an understanding of the concepts of fundamental counting principles, permutations, combinations recurrence relation and countable uncountable sets. **CO(A) 2.** To enable learners to apply combinatorial techniques such as the inclusion–exclusion principle, Stirling numbers, and the pigeonhole principle in solving problems. **CO(A) 3.** To familiarize learners with the concepts of limits, continuity, and differentiability of real-valued functions and develop their ability to analyze and apply these concepts in mathematical problems. **CO(A) 4.** To facilitate learning of different Mean Value Theorems, tests to study the behavior of functions.	
8	**Course Outcomes**: Upon completion of the course, learner will be able to **CO 1** state and apply counting techniques such as fundamental counting principles, permutations, combinations and identify the countable and uncountable sets. **CO 2** solve problems based on concepts of inclusion–exclusion principle, Stirling numbers, and the pigeonhole principle. **CO 3** apply $\varepsilon - \delta$ definition of limit, continuity and develop the proof / apply properties of continuous, differentiable functions such as intermediate value property, Leibnitz rule. **CO 4** state/apply various mean value theorems, use first/second derivative tests to obtain extreme points, to identify where the function is increasing/decreasing.	

9	**Syllabus**

UNIT I: Preliminary and Advanced Counting

- Fundamental counting principles- Addition and Multiplication principles of counting.
- Permutation and combination of sets and circular permutations.
- Countable and uncountable sets.
- Stirling number of the second kind. Simple recursion formulae satisfied by $S(n,k)$ for $k = 1,2,3,\ldots,n-1,n$
- Pigeonhole principle (Simple and Strong form), its applications.
- Recurrence relations, the definition of homogeneous, non-homogeneous, linear, non-linear recurrence relation. Forming recurrence relation and solving linear homogeneous recurrence relation by using algebraic method (up to second degree).
- Binomial and Multinomial Theorem (Statement only). Examples.
- Non-negative integer solutions of the equation $x_1 + x_2 + \cdots + x_k = n$.
- Principle of inclusion and exclusion and its applications. Derangement (D_n) on n symbols and explicit formula for D_n (without proof), Euler's function $\phi(n)$.

UNIT II: Limit, Continuity, Differentiability of one variable function

- Graphs of standard function such as constant function, linear/quadratic/cubic polynomial, exponential function, inverse function etc.
- $\varepsilon - \delta$ definition of limit of a function, uniqueness of limits, left side limit and right side limit, algebra of limit, sandwich theorem, limit at infinity.
- $\varepsilon - \delta$ definition of continuity of a real valued function at a point, examples, results about continuous functions. Intermediate Value theorem and its applications, Bolzano-Weierstrass theorem (statement only): A continuous function on a closed and bounded interval is bounded and attains its bounds.
- Definition of differentiability of a function at a point of an open interval, examples of differentiable and non-differentiable functions, Chain rule (statement only), Higher order derivatives, Leibniz rule (statement only), Derivative of inverse functions.
- Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems, applications and examples, Monotone functions, examples. Definition of critical point, local maximum/minimum and its necessary condition, stationary points, second derivative test (statement only), examples. Taylor theorem (without proof) and its applications.

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. Norman Biggs, Discrete Mathematics, Oxford University Press.
2. Richard Brualdi, Introductory Combinatorics, John Wiley and Sons.
3. Allen Tucker, Applied Combinatorics, John Wiley and Sons.
4. Schaum's outline series, Discrete Mathematics.
5. V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
6. Discrete Mathematics and its Applications, Tata McGraw Hills.
7. R. G. Bartle-D. R. Sherbert, *Introduction to Real Analysis*, John Wiley & Sons, 1994.
8. Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, *A Foundation Course in Mathematics*, Narosa, 2018
9. Ajit Kumar, S. Kumaresan, *A Basic course in Real Analysis*, CRC Press, 2014
10. S. R. Ghorpade, B. V. Limaye, *A course in Calculus and Real Analysis*, Springer, 2006.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

First Year B. Sc. (Mathematics)

Semester- II

Title

Practical based on Discrete Mathematics and Calculus – II

Vertical - 1
Major - 2 Credits

With effect from
Academic Year 2026-2027

Title: Practical based on Discrete Mathematics and Calculus – II
Course Code: CHMMTII2

Sr. No.	Heading	Particulars
1	**Description of the Course**	This practical course develops core skills in combinatorics and one variable calculus through problem-solving and applications. Learners will work with counting principles, Stirling numbers, pigeonhole principle, recurrence relation, inclusion-exclusion principle, derangements, multinomial theorem. Problems on $\varepsilon-\delta$ definition of limits, continuity, sequential continuity will reinforce the concepts. Learners will also be exposed to problems based on theorems such as intermediate value theorem, mean value theorems, tests for extremum.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Group discussion/tech-based learning/problem solving etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1.** To enable learners to explore the concepts of fundamental counting principles, permutations, combinations, and recurrence relations through practical problem-solving. **CO(A) 2.** To develop skills among learners to apply combinatorial techniques such as the inclusion–exclusion principle, Stirling numbers, derangements, and the pigeonhole principle. **CO(A) 3.** To apply the fundamental concepts of limits, continuity, and differentiability of real-valued functions, including their interrelationships and applications. **CO(A) 4.** To provide knowledge of various Mean Value Theorems and tests and their applications in the analysis of the behavior of functions.	
8	**Course Outcomes**: Upon completion of the course, learner will be able to **CO 1** apply concepts of basic counting principles, permutations, combinations and recurrence relations for counting. **CO 2** solve problems involving inclusion–exclusion principle, Stirling numbers, derangements, and the pigeonhole principle. **CO 3** state and apply $\varepsilon-\delta$ definition of limit, continuity and prove/apply properties of continuous, differentiable functions such as intermediate value property, Leibnitz rule. **CO 4** employ mean value theorems, identify critical points, determine local extrema using derivative tests and examine where the function is increasing/decreasing.	

9

Syllabus

UNIT I: Practical for Discrete mathematics

1. Fundamental counting principles, permutation and combinations of sets
2. Countable and uncountable sets
3. Stirling number of the second kind
4. Pigeonhole principle
5. Recurrence relation
6. Binomial and Multinomial theorem
7. Principle of inclusion and exclusion, Derangements and Euler's function

UNIT II: Practical for Calculus II

1. Plotting of graphs of standard functions, Limit of a function and Sandwich theorem (use of Geogebra to experiment with $\varepsilon - \delta$ definition)
2. Continuous and discontinuous functions, Algebra of limits and continuous functions.
3. Sequential continuity, properties of continuous functions, Intermediate value theorem, Bolzano-Weierstrass theorem.
4. Properties of differentiable functions.
5. Higher order derivatives, Leibnitz rule
6. Mean Value Theorems
7. Increasing/decreasing functions, maxima, minima of a function

Case Study 1: Plotting of graphs and observe continuity/differentiability of various functions using **Geogebra**.

Case Study 2: Verify location of roots theorem, mean value theorems, maxima/minima for different functions using **WolframAlpha**.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks Time: 2 hours** Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4×3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2×4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test (Duration: 30 minutes) Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Norman Biggs, Discrete Mathematics, Oxford University Press.
2. Richard Brualdi, Introductory Combinatorics, John Wiley and Sons.
3. Allen Tucker, Applied Combinatorics, John Wiley and Sons.
4. Schaum's outline series, Discrete Mathematics.
5. V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
6. Discrete Mathematics and its Applications, Tata McGraw Hills.
7. R. G. Bartle-D. R. Sherbert, *Introduction to Real Analysis*, John Wiley & Sons, 1994.
8. Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, *A Foundation Course in Mathematics*, Narosa, 2018
9. Ajit Kumar, S. Kumaresan, *A Basic course in Real Analysis*, CRC Press, 2014
10. S. R. Ghorpade, B. V. Limaye, *A course in Calculus and Real Analysis*, Springer, 2006
11. Deisenroth, Marc Peter; Faisal, A. Aldo; Ong, Cheng Soon, ***Mathematics for Machine Learning***, Cambridge University Press, 1st Edition, 2020.
12. ***The official manual of Geogebra*** available on the website: www.geogebra.org .

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, Ulhasnagar (Autonomous)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Com.
(Mathematics)

Semester- II

Title: Practical Statistics for Business - II

Vertical - 3
Open Elective - 2 Credits
Mandatory

with effect from
Academic Year 2026-2027

Title: Practical Statistics for Business – II

Course Code: CHMMTII4

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces statistical techniques for analyzing relationships and trends in data. Topics include correlation, regression analysis, and their applications in interpreting bivariate data. It also covers time series analysis, trend estimation, and construction of index numbers for economic and business comparisons. Learners learn practical methods for data interpretation through case studies and real-world examples.
2	**Vertical 3**	Open Elective Mandatory
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1.** To introduce learners to the fundamental concepts of correlation and regression for analyzing relationships between variables in real-world datasets. **CO(A) 2.** To develop learners' ability to apply statistical techniques such as least squares, correlation measures, and regression analysis for interpreting data relationships. **CO(A) 3.** To enable learners to understand time series components and models for identifying trends and patterns in data. **CO(A) 4.** To facilitate learners' understanding of index numbers and their application in economic and business comparisons including cost of living and real income analysis.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain the concepts of correlation, covariance and regression and interpret their statistical meaning. **CO 2** apply the method of least squares to fit linear regression models and interpret regression coefficients. **CO 3** analyse time series data by identifying components and estimating trends using graphical and analytical methods. **CO 4** evaluate various types of index numbers to compare economic indicators and assess changes in cost of living and real income.	

9	**Syllabus**

	UNIT I: Correlation and Regression Analysis
	• **Correlation:** Bivariate data, Scatter diagram, Covariance between two variables, Karl Pearson's correlation coefficient (Product Moment correlation coefficient) and its properties.
	• Spearman's Rank correlation coefficient.
	• **Regression:** Concept of linear regression analysis, Fitting of a linear regression line by method of least squares. Relation between regression coefficients and correlation coefficients.
	• Case Studies such as
	    o Analysis (using Rank Correlation) based on Sales Volume and Customer Feedback Scores of various commodities of the same type
	    o Analyze how marketing investment influences business sales using correlation (Learners can take the help of AI (such as Julius AI or Wolfram Alpha) for collecting data, ranking variables, calculating correlation coefficients, visualizing relationships, and interpreting results)
	
	UNIT II: Time Series and Index Number
	
	• Definition of time series, Components of time series, Models of time series. Estimation of trend by i) Freehand curve method ii) Method of least squares.
	• Index number as a comparative tool, Simple and composite Index Numbers, Some standard index numbers - Laspeyres', Paasche's, Marshal-Edgeworth's, Dorbish-Bowley's and Fisher's Index Numbers.
	• Cost of Living Index Number, Concept of Real Income based on the Wholesale Price Index Number.
	• Case Studies such as
	    o Apply time series methods to detect trend, seasonal, and irregular components in sales performance
	    o Examine trends and growth patterns in transportation demand using linear trend estimation.
	    (Learners can take the help of AI (such as Julius AI or Google Gemini) for identifying trend, seasonal, cyclical, and irregular components, estimating linear trends, generating forecasts, and interpreting business implications.)
	
	Recommended that data be collected on different variables related to the area chosen by the learner, summarize the data and variability in it using the techniques covered in Unit 1, 2, represent the data measures on a histogram, and comment on the observations. Also, state with reason the measures that you would recommend for your data set and the purpose of study.
	Technology integration: Use of spreadsheet like EXCEL is encouraged while doing case studies

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks   Time: 1 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
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

Format of Question Paper

Sr. No.	Particulars	Marks
1	Test – MCQs /Answer in one sentence / Problems / Match the pairs / Puzzles etc.	10
2	Mini-project / Case study / Presentation / Open book test / Flipped classroom etc.	10
	Total	**20**

11

References:

1. Prem Mann: Introductory Statistics (7th Ed), John Wiley & Sons, INC
2. Gupta S. P.: Statistical Methods, S. Chand and Sons
3. Goon A.M., Gupta M.K., Dasgupta B.: Fundamentals of Statistics, Volume II: The World Press Private Limited, Calcutta (1968).
4. Kothari C.R.: Research Methodology, Wiley Eastern Limited, Second Edition. (2004)
5. Agarwal B.L.: Basic Statistics, New Age International Ltd.
6. Spiegel M.R.: Theory and Problems of Statistics, Schaum' s Publications series. Tata McGraw-Hill.
7. Elhance D. N, Elhance V, Aggarwal B. M, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi, 2018.
8. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

First Year

Semester- II

Title: Data Analysis with Advanced Excel

Vertical - 3
Open Elective - 2 Credits
Choice Based

with effect from
Academic Year 2026-2027

Title: Data Analysis with Advanced Excel

Course Code: CHMMTII4

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course provides practical training in data analysis using Excel, focusing on real-world skills needed to clean, organize, summarize, and interpret data. Students learn how to use Power Query for data preparation and Pivot Tables and charts for interactive reporting. The course emphasizes clear thinking and presentation of insights. AI tools, such as ChatGPT, are integrated for little assistance to help students draft interpretation statements and AI suggestions are verified using Excel, promoting analytical judgment and responsible technology use. The goal is not only to learn Excel features, but to develop the mindset of a data analyst who can think, question, validate and communicate data-driven conclusions.
2	**Vertical 3**	Open Elective Choice Based
3	**Type** **Teaching Method**	Theory + Practical Lecture/Hands on lab sessions /mini case study /mini project / tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** To develop skill in cleaning, transforming, and organizing data using Excel tools. **CO(A) 2** To apply functions, lookup methods and Pivot chart techniques to analyze datasets. **CO(A) 3** To utilize the Analysis ToolPak for descriptive statistics, histograms, and basic correlation and regression. **CO(A) 4** To incorporate AI tools for explanation and insights while maintaining verification using Excel outputs.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** clean, structure, and prepare data for analysis using Power Query and Excel functions. **CO 2** build Pivot tables, pivot charts and interactive dashboards to summarize insights. **CO 3** perform basic statistical analysis using the Analysis ToolPak and interpret results clearly. **CO 4** use AI tools responsibly for support while validating all results within Excel.	

9

Syllabus

UNIT I: Data Preparation, Transformation and Reporting

Review of core Excel functions such as writing formulae , relative and absolute referencing, if() , sumifs() , countifs() etc , pivot table , vlookup and mini case study applications of these to datasets from sales, banking, medical insurance , telecom, logistics ,HR etc .
Logical Function IFS , XLOOKUP (only demonstration)
Power Query (Get and Transform) for Data Cleaning, Web scraping
Filters and Advanced Filters , Apply multi-criteria filters
Pivot Tables , Pivot Charts and Slicers

UNIT II: Data Analysis ToolPak for basic Statistical Insights

Descriptive Statistics (mean, median, standard deviation), Histograms and frequency distributions, Correlation analysis, Introductory Regression analysis

Note : In both units , it is recommended that few AI tools like Claude AI to be used to get insights into data and further verify/validate them in Excel.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

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

Sr. No.	Pattern of the exam	Marks
1	Test (MCQ / Objectives)	12
2	Individual Mini Project, Report submission, Viva based on the project work	18
	Total	**30**

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

Sr. No.	Pattern of the exam	Marks
1	Mini case study	10
2	Practical exam (hands-on) in the lab OR Test	10
	Total	**20**

11

References:

1. M. L. Humphrey, Excel 2024 for Beginners, 2025
2. Ian Lamont, Excel Basics In 30 Minutes, 3rd Edition, i30 media corp, 2015
3. Michael McDonald, 200+ Excel Formulas and Functions, BPB publication, 2023
4. Paul McFedries, Microsoft Excel: Formulas and Functions (Office 2021 and Microsoft 365), Pearson Education, 2022
5. Wayne L. Winston, Microsoft Excel Data Analysis and Business Modeling (Office 2021 and Microsoft 365), 7th Edition, PHI, 2024
6. George Mount, Modern Data Analytics in Excel, O'Reilly Media, Inc., 2024
7. Simon Johnson, AI in Excel for Beginner: A Comprehensive Steps-by-Steps Guide, Kindle Edition

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Mathematics)

Semester- II

Title: **Computing with Python**

VSC
(As per NEP 2020)
2 Credits

with effect from
Academic Year 2026-2027

Title: Computing with Python
(Course Code : CHMMTII5)

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces learners to advanced Python programming for mathematical computation and data handling. Learners will explore **strings, lists, tuples, dictionaries, functions**, and **symbolic mathematics using SymPy**, along with **data visualization using Matplotlib**. The course emphasizes practical problem-solving, algorithmic thinking, and basic calculus applications, preparing learners for real-life mathematical and AI-based computations.
2	**Vertical**	VSC
3	**Type** **Teaching Method**	Practical Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1.** To introduce learners to advanced Python data structures, user-defined functions, and numerical data processing techniques for effective problem solving. **CO(A) 2.** To develop learners' ability to organize, manipulate, and process data using Python strings, lists, tuples, dictionaries and functions. **CO(A) 3.** To enable learners to perform symbolic computation, algebraic manipulation, equation solving, and calculus operations using the SymPy library. **CO(A) 4.** To facilitate the application of Python-based mathematical computing and visualization tools for solving computational and analytical problems.	
8	**Course Outcomes**: Upon completion of the course, learner will be able to **CO 1** Describe the concepts of Python data structures, user-defined functions, and number systems, and explain their role in organizing and processing data. **CO 2** Apply Python data structures and user-defined functions to develop programs for text processing, data organization, and computational problem solving. **CO 3** Identify the features and capabilities of SymPy and Matplotlib for symbolic computation, equation solving, calculus, and mathematical visualization. **CO 4** Analyze mathematical problems using SymPy and Matplotlib by solving equations, evaluating limits and derivatives, and interpreting graphical representations of functions.	

Syllabus

Unit I: Python Data Structures and Computing (30 Hours)

1. **Strings and Advanced String Processing**
   String indexing and slicing, String methods (split, join, replace, find, count), Pattern-based string processing, Real-world text processing examples
2. **Lists and Tuples**
   Nested lists, Tuple creation and immutability, Tuple operations and unpacking, Difference between lists and tuples, Applications in data organization
3. **Dictionaries and Sets**
   Dictionary creation and manipulation, Keys, values, and items operations, Nested dictionaries, Set operations (union, intersection, difference), Real-life use cases (learner records, contacts, etc.)
4. **Problem Solving Using Data Structures**
   Combining strings, lists, tuples, dictionaries, Algorithmic thinking using Python structures, Simple data processing problems
5. **User Defined Functions and Number Systems**
   Defining functions, parameters, arguments, return statement, Operations on integers, fractions, and complex numbers, Converting strings to fractions and complex numbers

Practicals

1. String indexing, slicing, and string methods ,pattern-based string processing programs
2. List creation, manipulation, and nested lists
3. Tuple creation, unpacking, and basic operations
4. Dictionary creation, updating, and nested dictionaries
5. Set operations (union, intersection, difference)
6. Programs combining strings, lists, tuples, and dictionaries
7. Functions for even/odd check, factor finding, and simple computations
8. Operations on integers, fractions, and complex numbers using functions

Unit II Doing with Python

1. **Introduction to SymPy**
   Installation and basic use of SymPy, Defining single and multiple symbols, Symbolic operations and simplification
2. **Algebraic Expressions using SymPy**
   Factorization and expansion of expressions, Substitution of values in expressions, Pretty printing (pprint)
3. **Equation Solving**
   Solving linear and quadratic equations, Solving simultaneous equations (2–3 variables), Expressing one variable in terms of others

	4. Introduction to Matplotlib Installation and basic plotting, Plotting mathematical expressions using SymPy and Matplotlib, Plotting standard functions: sin, cos, exp, log, Plotting multiple functions on the same graph **5. Calculus using SymPy** Finding Limits of functions using SymPy, Verifying Basic idea of continuity using SymPy, Use of SymPy instead of math library, Evaluation of trigonometric functions **6. Derivatives and Applications** Instantaneous rate of change, Derivatives using SymPy, Maxima and minima (basic idea), Increasing and decreasing functions **Practicals** 1. Define symbols and perform symbolic operations using SymPy 2. Simplify, expand, and factor algebraic expressions 3. Substitution of values and use of pprint 4. Solve linear, quadratic, and simultaneous equations 5. Plot linear, quadratic, cubic, and user-defined functions using Matplotlib 6. Plot standard functions (sin, cos, exp, log) 7. Compute limits and check basic continuity using SymPy 8. Find derivatives and evaluate at specific points 9. Analyze increasing/decreasing functions and find maxima/minima
10	**Scheme of Examination and Assessment Pattern** (see below)

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 3 hour

Structure of Evaluation

Sr. No.	Structure of the Questions	Marks
1.	Practical Exam Attempt any **four** out of **six** questions (three questions from each unit)	20
2.	In semester participation (Active participation)	05
3.	Journal	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Quiz (MCQs/ Match the Pairs/ short answers/ Puzzles)	05
2	Hands-on test of problems/programs	10
3	Project / Seminar / Quiz / case study/ presentation	05
	Total	**20**

11	**References:** 1. E. Balagurusamy, Programming with Python, McGraw Hill Education, 2020 2. Mark Lutz, Learning Python, O'Reilly Media, 2013 3. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media, 2016 4. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2019 5. Amit Saha, Doing Math with Python, No Starch Press, Inc, 2015

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

First Year B. Sc.
(Mathematics)

Semester- II

Title: Data Analytics II

Vertical - 4
SEC - 2 Credits

with effect from
Academic Year 2026-2027

Title: Data Analytics II
Course Code: CHMMTII7

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces fundamental statistical tools for analysing relationships in bivariate data. Learners learn scatter plot interpretation, least-squares curve fitting, correlation measures, and basic regression for prediction. The second unit covers core inferential methods, including sampling distributions, confidence intervals, hypothesis testing, chi-square procedures, and one-way ANOVA. Emphasis is placed on interpreting results and applying statistical techniques to real-world data.
2	**Vertical**	SEC
3	**Type** **Teaching Method**	Practical Lecture/group discussion/seminar/tech based/hands-on learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1.** To introduce learners to the concepts of curve fitting, correlation, and regression techniques for analyzing relationships among variables in bivariate data. **CO(A) 2.** To develop learners' understanding of statistical methods for modeling data, including least squares fitting, correlation analysis, and regression-based prediction. **CO(A) 3.** To enable learners to understand sampling distributions, estimation techniques, and hypothesis testing procedures for making statistical inferences about populations. **CO(A) 4.** To facilitate the application of statistical tools and software such as Microsoft Excel and R for analyzing real-world datasets and interpreting inferential statistical results.	
8	**Course Outcomes**: Upon completion of the course, learner will be able to **CO 1** construct and interpret scatter diagrams and apply the method of least squares to fit straight-line models for bivariate data. **CO 2** calculate and analyse correlation and regression measures, including Karl Pearson's coefficient, Spearman's rank correlation, and regression equations, to interpret relationships between variables. **CO 3** explain and apply concepts of sampling distributions and estimation techniques to determine population parameters using appropriate statistical methods. **CO 4** perform and interpret hypothesis tests, chi-square tests, and one-way ANOVA using statistical tools such as Excel/R to draw conclusions from sample data.	

9	**Syllabus**

UNIT I: Curve Fitting and Bivariate Distribution

- Understanding the scattered nature of the data, concept of fitting a straight line to the data, method of least squares (only the idea is to be imparted, the proof etc is not expected), fitting a straight line using the method of least squares
  Problems based on
  - plotting scatter diagram of the data.
  - fitting a straight line to the data.
- Bivariate distribution, the concept of correlation, Karl Pearson's coefficient of correlation, correlation does not imply causation, qualitative data and Spearman's Rank correlation coefficient.
  Problems based on
  - identifying Univariate and Bivariate data.
  - finding Karl Pearson's coefficient of correlation.
  - correlation versus causation.
  - obtaining Spearman's Rank correlation coefficient.
- Concept of regression, obtaining regression lines of both types (y on x and x on y), obtaining means and correlation coefficient from regression lines.
  Problems based on
  - finding regression line from the data.
  - finding the point of intersection of the regression lines and verifying that it gives means of x and y.
  - identifying the type (x on y or y on x) regression lines and estimating the values of y for different values of x, estimating values of x for different values of y.

UNIT II: Sampling Theory and Inferential Statistics

- Sampling distributions
  Problems based on
  - Sampling distribution, sampling error, and non-sampling errors
  - Mean and Standard deviation of $\bar{x}$
  - Shape of the sampling distribution of $\bar{x}$
  - Applications of the sampling distribution of $\bar{x}$
- Estimation of the mean
  Problems based on
  - Estimation, point estimate and interval estimate
  - Estimation of a population mean: σ known
  - Estimation of a population mean: σ not known
- Hypothesis tests about mean
  Problems based on
  - Hypothesis tests: An introduction
  - Hypothesis tests about μ: σ known
  - Hypothesis tests about μ: σ not known
- Chi-square tests
  Problems based on
  - The Chi-square distribution
  - A Goodness-of-fit test
- Analysis of variance
  Problems based on

	- The F distribution - One-way analysis of variance (ANOVA) Use of real data published in newspapers or from different sources on internet for the above-mentioned problems is recommended **Technology integration** – Microsoft Excel software / R to be used for practicals. **Case Study 1: IPL Team Performance and Winning Prediction** A sports analyst studies IPL data containing: Runs scored, Strike rate, Wickets taken, Net run rate, Match results **Learners need to**: Plot scatter diagrams between strike rate and runs, Find Karl Pearson's correlation coefficient, Fit regression lines to predict match performance, Analyze whether correlation implies causation, Perform hypothesis testing on team performance **Suggested Data Sources:** Kaggle IPL Datasets, ESPN Cricinfo Statsguru, BCCI Official Website **Suggested AI Tools:** ChatGPT for interpretation and regression analysis guidance, Microsoft Copilot for Excel-based calculations, Tableau Public for dashboards and visualizations **Case Study 2: Relationship Between Study Hours and Academic Performance** A college studies the impact of study habits on learner marks using: Daily study hours, Attendance percentage, Internal marks, Sleep duration, Assignment completion rate **Learners need to**: Identify bivariate data, Construct scatter plots, Compute correlation coefficients, Obtain regression equations, Estimate marks using regression models, Conduct hypothesis testing on average marks **Suggested Data Sources:** Kaggle Learner Performance Datasets, UCI Machine Learning Repository, Google Forms for primary survey data **Suggested AI Tools:** ChatGPT for statistical interpretation, Google Gemini for report generation, Google Colab for regression analysis using Python/R **Case Study 3: Air Pollution and Respiratory Health Analysis** Environmental researchers analyze: AQI levels, PM2.5 concentration, Temperature, Number of respiratory illness cases, Humidity levels **Learners need to**: Analyze correlation between pollution and illness, Fit regression models, Test hypotheses about mean AQI, Perform Chi-square goodness-of-fit tests, Conduct ANOVA for pollution levels across regions **Suggested Data Sources:** Central Pollution Control Board (CPCB), OpenAQ, Data.gov.in **Suggested AI Tools:** ChatGPT for explaining inferential statistics, R Project for ANOVA and Chi-square tests, Orange Data Mining for no-code analytics **Case Study 4: Online Food Delivery and Customer Satisfaction** A food delivery platform studies: Delivery time, Order value, Customer ratings, Distance travelled, Number of complaints **Learners need to**: Analyze correlation between delivery time and ratings, Obtain regression equations, Conduct sampling-based estimation, Test hypotheses about average customer satisfaction, Use ANOVA to compare ratings across delivery zones **Suggested Data Sources:** Kaggle Food Delivery Datasets, Swiggy and Zomato public statistics/reviews, Google Forms for surveys **Suggested AI Tools:** Microsoft Excel for regression and ANOVA, ChatGPT for interpretation and hypothesis testing guidance, Tableau Public for visualization

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No	Title	Marks
1.	Problems / Programs (**four** out of **six**) (three from each unit)	20
2.	Journal	05
3.	In semester participation (Active participation)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Quiz (MCQs/ Match the Pairs/ short answers/ Puzzles)	05
2	Hands-on test of problems/programs	10
3	Project / Seminar / Quiz / case study/ presentation	05
	Total	**20**

11 **References:**

1. Mann, P. S., *Introductory Statistics*, 8th Edition, John Wiley & Sons, Inc., 2013.
2. Anderson, D. R., Sweeney, D. J., and Williams, T. A., *Statistics for Business and Economics*, 11th Edition, Cengage Learning, 2011.
3. Gupta, S. C. and Kapoor, V. K., *Fundamentals of Mathematical Statistics*, 12th Edition, Sultan Chand & Sons, 2020.
4. Gupta, S. C. and Gupta, I., *Business Statistics*, 6th Edition, Himalaya Publishing House, 2013.
5. Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., and Cochran, J. J., *Essentials of Modern Business Statistics with Microsoft Excel*, 7th Edition, Cengage Learning, 2014.
6. Panneerselvam, R., *Business Statistics Using Excel: A Complete Course in Data Analytics*, Routledge (Taylor & Francis), 2024.
7. McClave, J. T. and Sincich, T., *A First Course in Statistics*, 12th Edition, Pearson Education Limited, 2018.
8. Illowsky, B., Dean, S., and Chiappetta, L., *Introductory Statistics*, OpenStax, 2013.
9. Grolemund, G., *Hands-On Programming with R*, O'Reilly Media, 2014.

Smt. Chandibai Himathmal Mansukhani College
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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	**Description of the Course:**	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	**Vertical 5**	**AEC: Advanced English for Workplace and Academic Communication**
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 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	**Course Outcomes**: After completing this course, learners will be able to: **CO-1:** Demonstrate clarity, precision, and professionalism in communication. **CO-2:** Interpret and summarize written texts, visuals, and data accurately. **CO-3:** 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	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** Attempt **Essay Type** question. (1 out of 2) - **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - Unit 2 **OR**	15

	Attempt **Essay Type** question. (1 out of 2) - Unit 2	
	Total	**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	**Marks**
1.	Assignments on **any one** 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
	Total	**20**

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)	Raskar
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	Mothe
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

HSNC Board’s

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

Affiliated to the University of Mumbai

Bachelor of Commerce/ Arts/Science/ SFC (Sindhi)

(AEC – Ability Enhancement Course)
(Aided Course)

Semester – II

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

PREAMBLE

The Bachelor of Commerce (B.Com.) in Sindhi is a comprehensive program designed to develop Sindhi language. Language is the soul of Literature. Sindhi is medium of Communication, Education and Cultural exchange. Curriculum is designed specially in digital age.

Language enriches literature. This curriculum is prepared according to Social, Cultural and Academic needs. The B.Com. Sindhi subject offers students a unique opportunity to explore and widened Sindhi Culture through a wide range of literary programs. The curriculum not only emphasizes literary appreciation and analysis but also fosters ethical awareness, intercultural sensitivity and social responsibility.

The program is committed to developing critical thinking, ethical reasoning and inclusive perspectives. It encourages students to reflect and engage with communication in Sindhi, expertise in Business and Employment Creative work, meditation and listening, use of visual tails, expertise of asking questions, knowledge of different languages through communication.

Language allows us to share our ideas, thoughts, feelings and emotions with others through communication. There is a special contribution of the ideal citizen in nation building. It plays crucial role in creating civilized society.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1 Students will understand the communication skills and role of language in communication.

PSO-2 Students will be able to talk effectively in Sindhi language with friends, relatives and Business customers.

PSO-3 Students will understand aspects of language.

PSO-4 Students will be able to understand the Importance of communication, and they will communicate in different ways i.e. verbal, non-verbal, written and Digital methods.

Smt

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

First Year

Semester- II

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: CHMSINIIAEC

Sr. No.	Heading	Particulars
1	**Description the Course:**	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	**Vertical 1**	AEC – Ability Enhancement Course
3	**Type**	Theory + Practicum (Teaching Method: Lecture/ Discussion/Reading)
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**	50Marks
7	**Course Objectives**: After successful completion of this course: **CO(A) 1:** The learner will get understanding of communication skills. **CO(A) 2:** The learner will understand how to accurate the pronunciation of special words in Sindhi **CO(A) 3:** The learner will improve the conversation skill in Sindhi. **CO(A) 4:** The learner will become best communicator in Sindhi language	
8	**Course Outcomes**: Student will be able to **CO1**: Know the basic special features of Sindhi language. **CO2**: Understand communication skills. **CO3**: Knowing the conversation with businessmen and customers **CO4**: Know the etiquettes with parents, relatives, friends and others in effective way	

9	**Syllabus** **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 जाण हासुल करण, वेंती मोकिलण, अर्ज करण, हिदायतूं डियण, सौली सिंधीअ में गालाईण. ● कम करण वारी जगह ते राबतो ऐ कारोबारी राबतोः ग्राहकनि सा गुफ्तगू, ऑफिस में पूछताछ, परमीशन, शिकायत पत्र, बैंक जे करमचारियुनि सा गुफ्तगू, ग्राहकनि सा गालिहाइणि, 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. ********

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
	Total	**30**
		Total 30

Internal Examination: Continuous Evolution - 20 marks

	Assessment / evaluation	Marks
1.	**Written assignment on any one of the following topics** 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
	Total	**20**

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

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

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

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	**Description the Course:**	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. 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. 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.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

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Syllabus

Unit I - Suggested Areas of Participation in the activities:

- **Cultural Events:** Drama, dance, music, literary events, debates, etc.
- **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives.
- **Clubs & Societies:** Photography, quiz, environment club, shram club, etc.
- **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges.
- **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events.
- **National Festivals:** Independence Day, Republic Day etc.

Unit II - Program Specific Topics

- **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks.
- **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience

Mode of Evaluation:

- **Faculty Coordinator:** To guide and evaluate student progress.
- **Participation Proof:** Certificates, photos, attendance records.
- **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth.
- **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.

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Scheme of Examination and Assessment Pattern
Based on 3 approved Activities
Semester End External - 30 marks

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
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

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
(Mathematics)
(Aided Course)

Semester – III

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

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Second Year B.Sc. (Mathematics)

Semester- III

Title: Real Analysis and Linear Algebra I

Vertical - 1
Major (Theory) - 2 Credit

With effect from Academic Year 2026-2027

Title: Real Analysis and Linear Algebra I
(Course Code : CHMMTIII1)

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course aims to provide understanding of Real Analysis and Linear Algebra. The students will delve into concepts like Series, Riemann integration of functions, system of linear equations, vector space, linear dependence/ independence of vectors, and linear span of vectors.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech based learning/flipped class room/problem based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: CO(A) 1. To explain students, the concepts of convergence / divergence of infinite series and use the tests related to their convergence, such as comparison test, ratio test, root test, p-series test, Leibnitz test. CO(A) 2. To make students learn to analyze definition/concepts/results of Riemann integrability, Riemann criteria, algebra of Riemann integrable functions, R-integrability for monotone continuous functions and functions with finite discontinuities. Apply the Fundamental theorem (first form and second form) to solve the problems. CO(A) 3. To enable students to solve homogeneous and non-homogeneous systems of linear equations and analyze the nature of their solutions using matrices and elementary row operations. CO(A) 4. To introduce students to the fundamental concepts of vector spaces, subspaces, linear span, and linearly dependent and independent sets.	
8	**Course Outcomes**: On completion of the course, learner should be able to CO 1 explain the concepts such as convergence/divergence of infinite series. Execute the tests related to infinite series such as comparison test, ratio test, root test, p-series test, Leibnitz test. determine conditional convergence and absolute convergence of infinite series. 1,2, 3 CO 2 Interprete the concept of Riemann integrability. Use Riemann criteria to show algebra of R-integrable functions, R-integrability of monotone continuous functions and function with finite discontinuities. Solve problems by Fundamental theorem (first form and second form). CO 3 apply matrix techniques to solve homogeneous and non-homogeneous systems of linear equations and explain the conditions for consistency, uniqueness, and the nature of their solutions. CO 4 identify whether a given subset of a vector space is a subspace, find the linear span of a set, and differentiate between linearly dependent and independent sets	

9	**Syllabus**

UNIT I: Infinite Series, Riemann Integration and its Applications

- Infinite series in $\mathbb{R}$: Definition of convergence and divergence of infinite series with examples. Elementary standard results, Cauchy Criterion (statement only), Algebra of convergent series (statements only).
- Tests for convergence: Comparison Test, Limit comparison Test, Ratio Test, Root Test, $p-$series test, Leibnitz's Test for alternating series (Statements only). Definition and Standard Results about Absolute and conditional convergence.
- Riemann integral of a bounded real valued function defined on closed and bounded interval: motivation and definition, criterion for Riemann integrability, characterization of the Riemann integral as the limit of a sum (statement only). Algebra of Riemann integrable functions and standard results (statements only).
- Riemann integrability of monotone, continuous function. Riemann integrability of functions with finitely many discontinuities (only statement).
- First and Second Fundamental Theorems of Calculus (statements only).

Unit II: System of Linear Equations, Matrices and Vector Spaces

- System of homogeneous and non-homogeneous linear equations with geometric interpretation of the solutions. Echelon form of a matrix, Gaussian elimination. Sufficient condition for a homogeneous system to have infinite solutions. Applications of system of linear equations to real world scenarios.
- Elementary matrices and their relation with elementary row operations, result relating invertibility of a square matrix and its reduced row echelon form and applying it to finding inverse of a matrix.
- Equivalence of the row rank and the column rank (statement only).
- Necessary and sufficient condition for a system of non-homogeneous linear equations to have a solution (statement only) and nature of its solutions, equivalence of the following statements:
    - The system AX = b of non-homogeneous linear equations has a unique solution.
    - The system AX = 0 of homogeneous linear equations has no nontrivial solution.
    - A is invertible.
    - det A $\neq$ 0.
    - rank(A) = n
- Vector space over $\mathbb{R}$: definition, examples, subspaces, criterion for a nonempty subset to be a subspace of a vector space. Intersection, union and sum of subspaces. Linear span, linear dependence and independence of subsets of a vector space.

Technology and AI Integration: Digital tools such as GeoGebra, SageMath, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11

References:

1. Sudhir Ghorpade, Balmohan Limaye; A Course in Calculus and Real Analysis (second edition); Springer, 2006.
2. R.R. Goldberg; Methods of Real Analysis; Oxford and IBH Pub. Co., New Delhi, 1970.
3. R.G. Bartle and D. R. Sherbert; Introduction to Real Analysis Second Ed.; John Wiley, New York, 1992.
4. D. Somasundaram and B. Choudhary; A First Course in Mathematical Analysis, Narosa, New Delhi, 1996.
5. Calculus and Analytic Geometry (Ninth Edition); Thomas and Finney; Addison-Wesley, Reading Mass., 1998.
6. T. Apostol; Calculus Vol. 1; John Wiley, 1991.
7. Howard Anton and Chris Rorres; Elementary Linear Algebra, 11th Edition, Wiley, 2013.
8. Serge Lang; Introduction to Linear Algebra, 2nd Edition, Springer, 1986.
9. S. Kumaresan; Linear Algebra: A Geometric Approach, Prentice-Hall of India, 2000.
10. Ajit Kumar, S.Kumaresan; A Basic Course in Real Analysis; CRC Press, 2014

	11. J. Stewart; Calculus, Booke/Cole Publishing Co, 1994. 12. J. E. Marsden, A.J. Tromba and A. Weinstein; Basic Multivariable Calculus; Springer, 1993. 13. M. H. Protter; Basic Elements of Real Analysis; Springer-Verlag, New York, 1998. 14. Gareth Williams; Linear Algebra with Applications, 6th Edition, Jones and Bartlett Publishers, 2008.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- III

Title
Practical based on Real Analysis and Linear Algebra I

Vertical - 1
Major (Practical) - 2 Credits

With effect from
Academic Year 2026-2027

Title: Practical based on Real Analysis and Linear Algebra I
(Course Code: CHMMTIII2)

Sr. No.	Heading	Particulars
1	**Description the Course:**	Problem-solving is a fundamental aspect of any Mathematics course. While advanced courses often emphasize the theoretical nature of the subject, engaging students in problem-solving reinforces concepts and enhances their ability to analyse existing problems and devise solutions. This activity not only motivates students but also empowers them to formulate new results, propose conjectures, and develop innovative theories.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Group discussion/tech-based learning/problem-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To explain students to apply the concepts of convergence / divergence of infinite series and lead to analyze their convergence using comparison test, ratio test, root test, p-series test, Leibnitz test. **CO(A) 2** To facilitate students' understanding of Riemann integrability and enable them to apply these concepts to solve problems using R-integrability of monotone, continuous functions and Fundamental theorem of Integral Calculus. **CO(A) 3** To develop students problem-solving skills for solving homogeneous and non-homogeneous systems of linear equations and analysing the nature of their solutions. **CO(A) 4** To enable students to identify/verify vector spaces and subspaces, find the linear span of a set of vectors, and check linear dependence and independence of sets.	
8	**Course Outcomes**: On completion of the course, learner should be able to **CO 1** use the results such as limit form of comparison test, p-series, ratio test and root test to illustrate the convergence/divergence of a series **CO 2** explain the concept of upper sum, lower sum and test the Riemann integrability of a function and solve problems by fundamental theorems of integral calculus. **CO 3** explain the conditions for consistency and the nature of solutions of homogeneous and non-homogeneous systems of linear equations, and apply Gaussian elimination, elementary row operations, determinants, and matrix techniques to solve them. **CO 4** identify vector spaces and subspaces using the subspace criterion, determine the linear span of a given set of vectors, and differentiate between linearly dependent and independent sets.	

9	**Syllabus**

Syllabus

UNIT I: Practicals for Real Analysis

1. Convergent and divergent series and algebra of convergent series.
2. Comparison and limit comparison test.
3. Ratio test and root test.
4. Alternating Series and p-series test, Absolute and conditional convergence
5. Upper sum and lower sum.
6. Riemann integral and its properties.
7. Fundamental Theorems of Calculus.
8. Area between two curves, lengths of plane curves

Unit II: **Practicals for Linear Algebra I**

1. System of homogeneous and non-homogeneous linear equations
2. Gaussian elimination method
3. Elementary row (column) operations and elementary matrices
4. Determinant of a matrix, row space, column space, row rank and column rank, rank of a matrix
5. Consistency of system of linear equations (using determinants) and LU Decomposition
6. Vector spaces, subspaces, Linear span of a subset, Linearly independent set, linearly dependent set
7. **Applications of Matrices and Vector Spaces in Social Networks and Music Analytics**: **AI-Assisted Case Study**: Using reference texts as mentioned, students shall explore applications of matrices and vector spaces in social network analysis and music trend analytics. AI-assisted learning tools such as NotebookLM, Claude AI, or ChatGPT, together with Python libraries such as NumPy and Pandas, may be used for conceptual understanding and computational illustration. Students shall verify mathematical concepts through examples and computations and prepare a brief report highlighting the applications and conclusions of their study.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

	B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Sudhir Ghorpade, Balmohan Limaye; A Course in Calculus and Real Analysis (second edition); Springer, 2006.
2. R.R. Goldberg; Methods of Real Analysis; Oxford and IBH Pub. Co., New Delhi, 1970.
3. R.G. Bartle and D. R. Sherbert; Introduction to Real Analysis Second Ed.; John Wiley, New York, 1992.
4. D. Somasundaram and B. Choudhary; A First Course in Mathematical Analysis, Narosa, New Delhi, 1996.
5. Calculus and Analytic Geometry (Ninth Edition); Thomas and Finney; Addison-Wesley, Reading Mass., 1998.
6. T. Apostol; Calculus Vol. 1; John Wiley, 1991.
7. Howard Anton and Chris Rorres; Elementary Linear Algebra, 11th Edition, Wiley, 2013.
8. Serge Lang; Introduction to Linear Algebra, 2nd Edition, Springer, 1986.
9. S. Kumaresan; Linear Algebra: A Geometric Approach, Prentice-Hall of India, 2000.
10. Ajit Kumar, S.Kumaresan; A Basic Course in Real Analysis; CRC Press, 2014
11. J. Stewart; Calculus, Booke/Cole Publishing Co, 1994.
12. J. E. Marsden, A.J. Tromba and A. Weinstein; Basic Multivariable Calculus; Springer, 1993.
13. M. H. Protter; Basic Elements of Real Analysis; Springer-Verlag, New York, 1998.
14. Gareth Williams; Linear Algebra with Applications, 6th Edition, Jones and Bartlett Publishers, 2008.
15. Deisenroth, Marc Peter; Faisal, A. Aldo; Ong, Cheng Soon, *Mathematics for Machine Learning*, Cambridge University Press, 1st Edition, 2020.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Second Year B. Sc. (Mathematics)

Semester- III

Title: Indian Mathematics

Vertical - 1
Major (IKS) - 2 Credit

With effect from Academic Year 2026-2027

Title: Indian Mathematics
(Course Code: CHMMTIII3)

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course is designed and developed with the aim of providing adequate knowledge to the learners about the enormous contribution of Indian mathematicians in ancient and medieval times, without making any false or unproved pretences about the so-called scientific and technological developments that were, supposedly, existing. The learners will be able to fathom the depth of mathematical thoughts and ideas in ancient and medieval India.
2	**Vertical 1**	Indian Knowledge System
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/problem-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To learn about the significant mathematical contributions in arithmetic by ancient Indian scholars. **CO(A) 2** To study algebraic methods and elements of combinatorics, as seen in ancient Indian texts. **CO(A) 3** To get to know results in geometry and trigonometry discovered by Indian mathematicians. **CO(A) 4** To know the extent to which Indian mathematicians had contributed in the field of Calculus, much before it was thought of in Europe.	
8	**Course Outcomes**: On completion of the course, learner should be able to **CO 1** understand and explain the foundational mathematical contributions in arithmetic made by ancient Indian scholars. **CO 2** learn and apply algebraic and combinatorial methods developed by Indian mathematicians to solve different mathematical problems. **CO 3** evaluate geometrical and trigonometric developments in ancient and medieval India and compare them to the contemporary global methods **CO 4** analyze the foundational elements of Calculus developed in India to evaluate their chronological precedence over European development.	

9	**Syllabus**
	UNIT I: Arithmetic, Algebra and Combinatorics • The Zero and the Decimal System, The early appearance of Zero in ancient Indian texts. • Terms for the higher powers of ten, Different methods of expressing numbers, such as, (a) Aryabhata's method, (b) KaTaPaYaDi system (c) Bhoot-Sankhya Method • Operations with fractions, Operations with zero, Squares and Cubes, Methods to obtain square roots and cube roots, Varga-Sankramana, Quadratic Equations • The problem of Kuttaka (Linear Diophantine Equations) and the methods to solve the same, given by Brahmagupta and Bhaskaracharya. The problem of Varga Prakriti (known as Pell's equations) and the method to solve the same, given by Bhaskaracharya. • Progressions and Series. • Combinatorics as in Pingala's Chhanda:shastra and Bhaskaracharya's Ankapaash • **AI Integration:** Ancient Indian mathematicians relied heavily on algorithmic thinking, which serves as the foundational bedrock for modern machine learning and computational logic. **The Katapayadi System & Text Embedding:** How ancient alphanumeric coding (like *Katapayadi*) mirrors modern NLP text encoding, tokenization, and hashing techniques used to convert words into numerical vectors for AI models. **Unit II**: **Geometry, Trigonometry and Calculus** • Area of triangle and quadrilaterals, including cyclic quadrilateral • Circumference and area of a circle. The value of pi as given by Aryabhata, and as appeared in Shulba-sootras. • Volume of a sphere given by Bhaskaracharya, Volume of pyramid given by Brahmagupta, Brahmagupta's approximate formula to measure circumference of ellipse. • Pythagoras theorem as given by Aryabhata. Pythagorean triplets as appeared in Shulbasootras. The "sine-value" table as given by Aryabhata, Formula to find sine of an angle, given by Bhaskara-I. • Elements of Calculus, as perceived in Indian Mathematical texts. Madhava's Infinite series for sine, cosine, arctangent and pi • **AI Integration:** **Curve Fitting & Regression (Aryabhata's Sine-Values)** **Concept:** How AI learns continuous functions from data. **Task:** Use 5 lines of Python code (numpy and matplotlib) to plot Aryabhata's historical sine tables. **AI Lesson:** Show how standard regression tools "fit a curve" through these data points, just like a basic AI model learns to make predictions.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **C. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

D. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11

References:

1. Aryabhatiya of Aryabhata (volume I and II), edited by Kripa Shankar Shukla, Indian National Science Academy, New Delhi, 1976
2. Mahaviracharya's Ganit-Sar-Sangraha, edited by L.C. Jain, Jaina Sanskriti Sanrakshaka Sangha, Sholapur, 1980
3. Brahmasphutsiddhanta (volume I, II, III and IV), edited by Acharyavara Ram Swarup Sharma, Indian Institute of Astronomical and Sanskrit Research, New Delhi, 1976
4. Colebrook's translation of the Lilavati with notes, by Haran Chandra Banerjee, 1893
5. A History of Mathematics, by Carl Boyer, John Willey and Sons, 2011
6. History of science and technology in India, by Dr. Binod Bihari Satpathy, Himalaya Publishing House, 2025
7. Mathematics in India, by Kim Plofker, Princeton University Press, 2009
8. The Imperishable Seed, by Dr. Bhaskar Kamble, Garud Prakashan Private Limited, Gurgaon, 2024.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- III

Title: Basic Mathematics in Real Life-II

Vertical -2
Minor (Theory)-2 Credits

with effect from
Academic Year 2026-2027

Title: Basic Mathematics in Real Life-II

(Course Code: CHMMTIII4)

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course introduces fundamental concepts in algebra and linear systems, including solving and graphing polynomials, polynomial interpolation, and matrix operations. It covers systems of linear equations using Gaussian Elimination, explores conditions for solution uniqueness, and applies mathematical methods to real-world problems in forest management and electrical circuits. Euler's formula is introduced for analyzing geometric figures.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech based learning/flipped class room/problem based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to the fundamental concepts of polynomials, interpolation, and matrices, including their algebraic properties and graphical representations. **CO(A) 2** To develop students' ability to apply mathematical techniques for solving polynomial equations, interpolation problems, and matrix operations. **CO(A) 3** To enable students to understand and solve systems of linear equations using appropriate algebraic methods and interpret the uniqueness of solutions. **CO(A) 4** To facilitate the application of linear algebra concepts in real-world contexts such as forest management, electrical networks, and graph-based problems	
8	**Course Outcomes**: On completion of the course, learner should be able to CO 1 Solve and analyze quadratic and cubic polynomial equations, and interpret the relationship between roots and coefficients through graphical representations. CO 2 Apply polynomial interpolation techniques and matrix operations, including matrix multiplication and inverse calculation, to solve mathematical problems. CO 3 Apply Gaussian elimination and matrix methods to obtain solutions of systems of linear equations and determine conditions for uniqueness of solutions. CO 4 Analyze mathematical models based on linear systems and **interpret** their applications in areas such as forest management, Kirchhoff's laws, and planar graph problems.	

9	**Syllabus**

UNIT I: Polynomials, Interpolation and Matrices

- Solving a quadratic equation: conditions for repeated roots, discriminant
- Plotting a polynomial graph for degree two when roots are real. Example: (monic; not monic)
- Relation between roots and coefficients of a polynomial (degree two), plotting polynomial of degree three (some specific examples).
- Polynomial interpolation: Statement of the problem and motivation; calculation in degree two and degree three. Simple Examples
- Matrices multiplication and examples
- Finding inverse of a matrix using elementary matrices.
- Finding inverse of a matrix using Adjoint of a matrix.

Unit II: **System of Linear Equations and its Applications.**

- System of linear equations.
- Gaussian Elimination method to find solutions to system of linear equations.
- Relation between invertibility and uniqueness of solution to a linear system of equations (only statement) and examples.
- Application to Forest management.
- Application to Kirchhoff's laws.
- Counting edges, faces, and vertices in planar and non-coplanar figures. Statement of Euler's formula.

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

E. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

	F. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. Weyl, H., *Symmetry*, Princeton University Press, 1952.
2. Anton, H. and Rorres, C., *Elementary Linear Algebra: Applications Version*, 10th Edition, John Wiley & Sons, 2010.
3. Gallian, J. A., *Contemporary Abstract Algebra*, 8th Edition, Cengage Learning, 2013. (Indian Edition: Narosa Publishing House)
4. Tipler, P. A. and Mosca, G., *Physics for Scientists and Engineers: Electricity, Magnetism, Light, and Elementary Modern Physics*, 5th Edition, W. H. Freeman and Company, 2004.
5. Lay, D. C., Lay, S. R., and McDonald, J. J., *Linear Algebra and Its Applications*, 5th Edition, Pearson, 2016.
6. Strang, G., *Introduction to Linear Algebra*, 5th Edition, Wellesley-Cambridge Press, 2016.
7. Friedberg, S. H., Insel, A. J., and Spence, L. E., *Linear Algebra*, 5th Edition, Pearson, 2018.
8. Kumar, M., *A Textbook of Linear Algebra*, S. Chand Publishing, latest edition.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Second Year B. Sc. (Mathematics)

Semester- III

Title: Practical based on Basic Mathematics in Real Life - II

Vertical - 2
Minor (Practical) - 2 Credit

With effect from
Academic Year 2026-2027

Title: - Practical based on Basic Mathematics in Real Life - II
(Course Code: CHMMTIII5)

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This practical course develops computational skills in polynomial, interpolation, and matrix algebra, including row reduction and matrix inversion. Students solve systems of linear equations using Gaussian elimination and determinants, with a focus on interpreting solution types. Real-life applications such as forest management, Kirchhoff's Law, and Euler's Formula are explored to reinforce the practical relevance of algebraic concepts.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Practical Group discussion/Tech based learning/flipped class room/problem based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to computational techniques for solving polynomial equations, interpolation problems, and matrix operations using systematic mathematical procedures. **CO(A) 2** To develop students' practical skills in applying matrix methods, row reduction techniques, and inverse computation for solving algebraic problems. **CO(A) 3** To enable students to understand and implement methods for solving systems of linear equations and interpreting their solutions geometrically. **CO(A) 4** To facilitate the application of linear algebraic techniques in real-world contexts such as resource management, electrical networks, and graph-based problems.	
8	**Course Outcomes**: On completion of the course, learner should be able to **CO 1** Compute and analyze roots of polynomial equations, polynomial graphs, and interpolation models for representing and interpreting data. **CO 2** Apply matrix operations, row-reduction techniques, and inverse methods to solve problems involving matrices of different orders. **CO 3** Solve and interpret systems of linear equations using Gaussian elimination and determinant methods, and classify the nature of solutions. **CO 4** Analyze and apply linear system models to practical problems involving resource management, electrical networks, and Euler's formula for geometric structures	

9

Syllabus

UNIT I: Polynomials, Interpolation and Matrices

- Computing roots for quadratic equations.
- Plotting polynomials of degree at most three.
- Polynomial Interpolation with Examples.
- Polynomial Interpolation in Degree Two and Three.
- Multiplication of matrices of arbitrary sizes.
- Computation of Row-Echelon Form in 2 by 2 and 3 by 3 matrices.
- Computation of Row-Reduced-Echelon Form in 2 by 2 and 3 by 3 matrices.
- Calculating inverses of 2 by 2 matrices and 3 by 3 matrices using elementary matrices.
- Computing cofactors of 2 by 2 and 3 by 3 matrices. Computing adjoint and inverse of 2 by 2 and 3 by 3 matrices
- **Polynomial Modeling and Interpolation: AI-Assisted Case Study:** Using standard texts on Algebra and Numerical Methods, students shall investigate the use of polynomial functions and interpolation in modeling real-world data such as population growth, temperature variation, or business trends. AI-enabled tools such as NotebookLM and Claude AI, together with GeoGebra, Desmos, or spreadsheets, may be used to generate, visualize, and compare interpolation models. Students shall critically evaluate AI-generated explanations and results, validate findings using prescribed references, and prepare a brief report and presentation discussing the mathematical concepts, methodology, visualizations, and conclusions.

Unit II: **System of Linear Equations and its Applications.**

- Examples of systems of linear equations in two variables.
- Examples of systems of linear equations in three variables.
- Geometric interpretation of solutions of system of linear equations in two and three variables.
- Gaussian elimination to solve system of linear equations
- Determining solution of a system using determinant
- Nature of solutions – No solution, Unique solution, Infinite solutions
- Application of system of linear equations to Forest management.
- Kirchhoff's Law in Computing Current in given examples.
- Euler's Formula via Examples..Non-Planar Figures and Relation to Euler's Formula.
- **Applications of Linear Systems in Resource Management and Electrical Networks: AI-Assisted Case Study:** Using standard texts on Linear Algebra and Applied Mathematics, students shall investigate applications of systems of linear equations in forest management, transportation planning, electrical circuit analysis (Kirchhoff's Laws), or other resource-allocation problems. AI-enabled learning tools such as NotebookLM and Claude AI, together with spreadsheet software, GeoGebra, Python, or MATLAB, may be used to formulate and solve mathematical models. Students shall critically evaluate AI-generated solutions, verify results using prescribed references, and prepare a brief report and presentation highlighting the mathematical modeling process, computations, applications, and conclusions.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

C. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

D. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Weyl, H., *Symmetry*, Princeton University Press, 1952.
2. Anton, H. and Rorres, C., *Elementary Linear Algebra: Applications Version*, 10th Edition, John Wiley & Sons, 2010.
3. Gallian, J. A., *Contemporary Abstract Algebra*, 8th Edition, Cengage Learning, 2013. (Indian Edition: Narosa Publishing House)
4. Tipler, P. A. and Mosca, G., *Physics for Scientists and Engineers: Electricity, Magnetism, Light, and Elementary Modern Physics*, 5th Edition, W. H. Freeman and Company, 2004.
5. Lay, D. C., Lay, S. R., and McDonald, J. J., *Linear Algebra and Its Applications*, 5th Edition, Pearson, 2016.
6. Strang, G., *Introduction to Linear Algebra*, 5th Edition, Wellesley-Cambridge Press, 2016.
7. Friedberg, S. H., Insel, A. J., and Spence, L. E., *Linear Algebra*, 5th Edition, Pearson, 2018.
8. Kumar, M., *A Textbook of Linear Algebra*, S. Chand Publishing, latest edition

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- III

Title: **Java Programming**

Vertical 4
SEC-2 Credits

with effect from
Academic Year 2026-2027

Title: **Java Programming**

(Course Code : CHMMTIII7)

<table>
<tr><th>Sr. No.</th><th>Heading</th><th>Particulars</th></tr>
<tr><td>1</td><td>Description of the Course</td><td>This Course introduces learners to the fundamentals of Java programming and object-oriented software development. Students will learn Java syntax, program structure, variables, operators, decision-making, loops, arrays, strings, methods, and constructors using the NetBeans IDE. The course further explores object-oriented programming concepts such as classes, objects, inheritance, encapsulation, and polymorphism, along with basic file handling and simple AI-inspired applications. Through practical exercises and projects, students will develop problem-solving skills and gain hands-on experience in building structured Java applications.</td></tr>
<tr><td>2</td><td>Vertical 4</td><td>SEC</td></tr>
<tr><td>3</td><td>Type
Teaching Method</td><td>Practical
Lecture/group discussion/seminar/tech-based learning etc.</td></tr>
<tr><td>4</td><td>Credit</td><td>2 Credits</td></tr>
<tr><td>5</td><td>Hours allotted</td><td>60 Hours</td></tr>
<tr><td>6</td><td>Marks allotted</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">Course Objectives:
CO(A) 1 To introduce students to the fundamentals of Java programming, including the Java environment, syntax, data types, operators, control structures, arrays, strings, and methods.
CO(A) 2 To develop students' ability to design object-oriented programs using classes, objects, inheritance, polymorphism, constructors, and file handling techniques.
CO(A) 3 To enable students to apply Java programming concepts for developing structured applications, including simple AI-based programs and compare Java with Python for problem-solving.
CO(A) 4 To cultivate problem-solving skills through practical programming exercises, debugging, and the development of efficient Java applications.</td></tr>
</table>

8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** Explain the fundamentals of Java programming, including the Java platform, programming environment, variables, data types, operators, control structures, arrays, strings, methods, and constructors. **CO 2** Apply Java programming constructs to develop and debug programs using decision-making statements, loops, arrays, strings, methods, constructors, and the NetBeans IDE. **CO 3** Analyze object-oriented programming concepts and compare Java with Python for solving structured programming problems, including the use of classes, inheritance, polymorphism, and file handling. **CO 4** Develop Java-based object-oriented and simple AI applications by integrating programming concepts, file handling, and intelligent decision-making techniques to solve real-world problems

9	**Syllabus** **Unit I: Java Programming Fundamentals (30 Hours)** **1. Introduction to Java** • Features of Java • Java vs Python (basic comparison) • JVM, JRE, JDK • Structure of Java program • Compilation and execution process **2. Java Programming Environment** • Source code, compilation, bytecode concept • Working of JVM • Introduction to IDE-based programming **3. NetBeans IDE** NetBeans • Creating a Java project • Writing and running programs • Project structure • Debugging basics • Output window and error handling **4. Variables and Data Types** • Variables and constants • Data types • Type conversion • Input and output using Scanner class

5. **Operators and Expressions**
    - Arithmetic operators
    - Relational operators
    - Logical operators
    - Assignment operators
6. **Decision Making and Looping**
    - if, if-else, nested if
    - switch statement
    - for loop
    - while loop
    - do-while loop
    - break and continue
7. **Arrays and Strings**
    - One-dimensional arrays
    - Two-dimensional arrays
    - String operations
    - String methods
    - Basic array and string processing
8. **Methods and Constructors**
    - Defining methods
    - Method overloading
    - Constructors
    - this keyword

Practicals

1. Basic Java programs
2. Programs using operators and expressions
3. Programs using conditional statements
4. Loop-based programs
5. Array programs
6. String manipulation programs
7. Programs using methods and constructors

Unit II:

Object-Oriented Programming and Applications (30 Hours)

1. **Object-Oriented Programming Concepts**
    - Classes and objects

	• Encapsulation • Inheritance • Polymorphism - method overloading and method overriding **2. File Handling (Basic)** • Reading and writing text files • Simple file operations **3. Python vs Java Perspective** • How Python vs Java solve same problem • When to use Java for structured systems • Strength of OOP in system design **4. Simple AI-Based Programs in Java** • Chatbot using if-else statements • Student grade prediction • Weather suggestion system • Spam word checker using strings • Menu-driven intelligent response system **Practicals (Unit II)** 1. Classes, Objects, and Encapsulation in Java 2. Inheritance and Method Overriding 3. Polymorphism in Java 4. File Handling and Text File Operations 5. Python vs Java Problem Solving Comparison 6. Simple AI-Based Programs in Java 7. Chatbot and Spam Word Checker Using Java
10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **G. External Examination: Semester End External - 30 marks, Time: 3 hour** Structure of Evaluation

Q. No.	Structure of the Questions	Marks
1.	Practical Exam Attempt any four out of six questions (three questions from each unit)	20
2.	In semester participation (Active participation)	05
3.	Journal	05
	Total	**30**

	H. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Quiz (MCQs/ Match the Pairs/ short answers/ Puzzles)	05
2	Mini case study/ test of comprising of problems/programs	15
	Total	**20**

11 **References:**

1. Herbert Schildt, *Java: The Complete Reference*, McGraw Hill Education, 2020.
2. E. Balagurusamy, *Object-Oriented Programming with Java*, McGraw Hill Education, 2017.
3. E. Balagurusamy, *Programming with Java: A Primer*, McGraw Hill Education, 2019.
4. Y. Daniel Liang, *Introduction to Java Programming*, Pearson, 2021.
5. Cay S. Horstmann, *Core Java Volume I*, Pearson, 2022.

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Second Year B.Sc.

Semester- III

Vertical – 5

Ability Enhancement Course (English)

2 Credits

(To be offered to Students who opted Sindhi AEC in Sem I & II)

with effect from Academic Year 2025-2026

Title: Introduction to Communication Skills in English
Course Code: CHMBSCAECIII

Sr. No.	Heading	Particulars
1	**Description the Course:**	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. 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.
2	**Vertical 4**	Ability Enhancement Course
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 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.
8	**Course Outcomes**: 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.

9	**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	**Short Notes** (Attempt any 3 out of 5) - **Unit 1** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 1**	15
Q. 2	**Short Notes** (Attempt any 3 out of 5) - **Unit 2** **OR** **Essay-Type Question** (Attempt any 1 out of 2)- **Unit 2**	15
	Total	**30**

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 **OR** Draft an SoP with the help of the following AI assistance: Quillbot, Yocket, Writesonic, Jasper AI	15
2.		05
	Total	**20**

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)	Raskar
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	Mothe
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)

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.	Description of the Course :	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.	Vertical : 5	AEC
3.	Type : Teaching Method	Theory + Practicum Lecture / Discussion / Presentation / Self Study, etc.
4.	Credit :	2 Credits
5.	Hours Allotted :	30 Hours
6.	Marks Allotted :	50 Marks
7.	Course Objectives : CO(A)1 : विद्यार्थियों को लेखन, वाचन कौशल का ज्ञज्ञन 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.	Course Outcomes : CO1 : विद्यार्थियों का लेखन, वाचन कौशल के ज्ञान प्राप्ति के साथ मौलिक अभिव्यक्ति में बदलाव आएगा । CO2 : विद्यार्थियों का लेखन, वाचन कौशल द्वारा मानसिक विकास होगा, पठन शक्ति, शैली का विकास होगा । CO3 : विद्यार्थियों को लेखन, भाषण कौशल से भषिक – शक्ति, शैलियों का संवर्धन होगा विशेषज्ञता आएगी । CO4 : विद्यार्थियों को लेखन, वाचन, श्रावण, भाषण कौशल की विशेषताओं और उपयोगिता का ज्ञान प्राप्त होगा ।
9.	**Syllabus**
	UNIT I : हिंदी भाषा कौशल के आधार
	1.1 लेखन कौशल का अर्थ एवं स्वरूप लेखन कौशल की उपयोगिता एवं महत्व 1.2 लेखन कौशल की विधियाँ एवं विशेषताएँ 1.3 वाचन कौशल का अर्थ, स्वरूप एवं विशेषताएँ 1.4 वाचन कौशल की उपयोगिता एवं विधियाँ
	UNIT II : हिंदी भाषा कौशल के आधार
	2.1 भाषण कौशल का अर्थ एवं स्वरूप 2.2 भाषण कौशल का महत्व एवं उपयोगिता 2.3 भाषण कौशल की विधियाँ एवं विशेषताएँ 2.4 श्रवण कौशल का अर्थ, स्वरूप एवं विशेषताएँ 2.5 श्रवण कौशल का महत्व एवं उपयोगिता

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
<u>बाह्य मूल्यांकन</u> 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 ☐
कुल अंक		**30**

मूल्यांकन प्रारूप	अंक
<u>आंतरिक मूल्यांकन</u> • AI Writing Tools की सहायता से हिंदी लेखन कौशल का अभ्यास, भाषा-संपादन, व्याकरण सुधार, सारांश लेखन एवं रचनात्मक लेखन करना। • AI की सहायता से दिए गए विषयों पर भाषण, लेख, संवाद एवं लघु-प्रस्तुति तैयार करना तथा भाषा, शैली एवं प्रभावशीलता का विश्लेषण करना। • AI Voice Tools का उपयोग करके हिंदी वाचन, भाषण, उच्चारण, स्वर, गति एवं प्रवाह का अभ्यास करना तथा AI आधारित Feedback प्राप्त करना। • 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। • AI की सहायता से Reading Comprehension, प्रश्नोत्तर, शब्दार्थ, शब्दावली (Vocabulary) एवं भाषा-अभ्यास गतिविधियाँ तैयार करना। • AI आधारित Mock Interview, Group Discussion तथा Public Speaking गतिविधियों के माध्यम से भाषण एवं संप्रेषण कौशल विकसित करना। • AI की सहायता से हिंदी Podcast, Audio Narration एवं Listening Exercises तैयार करना तथा श्रवण कौशल का मूल्यांकन करना।	20
कुल अंक	**20**

11.	**संदर्भ ग्रंथ सूची –** 1. हिंदी भाषा शिक्षण के विविध आयाम – प्राध्यापक डॉ. राठौर, किनले एडिशन 2. अभिनव पत्र लेखन – डॉ. अनिल सिंह 3. हिंदी के व्यावहारिक रूप – डॉ. संतोष मोटवानी, परिदृश्य प्रकाशन, मुंबई 4. हिंदी भाषा लेखन कौशल – गुलीबाबा पब्लिकेशन प्राइवेट लिमिटेड

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 : BMRochlani

Name & Signature of the Dean –

Dr. Nitin Arekar :

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

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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	**Description the Course:**	**(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	**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	**Course Objectives**: **CO(A) 1:** कार्यालयीन लेखन व्यवहार स्वरूप समजावून सांगणे. **CO(A) 2:** कार्यालयीन पत्रव्यवहाराचे स्वरूप समजावून सांगणे,. **CO(A) 3:** प्रभावी कार्यालयीन लेखनासाठी आवश्यक असणाऱ्या क्षमता ऑणि तंत्रांचा परिचय करून देणे,	
8	**Course Outcomes**: प्रस्तुत अभ्यासक्रम शिकल्यानंतर: **CO1**: विद्यार्थ्यांना कार्यालयीन लेखन व्यवहाराचे स्वरूप समजेल, **CO2:** विद्यार्थ्यांना कार्यालयीन पत्रव्यवहाराचे स्वरूप समजेल. **CO3:** प्रभावी कार्यालयीन लेखनासाठी आवश्यक असणाऱ्या तंत्रांचा विद्यार्थ्यांना परिचय होईल.	

9	**Syllabus** **UNIT I कार्यालयीन लेखनव्यवहार** १. जाहीर निवेदन आणि माहितीपत्रक २. इतिवृत्त लेखन ३. टिप्पणी लेखन (६० मिनिटांच्या १५ तासिका, श्रेयांकन १) (सूचना : विद्यार्थ्यांमध्ये उपरोक्त कार्यालयीन लेखन व्यवहार व पत्रव्यवहार करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.) . **UNIT II: कार्यालयीन पत्रव्यवहार** १. कार्यालयीन/प्रशासनिक पत्र २. नोकरीसाठी अर्जलेखन ३. पत्रात्मक लेखन: नवी रूपे (शुभेच्छा, निमंत्रण) (६० मिनिटांच्या १५ तासिका, श्रेयांकन-१) (सूचना : विद्यार्थ्यांमध्ये उपरोक्त कार्यालयीन लेखन व्यवहार व पत्रव्यवहार करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)
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
	Total 30	

Internal Examination: Continuous Evaluation - 20 marks

	Project and presentation / Viva	Marks
1.	• AI च्या साहाय्याने जाहीर निवेदन आणि माहितीपत्रक तयार करणे. त्यामध्ये शीर्षक, उद्दिष्ट, कार्यक्रमाचे वेळापत्रक, संपर्क इत्यादींची आकर्षक मांडणी करणे. • AI साधने वापरून सभेचे Audio/Video नुसार इतिवृत्त तयार करणे.	20

				त्यानंतर विद्यार्थ्यांनी त्यात आवश्यक ती सुधारणा करणे. • AI चा वापर करून कार्यालयीन टिप्पणी तयार करणे. त्यातील भाषा, रचना, औपचारिकता इत्यादींचे परीक्षण करून सुधारित टिप्पणी तयार करणे. • AI साधनांच्या माध्यमातून प्रशासनिक पत्रांचे विविध नमुनारूप तयार करणे. भाषेची औपचारिकता तपासणे. • AI साधनांच्या साहाय्याने नोकरीसाठी अर्ज तयार करणे. दिलेल्या जाहिरातीवर आधारित Cover Letter तयार करणे. • विविध प्रसंगांसाठी AI साधनांच्या आधारे निमंत्रणपत्र व शुभेच्छापत्र तयार करणे. **AI** साधने: ChatGPT, Google Gemini, Claude, Perplexity AI, NotebookLM, Canva, CapCut, InVideo, Grammarly, QuillBot, Whisper, ElevenLabs		
				Total 20		
11	संदर्भ ग्रंथ **(Reference Books) :** १. प्रशासनिक लेखन, भाषा संचालनालय, महाराष्ट्र शासन, मुंबई, १९६६ २. भाषिक सर्जन आणि उपयोजन, राजन गवस, अरुण शिंदे, गोमटेश्वर पाटील, दर्या प्रकाशन, पुणे, २०१२ ३. परब प्रकाश, व्यावहारिक मराठी, मिथुन प्रकाशन, डोंबिवली पूर्व, मुंबई, १९८९ ४. नाईक सदानंद, राजभाषा मराठी, व्यावहारिक मराठी, प्रका-नागरी सेवा प्रबोधिनी, मुंबई, २००२ ५. तावरे स्नेहल (संपा.), व्यावहारिक मराठी, स्नेहवर्धन प्रकाशन, पुणे, चौथी आवृत्ती, २०११ ६. केतकी मोडक, संतोष शेणई, सुजाता शेणई (संपा.), उपयोजित मराठी, पद्मगंधा प्रकाशन, २०१२ ७. नसीराबादकर ल. रा., व्यवहारिक मराठी, भाषा विकास संशोधन संस्था, कोल्हापूर २०२३					

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Second Year

Semester - III

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	**Description the Course:**	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	**Vertical 5**	VEC
3	**Type & Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To introduce about ecosystems, biodiversity and to make aware for the need of conservation. **CO(A)2:** To sensitize students towards environmental concerns, issues, and impacts of human population. **CO(A)3:** To analyze the impact of human population growth and development activities on the environment, including issues related to displacement, disaster response, and rehabilitation. **CO(A)4:** To foster awareness of environmental ethics and the role of cultural and social movements in shaping sustainable environmental practices through communication, policy, and activism.	
8	**Course Outcomes**: Student will be able to **CO1:** Explain the interrelationships within ecosystems and analyze energy flow and succession, using examples from various ecological zones. **CO2:** Critically evaluate biodiversity levels and conservation strategies, applying knowledge of endemic species, threats, and ecological services to real-world scenarios. **CO3:** Assess the socio-environmental implications of population growth, displacement, and disasters, incorporating case studies to understand sustainable development challenges. **CO4:** Demonstrate an understanding of environmental ethics and advocacy, by interpreting the influence of cultural values, environmental movements, and communication strategies on sustainability.	

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
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
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
TOTAL		**20**

11 **REFERENCES:**

1. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press.
3. Gleeson, B., & Low, N. (Eds.). (1999). *Global Ethics and Environment*. Routledge.
4. Gleick, P. H. (1993). *Water in Crisis*. Pacific Institute for Studies in Development, Environment & Security; Stockholm Environment Institute; Oxford University Press.
5. Sodhi, N. S., Gibson, L., & Raven, P. H. (Eds.). (2013). *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
6. Thapar, V. (1998). *Land of the Tiger: A Natural History of the Indian Subcontinent*.
7. Warren, C. E. (1971). *Biology and Water Pollution Control*. W. B. Saunders.
8. Wilson, E. O. (2006). *The Creation: An Appeal to Save Life on Earth*. W. W. Norton.
9. Harper, Charles L. (2017). *Environment and Society: Human Perspectives on Environmental Issues* (6th Edition). Routledge.
10. Rajagopalan, R. (2011). *Environmental Studies: From Crisis to Cure*. Oxford University Press.
11. Harris, Frances (2012). *Global Environmental Issues* (2nd Edition). Wiley-Blackwell.

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

Dr. Nitin Arekar

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	**Description the Course:**	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. 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. 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.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9

Syllabus

Unit I - Suggested Areas of Participation in the activities:

- **Cultural Events:** Drama, dance, music, literary events, debates, etc.
- **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives.
- **Clubs & Societies:** Photography, quiz, environment club, shram club, etc.
- **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges.
- **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events.
- **National Festivals:** Independence Day, Republic Day etc.

Unit II - Program Specific Topics

- **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks.
- **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience

Mode of Evaluation:

- **Faculty Coordinator:** To guide and evaluate student progress.
- **Participation Proof:** Certificates, photos, attendance records.
- **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth.
- **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.

10

Scheme of Examination and Assessment Pattern
Based on 3 approved Activities
Semester End External - 30 marks

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
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

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

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Com.

Semester- III

Title: Field project

Vertical - 6
Field Project 2 Credits

with effect from
Academic Year 2025-2026

Title: Field Project
Course code:

Sr. No.	Heading	Particulars
1	**Description the Course:**	The Field Project course, introduced under CHM Autonomy in alignment with the NEP 2020, aims to bridge theoretical knowledge with practical experience. It provides students with hands-on exposure to real-world socio-economic contexts through field visits, observation, and analysis in both urban and rural settings. By engaging directly with development-related issues, students enhance their research, problem-solving, and analytical skills while fostering social responsibility and environmental awareness. The course ultimately prepares learners for employability and active participation in nation-building.
2	**Vertical 6**	Field Project
3	**Type & Teaching Methods**	Field work
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** 1. To connect theoretical learning with real-world socio-economic contexts through practical field experiences. 2. To develop analytical, problem-solving, and teamwork skills in addressing contemporary social issues. 3. To cultivate an appreciation for research and its role in promoting societal and national development.	
8	**Learning Outcomes:** **students will be able to:** **LO1**: Apply classroom knowledge to analyze real-life socio-economic challenges effectively. **LO2**: Demonstrate critical thinking, teamwork, and decision-making skills through field-based activities. **LO3**: Reflect on the relevance of research and experiential learning in contributing to social and national progress.	

9

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

External Examination: Semester End External - 30 marks

Format of Question Paper

Nature of Evaluation	Marks
Field Project Report	30
	Total 30

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Involvement in Survey of Field Project /	05
2.	Field visit participation & completion	10
3.	Overall Impression	05
		Total 20

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/Principal**

Board of Examination

Principal & Chief Controller
Board of Examination

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science

(Mathematics)

(Aided Course)

Semester – IV

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

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- IV

Title: Multivariable Calculus and Ordinary Differential Equations

Vertical - 1
Major (Theory) - 2 Credits

With effect from
Academic Year 2026-2027

Title: Multivariable Calculus and Ordinary Differential Equations

(Course Code: CHMMTIV1)

Sr. No.	Heading	Particulars
1	**Description of the Course**	Multivariable Calculus and Differential Equations find extensive applications in diverse fields such as Physics, Chemistry, Biotechnology, Engineering, and more. This course seeks to provide learners with a comprehensive understanding of Multivariable Calculus, building upon a rigorous foundation laid by Mathematical Analysis. Through the exploration of various properties of derivatives of scalar fields and vector fields, students will gain valuable insights into the analytical aspects of Multivariable Calculus. This course also develops skills to solve nth order Homogeneous and Non homogeneous linear differential equations, focusing 2^{nd} order linear differential equations.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech-based learning etc.
4	**Credits**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to the concepts of scalar and vector fields, continuity, differentiability, and fundamental tools of multivariable calculus. **CO(A) 2** To develop students' ability to apply partial derivatives, directional derivatives, gradients, total derivatives and optimization techniques for analyzing functions of several variables. **CO(A) 3** To enable students to understand the theory and methods of higher-order linear differential equations and their solution techniques. **CO(A) 4** To facilitate the application of differential calculus and differential equation methods in mathematical modeling and problem-solving contexts.	
8	**Learning Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain and analyze scalar and vector fields, limits, continuity, partial derivatives, directional derivatives, and differentiability of functions of several variables. **CO 2** apply gradient, chain rule, Taylor's theorem, and optimization techniques to determine directional rates of change, compute equation of tangent planes, and extrema of scalar fields.	

	CO 3 solve higher-order homogeneous linear differential equations using characteristic equations and appropriate solution methods. **CO 4** apply and analyze methods such as inverse differential operators, variation of parameters, and undetermined coefficients to obtain solutions of non-homogeneous linear differential equations.
9	**Syllabus** **UNIT I: Continuity and Differentiability of Scalar Fields and Applications** • Real-valued functions of several variables (Scalar fields). Graph of a function. Level sets (level curves, level surfaces, etc). Examples. Vector valued functions of several variables (Vector fields). Component functions. Examples. • Sequence in $\mathbb{R}^n$ [with emphasis on $\mathbb{R}^2$ and $\mathbb{R}^3$] and their limits. Neighbourhoods in $\mathbb{R}^n$. Limits and continuity of scalar fields. Algebra of limits and continuity (without proofs). Iterated limits. • Definitions of partial derivative and directional derivative of scalar fields (with emphasis on $\mathbb{R}^2$ and $\mathbb{R}^3$). Mean Value Theorem of scalar fields. • Differentiability of scalar fields (in terms of linear transformation). The concept of (total) derivative. Uniqueness of total derivative of a differentiable function at a point, basic results such as (i) continuity at a point of differentiability, (ii) existence of partial derivatives at a point of differentiability and (iii) differentiability when the partial derivatives exist and are continuous. • Gradient. Relation between total derivative and gradient of a function. Chain rule (without proof). Geometric properties of gradient. Tangent planes. • Euler's Theorem, Higher order partial derivatives. Mixed Partial Derivatives Theorem for $n = 2$ (without proof). • Taylor's Theorem for twice continuously differentiable functions (without proof). • The maximum and minimum rate of change of scalar fields. Notions of local maxima, local minima and saddle points. Hessian matrix, First Derivative Test, Second Derivative Test for functions of two variables (statement only). Examples. **UNIT II: Homogeneous and Non-homogeneous Higher Order Linear Differential Equations** The general $n-$th order linear differential equation, linear independence of solutions of LDE, existence and uniqueness theorem (Statement only), Wronskian, classification of D.E.: homogeneous and non-homogeneous, general solution of homogeneous and non-homogeneous LDE, the differential operator and its properties. • Higher order homogeneous linear differential equations with constant coefficients, the auxiliary equations, roots of the auxiliary equations: real and distinct, real and repeated, complex and complex repeated. • Non-homogeneous equations: The inverse differential operator and particular integral, evaluation of $\frac{1}{f(D)}$ (without proof) for the functions like e^{ax}, $\sin ax$, $\cos ax$, x^m, $x^m \sin ax$, $x^m \cos ax$, $e^{ax}V$ and xV where V is any function of x. • The method of variation of parameters, undetermined coefficients

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	**Particulars**	**Marks**
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11

References:

1. Apostol, T. M., *Calculus, Volume II*, 2nd Edition, John Wiley & Sons, 1969.
2. Ghorpade, S. R. and Limaye, B. V., *A Course in Multivariable Calculus and Analysis*, 2nd Edition, Springer, 2010.
3. Rudin, W., *Principles of Mathematical Analysis*, 3rd Edition, McGraw-Hill, 1976.
4. Marsden, J. E., Tromba, A. J., and Weinstein, A., *Basic Multivariable Calculus*, Springer, 1993.
5. Somasundaram, D. and Choudhary, B., *A First Course in Mathematical Analysis*, Narosa Publishing House, New Delhi, 1996.
6. Stewart, J., *Calculus*, Brooks/Cole Publishing Company, 1994.

	7. Simmons, G. F., *Differential Equations with Applications and Historical Notes*, 3rd Edition, CRC Press (Taylor & Francis), 2017. 8. Rainville, E. D. and Bedient, P. E., *Elementary Differential Equations*, Macmillan Publishing Company. 9. Thomas, G. B. and Finney, R. L., *Calculus and Analytic Geometry*, 9th Edition, Addison-Wesley, 1998. 10. Anton, H., *Calculus: A New Horizon*, 6th Edition, John Wiley & Sons, 1999. 11. Gupta, S. L. and Rani, N., *Principles of Real Analysis*, Vikas Publishing House Pvt. Ltd. 12. Shabanov, S., *Concepts in Calculus III: Multivariable Calculus*, University Press of Florida, 2012. 13. Malik, S. C. and Arora, S., *Mathematical Analysis*, New Age International Publishers. 14. Coddington, E. A. and Carlson, R., *Linear Ordinary Differential Equations*, SIAM. 15. Raisinghania, M. D., *Ordinary and Partial Differential Equations*, S. Chand Publishing.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B.Sc.
(Mathematics)

Semester- IV

Title: Linear Algebra II

Vertical - 1
Major (Theory) - 2 Credits

With effect from
Academic Year 2026-2027

Title: Linear Algebra II

(Course Code : CHMMTIV2)

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces fundamental concepts of Linear Algebra, including bases of vector spaces over $\mathbb{R}$, linear transformations, eigenvalues, and eigenvectors. It also covers inner product spaces, orthogonality, diagonalization, and the spectral theorem. Emphasis is placed on understanding theoretical concepts and applying them to problems involving matrices, quadratic forms, and conic sections.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech-based learning/flipped class room/problem-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to the concepts of vector spaces, bases, dimension, and linear transformations and their fundamental properties. **CO(A) 2** To enable students to study eigenvalues, eigenvectors, characteristic polynomials, and their applications in solving problems. **CO(A) 3** To familiarize students with inner product spaces and the concepts of orthogonality and orthonormality. **CO(A) 4** To enable students to apply the process of diagonalization and the Spectral Theorem to quadratic forms.	
8	**Learning Outcomes**: On completion of the course, learner should be able to **CO 1** explain the concepts of basis, dimension, and linear transformations, and apply the properties of kernels, images, and the Rank–Nullity Theorem to solve problems. **CO 2** compute eigenvalues and eigenvectors of matrices and linear transformations and examine their properties while applying the Cayley–Hamilton Theorem to solve matrix problems. **CO 3** identify inner product spaces and orthogonal vectors, and apply the concepts of orthogonality, orthonormality, and the Gram–Schmidt process to solve problems. **CO 4** explain the procedure for diagonalization and evaluate real symmetric matrices using the Spectral Theorem to identify quadratic forms.	

9

Syllabus

UNIT I: Basis, Linear Transformations, Eigenvalues and Eigenvectors

- Basis and dimension of a vector space. Bases of a vector space as a maximal linearly independent set and minimal generating sets (without proof). Sum of subspaces and its dimension.

- Linear transformation and its elementary properties. Sum, Scalar multiples and composition of linear transformations.

- Kernel and Image of a linear transformation and Rank Nullity Theorem.

- Matrix associated with linear transformation $T: V \to W$, where V and W are finite dimensional vector spaces over $\mathbb{R}$. Linear Isomorphisms. Effect of change of bases on matrix of a linear operator.

- Characteristic polynomial and its properties (only statements). Eigenvalues and eigenvectors of a square matrix and a linear transformation from a vector space to itself. The eigenvectors corresponding to distinct eigenvalues are linearly independent. Eigen spaces. Algebraic and geometric multiplicities of an eigenvalue. Cayley-Hamilton theorem (only statement) and its applications.

Unit II: **Inner Product Space, Orthogonality and Diagonalization**

- Inner product space over $\mathbb{R}$. Norm associated to inner product. Cauchy Schwarz inequality. Triangle inequality.

- Angle between two vectors, Orthogonality of vectors, Pythagoras theorem, Orthogonal and Orthonormal sets. Gram Schmidt orthogonalization process. Orthogonal and orthonormal basis for a finite dimensional inner product space.

- Orthogonal complement of any set of vectors in an inner product space. Orthogonal projection of a vector onto a line.

- Diagonalizable matrix. A real square matrix A is diagonalizable if and only if there is a basis of $\mathbb{R}^n$ consisting of eigenvectors of A. $A_{n\times n}$ is diagonalizable if and only if algebraic multiplicity is equal to geometric multiplicity for all the eigenvalues of A (statement only). Procedure for diagonalizing a matrix.

- Spectral Theorem for Real Symmetric Matrices (Statement only). Examples of orthogonal diagonalization of real symmetric matrices. Applications to quadratic forms and identification of conic sections.

Technology and AI Integration: Digital tools such as GeoGebra, SageMath, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **C. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

D. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	**Particulars**	**Marks**
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. Howard Anton and Chris Rorres ,*Elementary Linear Algebra*, 11th Edition, Wiley, 2013.
2. Serge Lang, *Introduction to Linear Algebra*, 2nd Edition, Springer, 1986.
3. S. Kumaresan, *Linear Algebra: A Geometric Approach*, Prentice-Hall of India, 2000.
4. Sheldon Axler,*Linear Algebra Done Right*, 3rd Edition, Springer, 2015.
5. Gareth Williams,*Linear Algebra with Applications* 6th Edition, Jones and Bartlett Publishers, 2008.
6. David W, Lewis,*Matrix, Theory*, World Scientific Publishing Company, 1991.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- IV

Title

Practical based on Multivariable Calculus, Linear Algebra II and Ordinary Differential Equations

Vertical - 1
Major (Practical) - 2 Credits

With effect from
Academic Year 2026-2027

Title: Practical based on Multivariable Calculus, Linear Algebra II and Ordinary Differential Equations
(Course Code: CHMMTIV3 **)**

Sr. No.	**Heading**	**Particulars**
1	**Description the Course:**	This practical course develops computational skills in multivariable calculus, differential equations, and linear algebra. Students learn to analyze scalar fields, solve higher-order ODEs, and apply optimization techniques. The course also builds proficiency in linear transformations, matrix representations, orthogonality, eigen-analysis, and diagonalization, enabling students to model, interpret, and solve mathematical problems arising in science and engineering.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Group discussion/tech-based learning/problem-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO 1** To introduce students to computational techniques for multivariable calculus, including differentiation, optimization, and solutions of ordinary differential equations using mathematical software/tools. **CO 2** To develop students' practical skills in analyzing scalar fields, computing derivatives, and applying optimization methods to solve mathematical and real-world problems. **CO 3** To develop students problem-solving skills in working with bases, dimensions, linear transformations, kernels, matrix representations, and isomorphisms. **CO 4** To enable students to investigate inner product spaces, orthogonality, eigenvalues, eigenvectors, and diagonalization through practical computations.	
8	**Learning Outcomes**: On completion of the course, learner should be able to **CO 1** compute and analyze limits, continuity, partial derivatives, gradients, Jacobian/Hessian matrices, and extrema of scalar fields using appropriate mathematical techniques. **CO 2** solve and interpret higher-order ordinary differential equations using methods such as Wronskian, undetermined coefficients, variation of parameters, and evaluate their applications in real-world problems. **CO 3** explain the concepts of basis, dimension, and linear transformations, and apply them to determine kernels, matrix representations, and isomorphisms of linear transformations. **CO 4** identify orthogonal and orthonormal sets, apply the Gram–Schmidt orthogonalization process and diagonalization techniques, and evaluate quadratic forms using the Spectral Theorem.	

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Syllabus

UNIT I: Practical based on Multivariable Calculus and Ordinary Differential Equations

1. Limits and continuity of scalar fields, iterated limits, Directional derivatives. Partial derivatives and mean value theorem
2. Differentiability of scalar field and total derivative
3. Gradient, level sets and tangent planes, Chain rule, higher order partial derivatives and mixed partial derivatives of scalar fields
4. Maximum and minimum rate of change of scalar fields. Computing Hessian / Jacobian matrix. Taylor's theorem.
5. Finding maxima, minima and saddle points. 1^{st} & 2^{nd} derivative test for extrema of functions of two variables
6. Wronskian and Linear independence of solutions, Higher order homogeneous linear differential equations with constant coefficients. Method of undetermined coefficients, Method of variation of parameters
7. Evaluation of particular integral for $X = e^{ax}, \sin ax , \cos ax, e^{ax}V , x^m,$ $x^m \sin ax , x^m \cos ax$. and $X = xV$ where V is any function of x
8. Applications of Multivariable Optimization and Differential Equations:
AI-Assisted Case Study: Using standard reference texts as suggested, students shall investigate real-world applications of multivariable optimization and differential equations in areas such as economics, population growth, epidemiology, heat transfer, and engineering systems. AI-enabled learning tools such as NotebookLM and Claude AI, together with visualization software such as GeoGebra, Desmos, MATLAB, or Python, may be used to explore mathematical models and visualize solutions. Students shall critically evaluate AI-generated explanations and solutions, validate findings using prescribed reference materials, and prepare a brief report and presentation highlighting the mathematical concepts, methodology, results, and conclusions of their study.

Unit II: **Practical based on Linear Algebra II**

1. Basis and dimension of a vector space.
2. Linear transformation, kernel and Rank Nullity Theorem.
3. Matrix representation of a linear transformation and Isomorphism
4. Inner product space and Orthogonal complement of a subspace
5. Gram Schmidt Orthogonalization Process , Eigenvalues, eigenvectors, Cayley Hamilton Theorem and its Applications.
6. Diagonalization of Matrices and Quadratic forms.
7. Applications of Linear Algebra in Search Engines and Text Classification: AI-Assisted Case Study: Using reference texts as mentioned, students shall explore applications of linear algebra in search engine ranking and text/document classification. AI-assisted learning tools such as NotebookLM, Claude AI, or ChatGPT, together with Python libraries such as NumPy and Pandas, may be used for conceptual understanding and computational illustration.

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10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks Time: 2 hours** Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4×3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2×4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test (Duration: 30 minutes) Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Apostol, T. M., *Calculus, Volume II*, 2nd Edition, John Wiley & Sons, 1969.
2. Ghorpade, S. R. and Limaye, B. V., *A Course in Multivariable Calculus and Analysis*, 2nd Edition, Springer, 2010.
3. Rudin, W., *Principles of Mathematical Analysis*, 3rd Edition, McGraw-Hill, 1976.
4. Marsden, J. E., Tromba, A. J., and Weinstein, A., *Basic Multivariable Calculus*, Springer, 1993.
5. Somasundaram, D. and Choudhary, B., *A First Course in Mathematical Analysis*, Narosa Publishing House, New Delhi, 1996.
6. Stewart, J., *Calculus*, Brooks/Cole Publishing Company, 1994.
7. Simmons, G. F., *Differential Equations with Applications and Historical Notes*, 3rd Edition, CRC Press (Taylor & Francis), 2017.
8. Rainville, E. D. and Bedient, P. E., *Elementary Differential Equations*, Macmillan Publishing Company.
9. Thomas, G. B. and Finney, R. L., *Calculus and Analytic Geometry*, 9th Edition, Addison-Wesley, 1998.
10. Anton, H., *Calculus: A New Horizon*, 6th Edition, John Wiley & Sons, 1999.
11. Gupta, S. L. and Rani, N., *Principles of Real Analysis*, Vikas Publishing House Pvt. Ltd.

	12. Shabanov, S., *Concepts in Calculus III: Multivariable Calculus*, University Press of Florida, 2012. 13. Malik, S. C. and Arora, S., *Mathematical Analysis*, New Age International Publishers. 14. Coddington, E. A. and Carlson, R., *Linear Ordinary Differential Equations*, SIAM. 15. Raisinghania, M. D., *Ordinary and Partial Differential Equations*, S. Chand Publishing.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- IV

Title: Basic Mathematics in Real Life-III

Vertical - 2
Minor (Theory) - 2 Credit

With effect from
Academic Year 2026-2027

Title: Basic Mathematics in Real Life-III

(Course Code: CHMMTIV4)

Sr. No.	Heading	Particulars
1	**Description of the Course:**	To underline the importance of concepts in mathematics that have physical interpretation, especially in other sciences like physics and chemistry.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Theory + Practicum Lecture/group discussion/seminar/tech based learning/flipped class room/problem based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: This course emphasizes the concepts of mathematics applicable, especially in physics and chemistry. In this course, students from various science streams will be introduced to fundamental concepts from mathematics relevant to daily life and learn **CO(A) 1** To introduce the fundamental concepts of linear dependence, independence, inner product spaces, and vector operations in real and complex vector spaces. **CO(A) 2** To develop the ability to analyze vector spaces using inequalities, norms, determinants, and matrix properties such as Hermitian and unitary matrices. **CO(A) 3** To enable students to understand eigenvalues, eigenvectors, orthogonalization techniques, and their applications in linear algebra. **CO(A) 4** To facilitate the understanding of permutations, symmetry groups, and introductory quaternion algebra for solving mathematical and engineering problems.	
8	**Learning Outcomes**: On completion of the course, learner should be able to **CO 1** explain the concepts of linear dependence and independence, inner product spaces, vector operations, and the properties of real and complex vector spaces. **CO 2** apply vector operations, Cauchy–Schwarz inequality, arithmetic mean–geometric mean inequality, and matrix properties to solve problems involving vectors, moments, and inner product spaces. **CO 3** analyze eigenvalues, eigenvectors, Gram–Schmidt orthogonalization, and symmetry operations to interpret the structure and properties of matrices and geometric transformations. **CO 4** evaluate permutation groups, symmetry composition tables, and quaternion operations to solve problems involving algebraic structures and geometric symmetries.	

9	Syllabus
	UNIT I: Linear dependence, independence and inner product spaces • Linear dependence and independence in two and three dimensions over reals, definitions, and simple examples. • Further examples of dependence and independence. • Linear dependence and independence of vectors and relation to determinants. • Cross products of vectors in $\mathbb{R}^3$ basic properties like the angle between two vectors. • Cross product on $\mathbb{R}^3$ and Jacobi identity; characterization of cross product is zero. • Use of cross product to calculate moment about a point: definition and formula • Moment of a force about a point: examples. • Problems involving angle bars and estimates on the magnitude of the moment about a point. • Inner product spaces definitions, examples, and properties. • Arithmetic mean—geometric mean inequality: statement, proof (for two numbers only) and applications (for two or more). • Cauchy-Schwarz inequality (real numbers) statement and proof, norm of a vector. • Problems based on Cauchy-Schwarz inequality, like finding the maximum possible value of a dot product. • Inner product spaces with complex coefficients. • Proof of Cauchy-Schwarz inequality for complex numbers. • Hermitian and unitary matrices and their examples. **Unit II**: **Eigenvalues and eigenvector orthonormalization and symmetry** • Definition of eigenvector and eigenvalue. • Examples of eigenvector and eigenvalue in 2 by 2 matrices. • Examples of eigenvectors and eigenvalues in 3 by 3 matrices. • Gram-Schmidt orthogonalization process: formula. • Gram-Schmidt orthogonalization process with examples. • Playing cards and counting permutations (ordered arrangements) • Further problems on cards. • Set game: introduction, counting: Calculation of total number of cards, calculation of the number of sets, calculation of cards with certain properties. • Permutations of an equilateral triangle. • Writing composition tables for symmetries (group) of equilateral triangles. • Permutation on four symbols. • Rule for composition of above permutations. • Symmetries of the square. • Writing a composition table for symmetries of a square. • Introduction to quaternions and their composition table. **Technology and AI Integration:** Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

E. External Examination: Semester End External - 30 marks, Time: 1 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
	Total	**30**

F. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. Halliday, D., Resnick, R., & Walker, J. *Halliday and Resnick's Principles of Physics*, 11th Edition, Wiley, 2018.
2. Hoffman, K., & Kunze, R. *Linear Algebra*, 2nd Edition, Pearson Education, 1971.
3. Shaeffer, R. E. *Elementary Structures for Architects and Builders*, 5th Edition, Pearson, 2007.
4. Anton, H., & Rorres, C. *Elementary Linear Algebra: Applications Version*, 10th Edition, Wiley, 2010.
5. Strang, G., *Introduction to Linear Algebra*, 5th Edition, Wellesley-Cambridge Press, 2016.
6. Axler, S., *Linear Algebra Done Right*, 3rd Edition, Springer, 2015.
7. Friedberg, S. H., Insel, A. J., and Spence, L. E., *Linear Algebra*, 5th Edition, Pearson, 2018.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- IV

Title: Practical based on Basic Mathematics in Real Life - III

Vertical - 2
Minor (Practical) - 2 Credit

With effect from
Academic Year 2026-2027

Title: - Practical based on Basic Mathematics in Real Life - III
(Course Code: CHMMTIV5)

<table>
<tr><th>Sr. No.</th><th>Heading</th><th>Particulars</th></tr>
<tr><td>1</td><td>Description of the Course:</td><td>To underline the importance of concepts in mathematics that have physical interpretation, especially in other sciences like physics and chemistry.</td></tr>
<tr><td>2</td><td>Vertical 2</td><td>Minor</td></tr>
<tr><td>3</td><td>Type
Teaching Method</td><td>Practical
Group discussion/Tech based learning/flipped class room/problem based learning etc.</td></tr>
<tr><td>4</td><td>Credit</td><td>2 Credits</td></tr>
<tr><td>5</td><td>Hours allotted</td><td>60 Hours</td></tr>
<tr><td>6</td><td>Marks allotted</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">Course Objectives:
This course emphasizes the concepts of mathematics applicable, especially in physics and chemistry. In this course, students from various science streams will be introduced to fundamental concepts from mathematics relevant to daily life and learn
CO(A) 1 To introduce students to the practical concepts of linear dependence, vector spaces, inner product spaces, and eigenvalue problems through computational exercises.
CO(A) 2 To develop students' computational and analytical skills in performing vector operations, orthogonalization, and matrix-related calculations.
CO(A) 3 To enable students to verify mathematical properties of real and complex vector spaces and apply linear algebra techniques in practical problem-solving.
CO(A) 4 To facilitate the understanding of permutations, symmetry groups, and geometric transformations through hands-on activities and practical examples</td></tr>
<tr><td>8</td><td colspan="2">Learning Outcomes: On completion of the course, learner should be able to
CO 1 explain the concepts of linear dependence, linear span, vector spaces, inner product spaces, and eigenvalues/eigenvectors through practical verification and examples.
CO 2 apply vector operations, cross products, moments, norms, and inner product properties to solve practical computational problems in real and complex vector spaces.
CO 3 analyze eigenvectors, orthogonalization techniques, Gram–Schmidt process, and permutation operations to interpret the structure of vector spaces and transformations.
CO 4 evaluate symmetry operations, composition of permutations, and geometric transformations of various figures to determine their mathematical properties and applications.</td></tr>
</table>

9	**Syllabus**

Syllabus

UNIT I: Practical for linear dependence, independence and inner product spaces (30 Hours)

1. Checking Linear dependence and independence.
2. Definition of Linear Span of Vectors and Examples of Finding the Span.
3. Calculations based on cross product.
4. Examples based on a moment about a point.
5. Further computations based on cross-product.
6. Verification of inner product via examples for real vector spaces.
7. Norms in inner product spaces, examples and properties.
8. Definition of vector space over real and complex numbers, Examples.
9. Inner product spaces over complex numbers, Definition and Examples.
10. Eigenvalues and Eigenvectors with basic calculations.

Applications of Vectors, Inner Product Spaces, and Eigenvalues: AI-Assisted Case Study: Using standard reference texts on Linear Algebra and Vector Analysis, students shall explore applications of vectors, inner products, and eigenvalues in areas such as computer graphics, recommendation systems, image processing, machine learning, and mechanics. AI-enabled learning tools such as NotebookLM and Claude AI, together with visualization software such as GeoGebra, Python, or MATLAB, may be used to investigate geometric interpretations and computational aspects of these concepts. Students shall critically evaluate AI-generated explanations, validate findings using prescribed reference materials, and prepare a brief report and presentation highlighting the mathematical concepts, applications, visualizations, and conclusions of their study.

Unit II: **Practical for eigenvalues and eigenvector orthonormalization and symmetry (30 Hours)**

1. Eigenvectors and Linear Independence.
2. Orthogonalization Formula and Examples.
3. Gram-Schmidt process with examples only of the from real plane.
4. Gram-Schmidt process with examples in three dimensions.
5. Problems based on permutations and their composition, Examples.
6. Problems based on the formula for permutations with possible constraints.
7. Problems based on the set game.
8. Composition of two permutations and further properties.
9. Symmetries of rectangles and pentagons and other figures.
10. Symmetries of letters of the alphabet of Indian languages and English.

Applications of Symmetry and Permutations: AI-Assisted Case Study: Using standard reference texts on Linear Algebra and Abstract Algebra, students shall investigate the role of permutations and symmetry in art, architecture, molecular structures, puzzles, cryptography, language patterns, and design. AI-enabled learning tools such as NotebookLM and Claude AI, together with visualization software such as GeoGebra or computational tools, may be used to model symmetries and analyze permutation-based structures. Students shall critically evaluate AI-generated content, verify results using prescribed references, and prepare a brief report and presentation discussing the mathematical concepts, visualizations, applications, and conclusions of their study.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **C. External Examination: Semester End External - 30 marks Time: 2 hours** Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

D. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test (Duration: 30 minutes) Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Halliday and Resnick's Principles of Physics, Wiley, Eleventh Edition,2018
2. Hoffman and Kunze, Linear Algebra, Second Edition, Pearson,1971
3. Shaeffer, R.E. *Elementary Structures for Architects and Builder.2007*
4. Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley, Tenth Edition, 2010
5. Strang, G., *Introduction to Linear Algebra*, 5th Edition, Wellesley-Cambridge Press, 2016.
6. Axler, S., *Linear Algebra Done Right*, 3rd Edition, Springer, 2015.
7. Friedberg, S. H., Insel, A. J., and Spence, L. E., *Linear Algebra*, 5th Edition, Pearson, 2018.

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 &Amp; 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, Ulhasnagar (Autonomous)

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year

Semester- IV

Title: Data Analysis – A Project Based Approach

Vertical - 3
Open Elective - 2 Credits
Choice Based

with effect from
Academic Year 2026-2027

Title: Data Analysis – A Project Based Approach

Course Code:

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course emphasizes learning through comprehensive data analysis projects. Students integrate data preparation, modeling, visualization, business intelligence, and communication skills to solve real-world problems using domain-specific datasets.
2	**Vertical 3**	Open Elective Choice Based
3	**Type** **Teaching Method**	Theory + Practical Lecture/Hands on lab sessions /mini case study /mini project / tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** To develop students' skills in advanced data preparation, transformation, modelling, and analytics using Power Query, DAX etc. **CO(A) 2** To enable students to design interactive BI dashboards and reports using advanced Power BI features and visualization principles. **CO(A) 3** To facilitate the application of BI concepts, KPI frameworks, dashboard storytelling, and decision analytics for solving practical problems. **CO(A) 4** To familiarise effective use of AI-assisted tools for insight generation, dashboard interpretation and report preparation while critically validating AI-generated outputs.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** apply advanced power query transformations, data modelling techniques, star schema concepts and DAX functions to prepare and manage business datasets for analysis. **CO 2** analyse business data to identify key performance indicators and design effective data visualizations and dashboard storytelling solutions for insights. **CO 3** develop interactive multi-page Power BI reports by implementing advanced DAX techniques, relationship optimization, drill-through analysis and executive dashboards. **CO 4** evaluate business performance by interpreting dashboard outputs, validating AI-assisted insights and presenting evidence-based recommendations using real-world datasets.	

9	Syllabus
	UNIT I: Advanced Data Preparation, Modeling and Applied Analytics Advanced Power Query including Merge, Append and Web Data; data transformation workflows; introduction to Fact and Dimension tables; Star Schema concepts and relationship management; Advanced DAX including CALCULATE, FILTER and RELATED functions; KPI identification and design; data visualization best practices; introduction to dashboard storytelling. **UNIT II: Advanced Business Intelligence and Decision Analytics** Relationship optimization; introductory Time Intelligence functions in DAX; advanced KPI framework; Drill-through analysis; Tooltips; Bookmarks; multi-page reports; executive dashboard design; dashboard storytelling; presentation and communication of insights. Few indicative project domains (or any other relevant domain) : Project 1: Retail and Customer Analytics – Goal: Analyze sales, customers, products and regional performance. Key Ideas: customer segmentation, product performance, profitability analysis, KPI design, executive dashboard. Project 2: HR and Workforce Analytics – Goal: Examine workforce characteristics, attendance, performance and attrition. Key Ideas: employee analytics, workforce planning metrics, attrition analysis, KPI dashboards, management reporting. Project 3: Healthcare/Insurance Analytics – Goal: Analyze claims, costs and utilization patterns. Key Ideas: demographic analysis, claim trends, cost drivers, risk indicators, dashboard reporting Note : The course adopts a project-based instructional approach wherein the faculty shall use real-world datasets and domain-specific case studies during lectures and laboratory sessions to illustrate and reinforce business intelligence concepts, data preparation, analytics techniques, dashboard design, interpretation of insights for data-driven decision-making. AI tools such as NotebookLM, Claude AI, Copilot, etc. may be used for advanced insight generation, dashboard interpretation and report preparation. Students shall critically validate and document AI-assisted insights using appropriate data analysis and visualization techniques.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks   Time: 1 hour

Format of Evaluation

Sr. No.	Particulars	Marks
1	Project work and Report	15
2	Project Viva and Presentation	15
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

Format of Evaluation

Sr. No.	Particulars	Marks
1	Test – MCQs /Answer in one sentence / Problems / Match the pairs / Puzzles etc.	10
2	Case Study / mini project	10
	Total	**20**

11	**References and Websites:**

1. Walkenbach, J. – Excel 2016 Bible
2. Winston, W. – Microsoft Excel Data Analysis and Business Modeling
3. Ferrari, A. & Russo, M. – Introducing Microsoft Power BI
4. Ferrari, A. & Russo, M. – The Definitive Guide to DAX
5. Kimball, R. – The Data Warehouse Toolkit
6. Microsoft Learn: https://learn.microsoft.com/power-bi/
7. Microsoft Power BI Documentation: https://powerbi.microsoft.com/
8. SQLBI: https://www.sqlbi.com/

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Sc.
(Mathematics)

Semester- IV

Title:

Computing with R and Advanced Python

Vertical - 4
VSC - 2 Credits

with effect from
Academic Year 2026-2027

Name of the Course: Computing with R and Advanced Python

(Course Code: CHMMTIV7**)**

Sr. No.	Heading	Particulars
1	**Description of the course**	This course introduces students to advanced programming and data analysis techniques using Python and concepts of statistical analysis using the R programming language. Students will learn to manage data, apply essential statistical techniques, and interpret outputs to support decision-making. Students learn numerical computing with Python using powerful libraries such as NumPy and Pandas. Topics include data analysis processes, data cleaning, transformation, visualization, and interpretation. Students gain hands-on experience in working with arrays, matrices, and data frames, and in performing efficient numerical and statistical operations.
2	**Vertical 4**	Vocational Skill Course
3	**Type** **Teaching Method**	Practical Group discussion/seminar/hands-on learning/flipped class room/problem-based learning etc.
4	**Credits**	2 credits
5	**Hours Allotted**	60 Hours
6	**Marks Allotted**	50 Marks
7	**Course Objectives (CO)** **CO(A) 1** To introduce learners to R programming for data analysis, statistical computing and data visualization. **CO(A) 2** To develop learners' ability to apply fundamental statistical methods to analyse data using R and to present meaningful insights in real-world datasets. **CO(A) 3** To familiarize students with Python libraries such as NumPy and Pandas for efficient numerical computing and data manipulation. **CO(A) 4** To enable students to use Python-based tools for data processing, computation, and visualization to solve data analysis problems.	
8	**Learning Outcomes:** After completion of the course, learner should be able to **CO 1** import and manage datasets in R , create and handle data structures such as vectors, matrices, data frames. **CO 2** analyse datasets using statistical methods in R and interpret the results. **CO 3** apply NumPy and Pandas to create and manipulate arrays and data structures **CO 4** develop Python programs to clean, transform, and analyze data for real-world applications.	

9. **Unit 1: Basic Data Exploration with R**

- Introduction to R and RStudio: Installing R and RStudio, environment overview, writing simple R commands, basic R operations , understanding packages ().
- Data Handling and Cleaning: Data types, data structure such as vectors, matrices, data frames, importing CSV/Excel files, handling missing values.
- Univariate Descriptive Statistics such as Measures of center and spread in R
- Data Visualization: Histograms, bar charts, line plots, boxplots using ggplot2.
- Probability Basics, Binomial distribution, Normal distribution and Z scores in R
- Sampling distribution and Central limit theorem
- Basic Inferential Statistics such as Correlation, Hypothesis testing basics, t-test etc. in R.

Mini Case Studies :

Case Study 1: Retail Sales Data Cleaning / Air Quality Monitoring Data Cleaning
Case Study 2: Monthly Revenue Trend Analysis / Climate and Temperature Trend Analysis
Case Study 3: Customer Satisfaction Survey Analysis / Clinical Trial Sampling Study
Case Study 4: Employee Productivity and Training Effectiveness / Credit Risk Assessment in Banking
Case Study 5 (AI- Assisted) : Data-Driven Investigation Using R and AI on a real-world dataset from domains such as business, finance, healthcare, environmental science, engineering, education.

Unit 2: Numerical Computing with Python

- Data Analysis Concepts: Types of data - Quantitative, qualitative, categorical, and time-series, Data analysis process - Problem definition, data collection, cleaning, exploration, modeling, evaluation, visualization, and interpretation. Basics of descriptive and predictive analytics.
- Advanced NumPy: Vectors, matrices, and multi-dimensional arrays. Indexing, slicing, reshaping, and broadcasting arrays. Vector arithmetic, statistical operations (sum, mean, median, standard deviation, correlation).Matrix operations- dot product, transpose, inverse, determinant.. Reading and writing arrays to files (CSV, text)
- Advanced Pandas: Series - creation, indexing, slicing, assignment, filtering, missing value handling, arithmetic operations. DataFrame - creation from arrays, lists, dictionaries, and external files. Selection, filtering, sorting, assignment, deletion, concatenation, merging. Data transformation - aggregation, group-by operations, transposition. Handling missing or inconsistent data, working with categorical and time-series variables. Preparing datasets for analysis and visualization

  Combining NumPy and Pandas for efficient numerical and structured data analysis.

Mini **Case Studies :**
Mini Case Study 1: Student Marks Analysis/ School Attendance Analysis
Mini Case Study 2: Cricket Scores Analysis/ Shopping Bill Calculator

	Mini Case Study 3: Library Book Records/ Employee Salary Records Mini Case Study 4 : Daily Step Counter/ Monthly Electricity Bill Analysis Mini Case Study 5: Missing Data in Student Records/ Mobile Shop Sales Note : The mini case studies listed are indicative and not restrictive; other case studies based on relevance and availability of datasets can be undertaken in this course.
10.	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 3 hours

Structure of Evaluation

Sr. No.	Pattern of evaluation	Marks
1.	Practical Exam Perform any four out of six programs (three questions from each unit)	20
2.	In-semester participation (Active participation)	05
3.	Journal	05
	Total	**30**

B. Internal Examination: Continuous Evaluation - 20 marks

Sr. No	Title	Marks
1.	Quiz (MCQs/ Match the Pairs/ Answer in one sentence/ Puzzles)/	5
2.	Mini Case Study / Programming questions	15
	Total	**20**

11. References :

1. Hands-On Programming with R – Garrett Grolemund , O'Reilly Media , 2014
2. Introductory Statistics Using R – Herschel Knapp, SAGE Publications , 2019 (2nd Edition)
3. Learning Statistics with R – Danielle Navarro , University of Adelaide / Open access Textbook , 2015
4. Wes McKinney - Python for Data Analysis Data Wrangling with pandas, NumPy, and Jupyter-OReilly Media (2022)
5. Alberto Boschetti Luca Massaron Python Data Science Essentials Third Edition Packt Publishing 2018
6. Eli Bressert SciPy and NumPy OReilly Media Publication
7. Gaël Varoquaux, Emmanuelle Gouillart, Olaf Vahtras, Pierre de Buyl Scipy Lecture Notes(www.scipy-lectures.org), 2020 edition
8. Joel Grus Data Science from Scratch OReilly publication.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B.Sc.

Semester- IV

Vertical – 5

Ability Enhancement Course (English)

2 Credits

(To be offered to Students who opted Sindhi AEC in Sem I & II)

with effect from
Academic Year 2025-2026

Title: Advanced English for Workplace and Academic Communication

Course Code: CHMBSCAECIV

Sr. No.	Heading	Particulars
1	**Description of the Course:**	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	**Vertical 5**	**AEC: Advanced English for Workplace and Academic Communication**
3	**Type** Teaching Methods:	Theory+ Practicum (Lecture/ Discussion/ Presentation/ Reading sessions/ Worksheets/ etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 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	**Course Outcomes**: After completing this course, learners will be able to: **CO-1:** Demonstrate clarity, precision, and professionalism in communication. **CO-2:** Interpret and summarize written texts, visuals, and data accurately. **CO-3:** Prepare well-structured reports, emails, and professional documents.	

<table>
<tr><td></td><td>CO-4: Use digital tools and virtual communication etiquette effectively.

CO-5: Communicate confidently in interviews, presentations, and teamwork situations</td></tr>
<tr><td>9</td><td>

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

</td></tr>
<tr><td>10</td><td>

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:

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

</td></tr>
</table>

	Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Assignments on **any one** 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
	Total	**20**

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)	Raskar
4.	Prof. (Dr.) Prashant Mothe	(Subject Expert outside University) Aadarsh Mahavidyalay, Umerga, Dharashiv, (Affiliated to Dr. Baba Saheb Ambedkar Marathwada University	Mothe
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)

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.	**Description of the Course :**	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 है, वर्तमान युग में रोजगार में बहुत से क्षेत्र भाषा से जुड़े हुए है, जिसके माध्यम से विद्यार्थी इनका लाभ ग्रहण कर सकते है, 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 कार्यो को करना होता है और ऐसे में कार्य-दक्ष्ता महत्व रखती है, हिंदी भाषा में व्यावहारिक प्रयोग को केंद्र में रखकर और इन्हीं पहलूओं 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 बनाए और बिना व्याकरण के यह संभव नहीं है, इस दृष्टि से **पाठ्यक्रम** सर्वाधिक लाभकारी सिद्ध होगा
2.	**Vertical : 5**	AEC
3.	**Type :** **Teaching Methods :**	Theory + Practium Lecture / Discussion / Presentation / Self Study, etc.

4.	**Credit :**	2 Credits (1 Credit = 15 Hours for Theory)
5.	**Hours Allotted :**	30 Hours
6.	**Marks Allotted :**	50 Marks
7.	**Course Objectives :** **CO(A)1:** विद्यार्थियों को राजभाषा हिंदी का विधिवत ज्ञान प्रदान करना । **CO(A)2:** विद्यार्थियों को राजभाषा हिंदी के संवैधानिक महत्तव से परिचित करवाना । **CO(A)3:** विद्यार्थियों को संज्ञा आदि का ज्ञान प्रदान करना। **CO(A)4:** विद्यार्थियों को कारकों, वाक्य रचना एवं भाषिक चिन्हों आदि का ज्ञान प्रदान करना ।	
	Course Outcomes : **CO1 :** विद्यार्थियों को राजभाषा हिंदी का ज्ञान प्राप्त होगा, एवं दक्षता प्राप्त होगी । **CO2 :** विद्यार्थियों को राजभाषा हिंदी के संवैधानिक महत्तव की जानकारी प्राप्त होगी । **CO3 :** विद्यार्थियों को हिंदी – संज्ञा आदि का ज्ञान प्राप्त होने के साथ भाषा के शुद्ध, व्यावहारिक रूप का ज्ञान होगा । **CO4 :** विद्यार्थियों को कारकों, वाक्य रचना एवं भाषिक चिन्हों आदि का ज्ञान प्राप्त होगा ।	
9.	**Syllabus**	
	UNIT I :	
	1. हिंदी भाषा – सामान्य परिचय	
	2. राजभाषा हिंदी – संवैधानिक महत्तव	
	3. वर्णमाला – स्वर एवं व्यंजन	
	4. शब्द भेद – सामान्य परिचय (संज्ञा आदि)	
	UNIT II :	
	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
<u>बाह्य मूल्यांकन</u> 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
	कुल अंक	**30**

मूल्यांकन प्रारूप	अंक
<u>आंतरिक मूल्यांकन</u> • AI की सहायता से हिंदी भाषा, राजभाषा हिंदी एवं उसके संवैधानिक महत्व पर शोध, सारांश एवं डिजिटल प्रस्तुति (Presentation) तैयार करना। • 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। • AI की सहायता से हिंदी व्याकरण पर आधारित प्रश्नसंच (Question Bank), Quiz तथा Interactive अभ्यास-पत्र तैयार करना। • 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। • AI की सहायता से कठिन शब्दों के अर्थ, पर्यायवाची, विलोम, शब्दावली तथा सरल भाषा में व्याख्या तैयार करना। • AI Voice Tools का उपयोग करके शुद्ध उच्चारण, वाचन एवं मौखिक अभिव्यक्ति का अभ्यास करना तथा उच्चारण संबंधी Feedback प्राप्त करना।	20
कुल अंक	**20**

11.	**संदर्भ ग्रंथ सूची –** 1. बाबूराम सक्सेना – सामान्य भाषा विज्ञान, हिंदी साहित्य सम्मेलन, प्रयाग । 2. कामताप्रसाद गुरू – हिंदी व्याकरण, लोकभारती प्रकाशन, इलाहाबाद । 3. आचार्य देवेंद्र नाथ शर्मा – भाषा विज्ञान की भूमिका, राधाकृष्ण प्रकाशन, दिल्ली । 4. भाषा विज्ञान एवं भाषा शास्त्र – कपिलदेव द्विवेदी, विश्वविद्यालय प्रकाशन, वाराणसी । 5. भोलानाथ तिवारी, भाषा विज्ञान, किताब महल, इलाहाबाद ।

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 : BMRochlani

Name & Signature of the Dean –

Dr. Nitin Arekar :

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

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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:**	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 भाषां'चे अध्ययन अनिवार्य करण्यात आले आहे. सदर **क्षमता वर्धन अभ्यासक्रमा**चे 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. 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.
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	**Course Objectives**: **CO1:** महाजालावरील लेखन कौशल्याचे स्वरूप समजावून सांगणे. **CO2:** महाजालावर प्रभावी लेखन करण्यासाठी आवश्यक असणाऱ्या तंत्रांचा परिचय करून देणे. **CO3:** नेहमीच्या पठडीतील लेखन व महाजालावरील लेखन यांमधील साम्य-भेद स्पष्ट करणे. **CO4:** विविध सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित करणे.
8	**Learning Outcomes**: प्रस्तुत अभ्यासक्रम शिकल्यानंतर: **LO1**: विद्यार्थ्यांना महाजालावरील लेखन कौशल्याचे स्वरूप समजेल. **LO2**: विद्यार्थ्यांना महाजालावर प्रभावी लेखन करण्यासाठी आवश्यक तंत्रांचा परिचय होईल. **LO3**: विद्यार्थ्यांना नेहमीच्या पठडीतील लेखन व महाजालावरील लेखन यांमधील साम्य-भेद स्पष्ट होईल. **LO4**: विद्यार्थ्यांमध्ये विविध सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील.
9	**Syllabus** **UNIT I: सामाजिक माध्यमस्थळांवर मराठी भाषा व देवनागरी लिपीचा वापर करून लेखन (भाग - १)** १. माध्यम साक्षरता २. अनुदिनी (ब्लॉग) लेखन ३. विकिपीडियावरील लेखन (६० मिनिटांच्या १५ तासिका, श्रेयांकन १) (सूचना : विद्यार्थ्यांमध्ये उपरोक्त सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.) . **UNIT II: सामाजिक माध्यमस्थळांवर मराठी भाषा व देवनागरी लिपीचा वापर करून लेखन (भाग - २)** १. फेसबुक, इन्स्टाग्राम, एक्स यांवरील लेखन २. समाज गट (कम्युनिटी ग्रुप), आभासी कट्टे यांवरील लेखन (६० मिनिटांच्या १५ तासिका, श्रेयांकन-१) (सूचना : विद्यार्थ्यांमध्ये उपरोक्त सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)

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
	Total	**30**

Internal Examination: Continuous Evaluation - 20 marks

	Project and presentation / Viva	**Marks**
1.	• **विकिपीडियासाठी माहिती संकलन, संदर्भ व्यवस्थापन, तथ्य पडताळणी Fact Checking tool तयार करणे आणि लेख तयार करणे.** • **AI साधने वापरुन Facebook, Instagram आणि X (Twitter) साठी मराठीतील पोस्ट, Caption, Hashtags आणि Content Calendar तयार करणे.** • **AI Copywriting Tools चा वापर करून सामाजिक माध्यमांसाठी आकर्षक व लक्षित (Targeted) मजकूर तयार करणे.** • **AI साधनाच्या सहाय्याने Social Media Content चे भाषा विश्लेषण, शुद्धलेखन तपासणी आणि देवनागरी लिपीतील लेखन सुधारणा करणे.** • **AI साधनाच्या सहाय्याने Community Groups आणि Virtual Discussion Platforms साठी माहितीपूर्ण पोस्ट, जनजागृती मोहीम आणि संवादात्मक मजकूर तयार करणे.** • **AI Image Generation आणि Video Tools च्या सहाय्याने सामाजिक माध्यमांसाठी Creative Campaign तयार करणे.** • **Blog, Wikipedia आणि Social Media Content यांची AI-assisted comparative analysis करून प्रभावी डिजिटल लेखनाचा अभ्यास करणे.** **AI** साधने: ChatGPT, Google Gemini, Claude, Perplexity AI, NotebookLM, Canva, CapCut, InVideo, Grammarly, QuillBot, Whisper, ElevenLabs	20
	Total	**20**

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

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year

Semester - IV

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	**Description the Course:**	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	**Vertical 5**	VEC
3	**Type & Teaching Methods**	Theory + Practicum Lectures/Discussions/Presentations/Case Studies, etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A)1:** To develop a comprehensive understanding of various types of environmental pollution, their sources, standards, and impacts on human health and ecosystems. **CO(A)2:** To familiarize students with environmental laws, constitutional provisions, and regulatory frameworks related to environmental protection and management. **CO(A)3:** To equip learners with knowledge of environmental management tools, pollution control measures, and sustainable waste management practices. **CO(A)4:** To create awareness about global and national sustainability initiatives such as the Sustainable Development Goals, Mission LiFE, and their role in achieving sustainable development.	

8	**Course Outcomes**: Student will be able to **CO1**: Identify and analyze different types of environmental pollution and assess their impacts on human health and ecological systems. **CO2**: Explain key environmental laws, constitutional provisions, and institutional mechanisms for environmental protection. **CO3**: Apply environmental management tools and sustainable waste management practices in real-world contexts. **CO4**: Evaluate sustainability initiatives such as the SDGs and Mission LiFE and relate them to environmental management and sustainable development practices.
9	**Syllabus** **UNIT I: Environmental Pollution and Health** • Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. • Air pollution: Sources of air pollution; Primary and secondary pollutants; Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. • 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. • Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. • Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. • Thermal and Radioactive pollution: Sources and impact on human health and ecosystems. **UNIT II: Environmental Management** • Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; • Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Life cycle analysis; Cost-benefit analysis • Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme. • Introduction to Millennium Development Goals, Sustainable Development Goals, & Mission Life.

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
TOTAL		**30**

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	**Marks**
1.	Assignment / Project	10
2.	Case Study / Assignment	10
TOTAL		**20**

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
ULHASNAGAR
421 003.

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	**Description the Course:**	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. 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. 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.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9

Syllabus

Unit I - Suggested Areas of Participation in the activities:

- **Cultural Events:** Drama, dance, music, literary events, debates, etc.
- **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives.
- **Clubs & Societies:** Photography, quiz, environment club, shram club, etc.
- **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges.
- **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events.
- **National Festivals:** Independence Day, Republic Day etc.

Unit II - Program Specific Topics

- **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks.
- **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience

Mode of Evaluation:

- **Faculty Coordinator:** To guide and evaluate student progress.
- **Participation Proof:** Certificates, photos, attendance records.
- **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth.
- **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.

10

Scheme of Examination and Assessment Pattern
Based on 3 approved Activities
Semester End External - 30 marks

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
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

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

SMT. CHANDIBAI HIMATHMAL MANSUKHANI COLLEGE ★ ULHASNAGAR 421 003.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Second Year B. Com.

Semester- III

Title: Field project

Vertical - 6
Field Project 2 Credits

with effect from
Academic Year 2025-2026

Title: Field Project

Course code:

Sr. No.	Heading	Particulars
1	**Description the Course:**	The Field Project course, introduced under CHM Autonomy in alignment with the NEP 2020, aims to bridge theoretical knowledge with practical experience. It provides students with hands-on exposure to real-world socio-economic contexts through field visits, observation, and analysis in both urban and rural settings. By engaging directly with development-related issues, students enhance their research, problem-solving, and analytical skills while fostering social responsibility and environmental awareness. The course ultimately prepares learners for employability and active participation in nation-building.
2	**Vertical 6**	Field Project
3	**Type & Teaching Methods**	Field work
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** 1. To connect theoretical learning with real-world socio-economic contexts through practical field experiences. 2. To develop analytical, problem-solving, and teamwork skills in addressing contemporary social issues. 3. To cultivate an appreciation for research and its role in promoting societal and national development.	
8	**Learning Outcomes**: **students will be able to:** **LO1**: Apply classroom knowledge to analyze real-life socio-economic challenges effectively. **LO2**: Demonstrate critical thinking, teamwork, and decision-making skills through field-based activities. **LO3**: Reflect on the relevance of research and experiential learning in contributing to social and national progress.	

9

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

External Examination: Semester End External - 30 marks

Format of Question Paper

Nature of Evaluation	Marks
Field Project Report	30
	Total 30

Internal Examination: Continuous Evaluation - 20 marks

	Assessment / evaluation	Marks
1.	Involvement in Survey of Field Project /	05
2.	Field visit participation & completion	10
3.	Overall Impression	05
		Total 20

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/Principal**

Board of Examination

Principal & Chief Controller
Board of Examination

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar (Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science
(Mathematics)
(Aided 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, Ulhasnagar
(Autonomous)
Department of Mathematics
Course Credit Structure 2026-27

TYBSc Semester V

Vertical	Type	Course	Credit	Total	Course Code
Major 1	Theory	Integral Calculus	**2**		CHMMATHV1
Major 2	Theory	Group Theory	**2**		CHMMATHV2
Major 3	Practical	Practical Based on Integral Calculus and Group Theory	**2**		CHMMATHV3
Major 4	Theory	Topology of Metric Spaces - I	**2**		CHMMATHV4
Major 5	Practical	Practical Based on Integral Calculus and Topology of Metric Spaces - I	**2**		CHMMATHV5
Major Elective	Theory	Graph Theory - I	**2**		CHMMATHV6
Major Elective	Practical	Practical Based on Graph Theory - I	**2**		CHMMATHV7
Major				**10+4=14**	
Minor	Theory	Numerical Methods – I	**2**	**Included for Applied Sciences**	CHMMATHV8
Minor	Practical	Practical Based on Numerical Methods – I	**2**		CHMMATHV9
Minor	Theory	Basics of Mathematics in Real Life – IV	**2**		CHMMATHV10
Minor	Practical	Practical Based on Basics of Mathematics in Real Life – IV	**2**		CHMMATHV11
Minor				**2**	**For Pure Sciences offered by other dept**
VSC	Practical	Computational Machine Learning	**2**	**2**	CHMMATHV12
CEP	Training	Community Engagement Programme	**2**	**2**	CHMMATHV13
CC	Activity based	Cocurricular course	**2**	**2**	CHMCCV
Semester V Total				**22**	

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Integral Calculus

Vertical - 1
Major - 2 Credits

with effect from
Academic Year 2026-2027

Title: Integral Calculus
Course Code: CHMMATHV1

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course introduces integration of functions of several variables, covering double and triple integrals with applications to area, volume, mass, and center of mass. Topics include Fubini's Theorem, change of variables, line and surface integrals, and extensions of fundamental theorems of Calculus - Green's, Stokes', and Gauss'. Emphasis is placed on physical interpretation and applications in geometry and physics.
2	**Vertical 1**	Major
3	**Type** **Teaching method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To extend the ideas of integral calculus from a function of one variable to a function of several variables by introducing the concepts of multiple integral, line and surface integral. **CO(A) 2** To equip the learners with appropriate results to enable them to compute multiple integral, line and surface integral. **CO(A) 3** To arrive at the three important theorems – Green's, Stokes' and Gauss divergence as higher dimensional analogues of the Fundamental Theorem of Calculus of one variable. **CO(A) 4** To develop the ability to apply multiple integral, line and surface integral to mathematical and physical problems.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** demonstrate an understanding of the concepts of double and triple integrals, line and surface integrals of scalar and vector field and compute them. **CO 2** state, interpret and apply the theoretical foundations such as Fubini's Theorem, Change of Variables Theorem, class of integrable functions, behaviour of line and surface integrals under equivalent parametrisations, the relation between conservative and gradient fields etc. to evaluate relevant integrals. **CO 3** prove results such as Fubini's theorem, continuous functions are integrable, Green's Theorem, Fundamental Theorems for Line Integrals, fundamental vector product as normal to the surface, Gauss Divergence Theorem etc. **CO 4** analyze problems to determine and apply the appropriate theorem of Green's, Stokes' or Gauss' Divergence Theorem to transform and simplify integral computations and model real world physical quantities.	

9	**Syllabus**
	Unit I: **Multiple Integrals** • Definition of double (resp: triple) integral of a function, bounded on a rectangle (resp: box). Geometric interpretation as area and volume. Fubini's Theorem over rectangles and any closed bounded sets, iterated Integrals. Following basic properties of double and triple integrals proved using the Fubini's theorem: • Integrability of the sums, scalar multiples, products. • Integrability of continuous functions. More generally, Integrability of functions with continuity everywhere except on subset of content zero (statement only). • Domain additivity of the integral. Change of variables formula (Statement only). Polar, cylindrical and spherical coordinates, and integration using these coordinates. Differentiation under the integral sign. **Applications / interpretations** of double and triple integral – determine mass, the center of mass and moment of inertia of objects. **Unit II**: **Line, Surface and Volume Integrals** • Review of Scalar and Vector fields on $\mathbb{R}^n$, Vector Differential Operators: Gradient, Curl, Divergence. • Paths (parametrized curves) in $\mathbb{R}^n$ (emphasis on $\mathbb{R}^2$ and $\mathbb{R}^3$), Smooth and piecewise smooth paths. Closed paths. • Equivalent parametrized curves (orientation preserving and orientation reversing equivalent paths). Line integral of a scalar field along a piecewise smooth path (definition and physical interpretations). Line integral of a vector field along a piecewise smooth path (definition and physical interpretation). Properties of line integrals (in case of both scalar fields & vector fields) including linearity, path-additivity and behavior under a change of parameters. • Notion of simple curve, simple closed curve, open connected set, path connected set, simply connected set (in $\mathbb{R}^2$). • Second Fundamental theorem of calculus for line integrals (gradient fields are conservative) • First Fundamental theorem of Calculus for Line Integrals (conservative fields are gradient fields). • Necessary and sufficient conditions for a vector field to be conservative (cross derivative test). Green's Theorem (proof in the case of rectangular domains). • Parameterized surfaces. Smoothly equivalent parameterizations. Fundamental vector product of a parametrization and geometrical interpretation of the length of it as local magnification factor for area. Regular points and singular points of a parametrization. Smooth and piecewise smooth surface. Fundamental vector product as a normal to the surface. • Area of a parametrized surface. Surface integral of a scalar field. Relation between fundamental vector product of smoothly equivalent parametrizations and Independence of surface integral over a field under a change of equivalent parametrizations (statement only).

	• Surface integral of a vector field. Curl and Divergence of a vector field. Elementary identities involving gradient, curl and divergence. Stokes' Theorem (without proof). Examples. Gauss' Divergence Theorem. Examples. **Technology and AI Integration:** Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.
10	**Scheme of Examination and Assessment Pattern**

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11	**References:** 1. Apostol, Calculus, Vol. 2, Second Ed., John Wiley, New York, 1969 Section 1.1 to 11.8. 2. James Stewart, Calculus with early transcendental Functions, 8^{th} Edition 2014 – Chapter 15 and 16. 3. Marsden and Jerrold E. Tromba, Vector Calculus, Fourth Ed., W.H. Freeman and Co., New York, 1996 Section 6.2 to 6.4. 4. T. Apostol, Mathematical Analysis, Second Ed., Narosa, New Delhi. 1947. 5. R. Courant and F.John, Introduction to Calculus and Analysis, Vol.2, Springer Verlag, New York, 1989. 6. W. Fleming, Functions of Several Variables, Second Ed., Springer-Verlag, New York, 1977. 7. M. H. Protter and C.B.Morrey Jr., Intermediate Calculus, Second Ed., Springer-Verlag, New York, 1995. 8. G. B. Thomas and R.L Finney, Calculus and Analytic Geometry, Ninth Ed. (ISE Reprint), Addison- Wesley, Reading Mass, 1998. 9. D. V. Widder, Advanced Calculus, Second Ed., Dover Pub., New York. 1989.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Group Theory

Vertical - 1
Major - 2 Credits

With effect from
Academic Year 2026-2027

Title: Group Theory

Course Code: CHMMATHV2

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course explores the foundational concepts of group theory, including groups, subgroups, cyclic groups, and group homomorphisms. It covers key results like Lagrange's Theorem, quotient groups, and the Fundamental Theorem of Homomorphisms. Students study group structures through examples such as symmetric, dihedral, and matrix groups, and learn about direct products, normal subgroups, and classification of groups up to order seven.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to the concepts of groups, subgroups, together with their algebraic properties, examples, and subgroup criteria. **CO(A) 2** To make students learn cyclic groups and structure-preserving mappings through group homomorphisms, isomorphisms, and automorphisms. **CO(A) 3** To familiarize students with cosets, normal subgroups, quotient groups, and the fundamental theorems relating homomorphisms to group structure. **CO(A) 4** To provide students with knowledge of direct products, Cayley's Theorem, and the classification of finite groups.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** identify and verify group and subgroup structures using definitions, elementary properties, and subgroup tests. **CO 2** construct cyclic groups, determine their generators, and apply the properties of cyclic groups, group homomorphisms, isomorphisms, and automorphisms to solve problems. **CO 3** apply Lagrange's Theorem to work with cosets, determine normal subgroups and quotient groups, and establish group isomorphisms using the Fundamental Theorem of Homomorphism. **CO 4** explain the properties of internal and external direct products and Cayley's Theorem and classify all possible groups of order up to 7.	

9	**Syllabus**

Unit I: Groups, Subgroups, Cyclic Groups, Group homomorphism and Isomorphism.

- Definition of Group, Abelian Group, Examples of groups including $\mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}$, Symmetric and alternating groups S_n and A_n respectively, $M_n(\mathbb{R})$ (the group of $n \times n$ real matrices), $GL_n(\mathbb{R})$(the group of $n \times n$ non-singular real matrices) , $SL_n(\mathbb{R})$(the group of $n \times n$ real matrices with determinant 1), T_n(the group of $n \times n$ nonsingular upper triangular matrices), L_n(the group of $n \times n$ nonsingular lower triangular matrices), D_n (the dihedral group of order $2n$), Klein 4-group, $\mathbb{Z}_n$ (the group of integers modulo n), $U(n)$(the group of integers modulo n that are coprime with n), μ_n (the group of nth roots of unity) and S^1(the unit circle in $\mathbb{C}, Q_8$ (Quaternions group)
- Elementary properties of a group. Order of a group, order of an element, Subgroup, subgroup tests (one step test, two steps test, finite subgroup test), Examples of subgroup including a subgroup generated by a single group element $'a'$ and a subgroup generated by a subset S of the parent group. Intersection and union of two subgroups. Center of a group, centralizer of a group element a, Normalizer of a subgroup H.
- Definition and examples of a cyclic groups, Subgroup of a cyclic group is cyclic. Description and counting: (i) Generators of finite and infinite cyclic groups (ii) Subgroups of finite and infinite cyclic groups (iii) elements of order d in a cyclic group of order n where $d|n$
- Homomorphism and Isomorphism of groups and their properties. Group Automorphism. Characterization of cyclic groups as being isomorphic to $\mathbb{Z}$ or $\mathbb{Z}_n$ for some $n \in \mathbb{N}$

Unit II: Normal subgroups, Direct products and Cayley's Theorem

- Cosets of a subgroup in a Group. Properties of cosets. Lagrange's Theorem and its corollaries. Normal subgroups. Examples. Quotient Group and its examples.
- Kernal of a homomorphism is a normal subgroup. For a group homomorphism, if $|ker\ \phi| = n$ then ϕ is n to 1 map. Fundamental theorem of homomorphism of Groups. Direct image of normal subgroup is normal under group homomorphism and Inverse image of a normal subgroup is normal under onto homomorphism.
- External direct product of groups. Order of elements in external direct product of groups. Criterion for external direct product to be a cyclic group. Internal product of groups. If G is internal direct product of two of its subgroups H and K then G is isomorphic to external direct product $H \times K$ of H and K.
- Cayley's Theorem for finite groups (Only statement).
- Classification of groups up to order 7

Technology and AI Integration: Digital tools such as SageMath, GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11

References:

1. Gallian, J. A. *Contemporary Abstract Algebra*, 10th Edition, Cengage Learning, 2023.
2. Herstein, I. N. *Topics in Algebra*, 2nd Edition, Wiley Eastern Limited, 1975.
3. Fraleigh, J. B. *A First Course in Abstract Algebra*, 7th Edition, Pearson Education, 2002.
4. Bhattacharya, P. B., Jain, S. K., and Nagpaul, S. *Abstract Algebra*, 2nd Edition, Foundation Books, New Delhi, 1995.
5. Gopalkrishnan, N. S. *University Algebra*, New Age International Publishers, 1986.
6. Artin, M. *Algebra*, 2nd Edition, Pearson Education, 2011.
7. Hungerford, T. W. *Algebra*, Graduate Texts in Mathematics, Springer, 1974.
8. Dummit, D. S. and Foote, R. M. *Abstract Algebra*, 3rd Edition, John Wiley & Sons, 2004.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Topology of Metric Spaces - I

Vertical - 1
Major - 2 Credits

with effect from
Academic Year 2026-2027

Title: Topology of Metric Spaces – I

Course Code: CHMMATHV4

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course introduces metric spaces and their topological properties, including open and closed sets, limit points, closure, and compactness. It covers sequences, convergence, Cauchy sequences, and completeness with key results like the Nested Interval and Cantor's Intersection Theorems. Emphasis is placed on examples from $\mathbb{R}^n$, function spaces, and discrete spaces, with applications in real analysis and topology.
2	**Vertical 1**	Major
3	**Type** **Teaching method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to the concept of metric as a generalization of the distance and the notion metric space. **CO(A) 2** To provide an understanding of basic concepts like open sets, closed sets, limit point, closure point of a set and their properties. **CO(A) 3** To make students learn the concept of completeness, Cantor's intersection Theorem/Nested Interval Theorem and their applications. **CO(A) 4** To familiarize students to the concept of compactness through various examples and properties of compact sets.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** define a metric space, workout several examples of metric spaces. **CO 2** apply basic concepts such as open sets, limit points, closure points and state/prove result based on all these concepts. **CO 3** define sequences in a metric space, state/develop proofs of result on complete metric space like Cantor's intersection Theorem/Nested Interval Theorem and their applications. **CO 4** apply definition of compactness to examine whether a set is compact, state and prove certain properties of compact sets.	

9

Syllabus

Unit I: Metric spaces

Definition and examples of metric spaces such as $\mathbb{R}$, $\mathbb{R}^2$, $\mathbb{R}^n$ with its Euclidean, sup and sum metrics. $\mathbb{C}$ (complex numbers). $l^1$and l^2spaces of sequences. $C[a,b]$ the space of real valued continuous functions on $[a,b]$. Discrete metric space. Metric induced by the norm. Metric subspaces. Product of two metric spaces. Open balls, closed balls and open sets in a metric space. Examples of open sets in various metric spaces. Hausdorff property. Properties of open sets. Interior of a set. Structure of an open set in $\mathbb{R}$. Distance of a point from a set. Diameter of a set. Bounded sets. Closed sets. Examples. Limit point of a set. Isolated point. Closure of a set and its properties. Dense subsets in a metric space and Separability.

Unit II: Sequences, Complete metric spaces and Compactness-I

Definition and examples of relative openness/closeness in subspaces. Sequences in a metric space. Convergent sequence in metric space. Cauchy sequence in a metric space. Subsequences. Examples of convergent and Cauchy sequences in different metric spaces. Characterization of limit points and closure points in terms of sequences. Definition of complete metric spaces. Examples of complete metric spaces. Completeness property in subspaces (Statements only).

Cantor's Intersection Theorem, Converse of Cantor's Intersection Theorem (Statement Only), Nested Interval theorem in $\mathbb{R}$ (without proof), Applications of Nested Interval Theorem such as (i) The set of real Numbers is uncountable; (ii) Density of rational Numbers; (iii) Intermediate Value theorem.

Definition of a compact metric space using open cover. Examples of compact sets in different metric spaces such as $\mathbb{R}$, $\mathbb{R}^2$, $\mathbb{R}^n$ with Euclidean metric. Properties of compact sets: A compact set is closed and bounded, (Converse is not true). Compact sets in discrete metric space, $\mathbb{N}$ and $\mathbb{Z}$ (with usual metric). Every infinite bounded subset of compact metric space has a limit point. A closed subset of a compact set is compact. Union and Intersection of Compact sets.

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. S. Kumaresan; *Topology of Metric Spaces*, Narosa Publishing House, 2011.
2. R. D. Bhat; *Intermediate Mathematical Analysis*, Narosa Publishing House, 2009.
3. E. T. Copson; *Metric Spaces*; Universal Book Stall, New Delhi, 1996.
4. D. Somasundaram, B. Choudhary; *A First Course in Mathematical Analysis*, Narosa Publishing House, 1996.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Practical based on Integral Calculus and Group Theory

Vertical - 1
Major - 2 Credits

with effect from
Academic Year 2026-2027

Title: Practical based on Integral Calculus and Group Theory
Course Code: CHMMATHV3

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course aims to develop spatial visual skills by training students to sketch and analyze 2D and 3D regions, then evaluate multiple integrals using concepts, Fubini's theorem, Change of variable theorem etc. The course builds problem-solving skills on how to choose and switch between different coordinate systems to simplify multiple integral problems and explore application of multiple integrals. This practical course also provides hands-on experience with the fundamental concepts of Group Theory, including groups, subgroups, cyclic groups, cosets, homomorphisms, and direct products. Through problem-solving and exploratory activities, students develop analytical skills for studying and interpreting algebraic structures.
2	**Vertical 1**	Major
3	**Type** **Teaching method**	Practical Problem solving/Group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To enhance conceptual understanding of multiple integrals through visualization and computing these integrals. **CO(A) 2** To develop practical skills in formulating and solving problems involving double and triple integrals in various coordinate systems. **CO(A) 3** To provide hands-on training in checking group and subgroup properties, finding the center of a group, calculating element orders, and working with cyclic groups and their generators. **CO(A) 4** To enable students to apply group homomorphisms, cosets, normal subgroups, Lagrange's Theorem, and direct products in solving practical problems.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** sketch regions, to correctly identify boundaries and solve multiple integral problems using foundational concepts like Fubini's theorem. **CO 2** select coordinate systems like cartesian, polar, cylindrical, and spherical to simplify multivariable calculus problems and solve real-world applications like area and volume. **CO 3** identify examples of groups, subgroups, and cyclic groups, verify group and subgroup properties, and find the center of a group, generators, and orders of elements. **CO 4** explain the concepts of group homomorphisms, cosets, normal subgroups, Lagrange's Theorem, and direct products, and apply them to solve practical problems.	

9	**Syllabus**
	Unit I: Practical /Case Study based on Integral Calculus 1. Sketching regions and calculating double Integrals in Cartesian Coordinate system 2. Reversing order of Integration by visualizing the boundaries of the regions 3. Finding Areas of flat regions using Double Integrals 4. Transforming and solving Double Integrals in Polar Coordinates 5. Visualizing regions in space and setting up Triple Integrals 6. Solving triple Integrals by transforming to Cylindrical and Spherical coordinate systems. 7. Geometric and Physical Applications of multiple integrals: AI assisted Case Study Using reference texts such as Apostol (Calculus, Vol. II), Stewart (Calculus) and tools such as NotebookLM, students can explore real-world applications of double and triple integral. Further tools like Claude AI and visualization software (GeoGebra) can be used to support conceptual understanding, and create visual representations. Students shall critically evaluate AI- generated content, validate findings using reference sources, and prepare and present a brief report on their study **Unit II: Practical based on Group Theory** 1. Examples of Groups and Subgroups 2. Center of a group, subgroup generated by a subset of a group, order of an element, order of a subgroup 3. Cyclic groups and their generators and subgroups 4. Properties of cyclic groups 5. Homomorphisms and Isomorphisms of groups 6. Cosets, Lagrange's theorem 7. Normal subgroups 8. External direct product, internal direct products of groups and Cayley's theorem **Miscellaneous Theory Practical based on both units.**

10	**Scheme of Examination and Assessment Pattern**

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **five** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (15 Marks: 5 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (10 marks: 2 × 5)	25
2	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Apostol, Calculus, Vol. 2, Second Ed., John Wiley, New York, 1969 Section 1.1 to 11.8.
2. James Stewart, Calculus with early transcendental Functions, 8^{th} Edition 2014 - Chapter 15 and 16.
3. Marsden and Jerrold E. Tromba, Vector Calculus, Fourth Ed., W.H. Freeman and Co., New York, 1996 Section 6.2 to 6.4.
4. T. Apostol, Mathematical Analysis, Second Ed., Narosa, New Delhi. 1947.
5. R. Courant and F.John, Introduction to Calculus and Analysis, Vol.2, Springer Verlag, New York, 1989.
6. W. Fleming, Functions of Several Variables, Second Ed., Springer-Verlag, New York, 1977.
7. M. H. Protter and C.B.Morrey Jr., Intermediate Calculus, Second Ed., Springer-Verlag, New York, 1995.
8. G. B. Thomas and R.L Finney, Calculus and Analytic Geometry, Ninth Ed. (ISE Reprint), Addison- Wesley, Reading Mass, 1998.
9. D. V. Widder, Advanced Calculus, Second Ed., Dover Pub., New York. 1989.
10. Gallian, J. A. Contemporary Abstract Algebra, 10th Edition, Cengage Learning, 2023.
11. Herstein, I. N. Topics in Algebra, 2nd Edition, Wiley Eastern Limited, 1975.
12. Fraleigh, J. B. A First Course in Abstract Algebra, 7th Edition, Pearson Education, 2002.
13. Bhattacharya, P. B., Jain, S. K., and Nagpaul, S. Abstract Algebra, 2nd Edition, Foundation Books, New Delhi, 1995.
14. Gopalkrishnan, N. S. University Algebra, New Age International Publishers, 1986.
15. Artin, M. Algebra, 2nd Edition, Pearson Education, 2011.
16. Hungerford, T. W. Algebra, Graduate Texts in Mathematics, Springer, 1974.
17. Dummit, D. S. and Foote, R. M. Abstract Algebra, 3rd Edition, John Wiley & Sons, 2004.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Practical based on Integral Calculus and Topology of Metric Spaces I

Vertical - 1
Major - 2 Credits

with effect from
Academic Year 2026-2027

Title: Practical based on Integral Calculus and Topology of Metric Spaces I
Course Code: CHMMATHV5

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This practical course provides experiential learning in Multivariable Calculus and Metric Space Theory through problem-solving, visualization, and AI-assisted exploratory activities. Students investigate line and surface integrals, integral theorems, and fundamental concepts of metric spaces, while developing analytical skills and mathematical reasoning through practical applications. This practical course develops core skills in the topics from metric spaces through problem-solving. Students will work with various examples of metric spaces and study their topological structures. Problems on limit points, closure points, sequences, Cauchy sequences, completeness of Metric spaces/subspaces, Nested Interval Theorem, Cantor's Intersection theorem, compactness will reinforce the concepts.
2	**Vertical 1**	Major
3	**Type** **Teaching method**	Practical Problem solving/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** To enhance conceptual understanding of line and surface integrals through visualization of curves and regions and computing these integrals. **CO(A) 2** To develop the ability to evaluate line and surface integral by applying the major integral theorems such as Green's, Stokes' and Gauss' and to model physical quantities. **CO(A) 3** To make students understand various examples of metric spaces, structure of open sets in these metric spaces and to find limit points, closure points of a set and to study and apply their various properties. **CO(A) 4** To develop students' skills of checking whether a metric space is complete and to apply Cantor's intersection theorem at different situations, also to learn examples of compact sets and to examine whether given set is compact.	

8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** apply definition, results and techniques of line and surface integrals to solve problems involving scalar and vector fields and to model physical quantities. **CO 2** analyse and decide applicability of Green's Theorem, Stokes' Theorem, and Gauss Divergence Theorem, apply the suitable results to evaluate integrals. **CO 3** apply definition of metric spaces, open sets in case of several examples and obtain limit points, closure points of sets and prove certain statements using their properties. **CO 4** examine whether a metric space is complete and apply Nested Interval Theorem, Cantor's intersection theorem. Identify and analyze properties of compact metric spaces.
9	**Syllabus** **Unit I: Practical/ Case Study based on Integral Calculus** 1. Parametrizing curves in $\mathbb{R}^2$ and $\mathbb{R}^3$ and computing line integrals of scalar fields 2. Visualizing vector fields and computing line integrals of vector fields using definitions, appropriate results 3. Connecting line integral and double integral through Green's theorem 4. Visualizing surfaces and computing surface integrals 5. Relating boundary curves and surfaces through Stokes' theorem 6. Linking flux and enclosed volume through Gauss divergence theorem 7. Modeling real-world phenomena using line integrals: an AI-assisted practical Using reference texts such as Apostol (Calculus, Vol. II) and Stewart (Calculus), students shall investigate applications of line integrals in scalar and vector fields using NotebookLM. Tools such as Claude AI and GeoGebra may be used to support visualization, conceptual understanding, and mathematical communication. Students shall critically evaluate AI-generated content, validate findings using authoritative sources, and prepare a brief report. **Unit II: Practical based on Topology of Metric Spaces I** 1. Metric Spaces, Subspaces and Normed Linear Spaces 2. Sketching of Open Balls in $\mathbb{R}^2$, Open and Closed sets 3. Interior of a set, Interior points and Limit Points, 4. Closure of a set, Dense Sets, Separability and Diameter of a set 5. Bounded, Convergent and Cauchy Sequences 6. Completeness of Metric Spaces and subspaces 7. Nested Interval /Cantor's Intersection Theorem and Applications 8. Compact metric spaces **Miscellaneous Theory practical based on both units**

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **A. External Examination: Semester End External - 30 marks Time: 3 hours** Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **five** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (15 Marks: 5 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (10 marks: 2 × 5)	25
2	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11 **References:**

1. Apostol, Calculus, Vol. 2, Second Ed., John Wiley, New York, 1969 Section 1.1 to 11.8.
2. James Stewart, Calculus with early transcendental Functions, 8th Edition 2014 - Chapter 15 and 16.
3. Marsden and Jerrold E. Tromba, Vector Calculus, Fourth Ed., W.H. Freeman and Co., New York, 1996 Section 6.2 to 6.4.
4. T. Apostol, Mathematical Analysis, Second Ed., Narosa, New Delhi. 1947.
5. R. Courant and F.John, Introduction to Calculus and Analysis, Vol.2, Springer Verlag, New York, 1989.
6. W. Fleming, Functions of Several Variables, Second Ed., Springer-Verlag, New York, 1977.
7. M. H. Protter and C.B.Morrey Jr., Intermediate Calculus, Second Ed., Springer-Verlag, New York, 1995.
8. G. B. Thomas and R.L Finney, Calculus and Analytic Geometry, Ninth Ed. (ISE Reprint), Addison- Wesley, Reading Mass, 1998.
9. D. V. Widder, Advanced Calculus, Second Ed., Dover Pub., New York. 1989.
10. S. Kumaresan; *Topology of Metric Spaces*, Narosa Publishing House, 2011
11. R. D. Bhat; *Intermediate Mathematical Analysis*, Narosa Publishing House, 2009.
12. E. T. Copson; *Metric Spaces*; Universal Book Stall, New Delhi, 1996.
13. D. Somasundaram, B. Choudhary; *A First Course in Mathematical Analysis*, Narosa Publishing House, 1996.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Graph Theory - I

Vertical - 1
Major Elective - 2 Credits

with effect from
Academic Year 2026-2027

Title: Graph Theory - I
Course Code: CHMMATHV6

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces the fundamental concepts of Graph Theory, including graph structures, graph representations, Eulerian and Hamiltonian graphs, and their characterizations. Students will study trees, spanning trees, graph algorithms, and minimal spanning trees, along with applications such as coding, decision trees and DNA sequencing. The course emphasizes both theoretical foundations and practical problem-solving using graph-theoretic techniques.
2	**Vertical 1**	Major (Elective)
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** To introduce to the students, the fundamental concepts, terminology, and representations of graphs and their properties. **CO(A) 2** To enable the students to study and understand Eulerian, Hamiltonian, bipartite, and connected graphs. **CO(A) 3** To familiarize students with graph algorithms for finding spanning trees such as BFS, DFS, and Kruskal's algorithm. **CO(A) 4** To demonstrate real-world applications of graph theory in computer science, coding, DNA sequencing and some Mathematical recreations like puzzles.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** analyze graph-theoretic concepts and matrix representations to interpret and classify different graph structures. **CO 2** evaluate graph properties using appropriate theorems to identify Eulerian, Hamiltonian, bipartite, and connected graphs. **CO 3** design and construct spanning trees, minimum spanning trees, and related tree structures using standard graph algorithms. **CO 4** apply and evaluate graph-theoretic methods to solve real-world problems in computer science, coding, DNA sequencing, and mathematical recreations.	

9	**Syllabus**
	Unit I: Basics of Graphs and Eulerian graphs Definition of general graph, Directed and Undirected graphs, Simple and Multiple graphs. Types of graphs - Complete graph, Null graph, Complementary graphs, Regular graph. Subgraph of a graph, Vertex and Edge induced subgraphs, Spanning subgraphs. Basic terminology - degree of a vertex, minimum and maximum degree, Walk, Trail, Circuit, Path, Cycle. Handshaking theorem and its applications. Isomorphism between the graphs and consequences of isomorphism between the graphs, Self complementary graphs, Connected graphs, Connected components. Matrices associated with the graphs – Adjacency and Incidence matrix of a graph, properties. Bipartite graphs and characterization in terms of cycle lengths. Degree sequence and Havel-Hakimi theorem. Eulerian graph and its characterization- Fleury's Algorithm (Chinese postman problem) Application: A puzzle with Multicolored cube **Unit II: Trees and Hamiltonian Graphs** Cut Edges and Cut Vertices and relevant results, Characterization of Cut Edge. Definition of a tree and its characterization, Spanning tree, Recurrence relation of Spanning trees and Cayley's formula for Spanning trees of K_n. Algorithms for spanning tree – Breadth First Search (BFS) and Depth First Search (DFS). Definition of Binary and m-ary tree, Weighted graphs and minimal Spanning trees, Kruskal's algorithm for minimal spanning trees. Hamiltonian graph, Necessary condition for Hamiltonian graphs using $G\setminus S$ where S is a proper subset of $V(G)$, Sufficient condition for Hamiltonian graphs- Ore's theorem and Dirac's theorem, Hamiltonian closure of a graph. Applications: Binary Search Tree, Decision Tree, Prefix codes and Huffman coding, Connector problem, Travelling Salesman Problem, DNA sequencing. **Technology and AI Integration:** Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

Recommended to undertake a mini research project based on the themes in the syllabus. The guidelines for mini research project is provided separately.

OR

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11

References:

1. Douglas B. West, Introduction to Graph Theory, 2nd Edition., Pearson, 2000
2. Kenneth and Rosen, Discrete Mathematics and its Applications, McGraw Hill, 8th Edition, 2021.
3. Bondy and Murty, Graph Theory with Applications, North Holland, 1st edition, 1976
4. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, 1st edition, Prentice Hall Learning Pvt Ltd, 2024
5. Gary Chartrand and Ping Zhang, A First Course in Graph theory, Dover Publications, Inc, New York, 1st edition, 2012.
6. S.A. Choudam, Introductory Graph Theory, Macmillan India Ltd, 2nd Edition, 2000

Smt. Chandibai Himathmal Mansukhani College (Autonomous)

Third Year B.Sc. (Mathematics)

Semester- V

Title: Practical based on Graph Theory - I

Vertical - 1
Major Elective - 2 Credits

With effect from
Academic Year 2026-2027

Title: Practical based on Graph Theory I
Course Code: CHMMATHV7

Sr. No.	Heading	Particulars
1	**Description of the Course**	This practical course provides hands-on experience in Graph Theory through problem-solving, algorithmic implementation, and graph analysis. Students will explore graph structures, graph matrices, connectivity, Hamiltonian graphs, trees, spanning trees, Eulerian graphs using standard algorithms such as BFS, DFS, Kruskal’s and Fleury’s algorithms. The course emphasizes computational techniques and applications of graph theory in Computer Science, coding, DNA sequencing.
2	**Vertical 1**	Major Elective
3	**Type** **Teaching Method**	Practical Problem solving /group discussion/presentation/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop students’ practical skills in constructing, analyzing, and classifying different types of graphs and obtaining matrix representations of the graph. **CO(A) 2** To provide hands-on understanding of graph properties such as connectivity, isomorphism, degree sequences and Eulerian characteristics. **CO(A) 3** To enable students to implement and apply graph algorithms for spanning trees, minimal spanning trees and obtaining Eulerian Circuit. **CO(A) 4** To familiarize students with applications of graph theory and Hamiltonian graphs properties.	
8	**Course Outcomes**: On completion of the course, learner should be able to **CO 1** analyze graph properties using graph-theoretic concepts, matrices, and degree-based characteristics. **CO 2** construct trees, spanning trees, network cut-elements, and optimal Huffman coding structures. **CO 3** apply standard graph algorithms including BFS, DFS, Kruskal's, and Fleury's to resolve network routing problems. **CO 4** evaluate complex theoretical and practical problems concerning connectivity, Eulerian paths, and Hamiltonian cycles.	

9	**Syllabus** **Unit 1: Practical/Case Study based on Unit I (Basics of Graphs and Eulerian graphs)** **1.** Classification of Graphs, subgraphs, Degree Analysis and Handshaking Theorem **2.** Walks, Trails, Paths, Circuits, Cycles **3.** Connected graphs and Self-complementary graphs **4.** Isomorphism of Graphs, Matrices associated with the graphs **5.** Self-complementary graphs, Connected graphs, **6.** Degree sequence and Havel-Hakimi theorem **7.** Eulerian graph and its characterization, Fleury's Algorithm **8.** **AI-Assisted Mini Project**: Any ONE using Digital tools such as GeoGebra, NotebookLM, or Claude AI can be used selectively to visualize concepts, and enhance mathematical communication • **Friend Recommendation System in Social Media** (Usage of AI in graph structures and degree sequences to suggest new friends based on mutual connections and user interaction patterns in social networks.) • **AI Traffic Signal Management System** (Understanding how AI applies connected graph concepts to manage traffic flow, optimize signal timing, and reduce congestion in smart cities.) **Unit 2: Practical/Case Study based on Unit II (Trees and Hamiltonian Graphs)** 1. Definition of a tree and its characterizations, 2. Cut vertices. Cut edges and its Characterization 3. Spanning tree and Recurrence relation of spanning trees, Cayley formula for spanning trees 4. Algorithms for spanning tree-BFS and DFS, Kruskal's algorithm for minimal spanning trees 5. Binary and m-ary tree, Prefix codes and Huffman coding 6. Hamiltonian graphs and Hamiltonian closures 7. **AI-Assisted Mini Project**: Any ONE with Digital tools such as GeoGebra, NotebookLM, or Claude AI to be used selectively to visualize concepts, and enhance mathematical communication) • **File Compression Using Huffman Coding** Introduction to AI-assisted data compression techniques using Huffman coding to efficiently reduce file size while preserving information. • **DNA Sequence Matching** Exploration of DNA sequencing analysis using Hamiltonian path concepts for identifying genetic patterns. **Miscellaneous theory practical based on both Units.**

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **five** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (15 Marks: 5 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (10 marks: 2 × 5)	25
2	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test • Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) • Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation/ Mini Project	5
Total		**20**

11 **References:**

1. Douglas B. West, Introduction to Graph Theory, 2nd Edition., Pearson, 2000
2. Kenneth and Rosen, Discrete Mathematics and its Applications, McGraw Hill, 8th Edition, 2021.
3. Bondy and Murty, Graph Theory with Applications, North Holland, 1st edition, 1976
4. Narsing Deo, Graph Theory with applications to Engineering and Computer Science, 1st edition, Prentice Hall Learning Pvt Ltd, 2024
5. Gary Chartrand and Ping Zhang, A First Course in Graph theory, Dover Publications, Inc, New York, 1st edition, 2012.
6. S.A. Choudam, Introductory Graph Theory, Macmillan India Ltd, 2nd Edition, 2000

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year
(Mathematics)

Semester- V

Title: Numerical Methods – I

Vertical - 2
Minor - 2 Credits

with effect from
Academic Year 2026-2027

Title: Numerical Methods - I
Course Code: CHMMATHV8

<table>
<tr><th>Sr. No.</th><th>Heading</th><th>Particulars</th></tr>
<tr><td>1</td><td>Description of the Course:</td><td>The reason for studying this course is that numerical methods can provide solutions to applied problems when analytical methods fail or are too complicated to solve. The increasing importance of numerical methods in applied sciences has led to a growing demand for courses dealing with the techniques of numerical analysis. This course aims to equip students with practical skills and mathematical tools for solving transcendental and polynomial equations, as well as systems of linear algebraic equations, using different numerical methods.</td></tr>
<tr><td>2</td><td>Vertical 2</td><td>Minor</td></tr>
<tr><td>3</td><td>Type
Teaching Method</td><td>Theory + Practicum
(Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)</td></tr>
<tr><td>4</td><td>Credit</td><td>2 Credits</td></tr>
<tr><td>5</td><td>Hours allotted</td><td>30 Hours</td></tr>
<tr><td>6</td><td>Marks allotted</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">Course Objectives:

CO(A) 1 To develop students' understanding of iteration methods based on first- and second-degree equations for solving nonlinear equations.
CO(A) 2 To enable students to investigate numerical methods for solving systems of nonlinear equations and analyze their convergence.
CO(A) 3 To familiarize students with direct and iterative methods for solving systems of linear algebraic equations.
CO(A) 4 To enable students to apply matrix decomposition techniques for solving systems of linear equations and finding matrix inverses.</td></tr>
</table>

8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain the concepts of direct and iterative methods, multiple roots, and rate of convergence, and apply first- and second-degree iteration methods to solve nonlinear equations. **CO 2** determine solutions of systems of nonlinear equations using the Newton–Raphson method and evaluate the convergence of iterative methods. **CO 3** identify different matrix representations and numerical methods for solving systems of linear equations, and apply direct and iterative methods to solve systems of the form AX=B **CO 4** explain LU decomposition, Cholesky decomposition, and matrix inversion techniques, and evaluate their suitability for solving systems of linear equations and finding matrix inverses.
9	**Syllabus** **UNIT I** • Concept of simple and multiple roots. Direct and Iterative methods, use of intermediate value theorem and finding initial approximation of a root. • Iteration methods based on first degree equation: Regula-Falsi method, Secant method, Newton-Raphson method, Geometrical interpretation of these methods, General Iteration Method. Methods for multiple roots. • Iteration methods based on second degree equation: Chebyshev method, Multipoint iteration method, Muller method. • System of non-linear equations by Newton- Raphson method. Methods for complex roots. • Rate of convergence of Secant method, Regula-Falsi method, Newton-Raphson method, General Iteration Method, Chebyshev method and Muller method. **UNIT II** • Matrix representation of linear system of equations AX=B, positive definite matrix, Tri-diagonal matrix. • Direct methods: Gauss elimination method, Forward and backward substitution methods, Triangularization methods-Doolittle`s and Crout`s method (LU decomposition), LU decomposition to Tri-diagonal system, Cholesky’s method. • Iteration methods: Jacobi iteration method, Gauss-Seidel iterative method, SOR method and their respective error formats. • Finding inverse of a matrix by LU decomposition, Cholesky’s method and Partition method and hence solve AX=B by matrix inversion method.

10	**Scheme of Examination and Assessment Pattern**

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	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

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
	Total	**20**

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 × 3)

11

References:

1. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers.
2. Madhumangal Pal (2009). Numerical Analysis for Scientists and Engineers (2nd Edition). Narosa Publishing House.
3. P. Sivaramakrishna Das and C. Vijayakumari (2014). Numerical Analysis. Pearson.
4. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson.
5. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year
(Mathematics)

Semester- V

Title: Practical Based on Numerical Methods – I

Vertical - 2
Minor - 2 Credits

with effect from
Academic Year 2026-2027

Title: Practical Based on Numerical Methods – I
Course Code: CHMMATHV9

Sr. No.	Heading	Particulars
1	**Description of the Course:**	The reason for studying this course is that numerical methods can provide solutions to applied problems when analytical methods fail or are too complicated to solve. The increasing importance of numerical methods in applied sciences has led to a growing demand for courses dealing with the techniques of numerical analysis. This course aims to equip students with practical skills and mathematical tools for solving transcendental and polynomial equations, as well as systems of linear algebraic equations, using different numerical methods.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Practical Problem solving /group discussion/presentation/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop students' computational skills in applying iterative methods for solving transcendental, polynomial, and nonlinear equations. **CO(A) 2** To enable students to investigate the convergence and efficiency of numerical methods for solving nonlinear equations. **CO(A) 3** To develop students' problem-solving skills in solving systems of linear algebraic equations using direct and iterative numerical methods. **CO(A) 4** To provide students with hands-on experience in implementing numerical methods through computational examples and programming.	

8	**Course Outcomes**: Upon completion of the syllabus, learner will be able to **CO 1** explain the principles of iterative methods for solving transcendental, polynomial, and nonlinear equations, and apply Regula–Falsi, Secant, Newton–Raphson, General Iteration, Chebyshev, Muller, and Multipoint methods to compute their solutions. **CO 2** compare the performance of different iterative methods and evaluate their suitability for solving nonlinear equations and systems of nonlinear equations. **CO 3** identify appropriate direct and iterative methods, and apply LU decomposition, Cholesky, Jacobi, Gauss–Seidel, and SOR methods to solve systems of linear equations and find matrix inverses. **CO 4** develop programs or computational algorithms that implement numerical methods for solving nonlinear equations, finding matrix inverses, and solving systems of linear algebraic equations.
9	**Unit 1: Practical on Transcendental and Polynomial Equations** • Iteration methods based on Regular-falsi method and secant method • Iteration methods based on Newton-Raphson method • Iteration methods based on general iteration method • Iteration methods based on Chebyshev method • Iteration methods based on Multipoint iteration method • Iteration methods based on Muller method • System of non-linear equations by Newton- Raphson method **Unit 2: Practical on System of Linear Algebraic Equations** • Doolittle`s method and Crout`s method • Cholesky's method • Solving Tri-diagonal system by LU decomposition • Finding inverse of a matrix by LU decomposition and Cholesky’s method • Finding inverse of a matrix by Partition method • Jacobi iteration method • Gauss-Seidel iterative method • SOR method

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 3:00 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) (CO1 to CO3)	(3 ×5 =1 5 Marks)
Q2	Attempt any Two out of Four (Two from Unit 1 and two From Unit 2). (CO 3 and CO 4)	(5 × 2 = 10 Marks)
Q3	Journal	5 (2.5 marks for each Unit 1 & Unit 2)
		Total: 30

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
		Total: 20

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: 5 × 2)

Duration: 1Hrs

While setting question paper four MCQ on module 1 and four MCQ on module 2 both.

11 **References:**

1. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers.
2. Madhumangal Pal (2009). Numerical Analysis for Scientists and Engineers (2nd Edition). Narosa Publishing House.
3. P. Sivaramakrishna Das and C. Vijayakumari (2014). Numerical Analysis. Pearson.
4. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson
5. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India

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

Sr. No.	Heading	Particulars
1	**Description of the Course:**	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.
2	**Vertical 2**	Minor
3	**Type**	Theory + Practicum (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** To introduce the fundamental concepts of integers, real numbers, complex numbers, sequences, counting principles, sets, functions, limits, and continuity. **CO(A) 2** To develop students' logical reasoning and mathematical thinking through proofs by mathematical induction, elementary number theory, and the study of functions and their properties. **CO(A) 3** To enable students to apply algebraic, combinatorial, and analytical techniques for solving problems involving divisibility, congruences, permutations, combinations, complex numbers, limits, and continuity. **CO(A) 4** To facilitate the development of problem-solving, analytical, and mathematical communication skills, providing a strong foundation for advanced studies in mathematics.	

8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** demonstrate the fundamental concepts of integers, rational and irrational numbers, divisibility, prime numbers, congruences, real numbers, complex numbers, and sequences. **CO 2** apply mathematical induction, Euclid's algorithm, De Moivre's theorem, and operations on complex numbers to solve mathematical problems and analyze numerical structures. **CO 3** apply counting techniques, permutations, combinations, set operations, and properties of functions to solve mathematical problems. **CO 4** analyze the behavior of functions using limits and continuity and evaluate the continuity of elementary functions through their fundamental properties.
9	**Syllabus** **Unit 1: Basics of integers, real numbers and complex numbers** • 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 2: Practical on System of Linear Algebraic Equations** • 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**

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 3:00 hour

Format of Question Paper

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

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
	Total	**20**

	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: 2×3)
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

Sr. No.	Heading	Particulars
1	**Description of the Course:**	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	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Practical Problem solving /group discussion/presentation/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To introduce students to practical techniques for exploring concepts of integers, divisibility, congruences, complex numbers, sequences, counting principles, functions, limits, and continuity. **CO(A) 2** To develop computational and analytical skills through practical exercises involving Euclid's algorithm, De Moivre's theorem, permutations, combinations, and functions. **CO(A) 3** To enable students to visualize and interpret mathematical concepts such as complex plane regions, sequences, functions, and continuity using graphical and computational approaches. **CO(A) 4** To facilitate the application of mathematical concepts and algorithms for solving practical problems and strengthening logical reasoning and problem-solving abilities.	

<table>
<tr>
<td>8</td>
<td>
Course Outcomes: Supon completion of the course, learner should be able to

CO 1 apply Euclid's algorithm, properties of divisibility and congruences, and De Moivre's theorem to solve computational problems involving integers and complex numbers.
CO 2 analyze the behavior of sequences and represent complex numbers graphically, including regions in the complex plane and their polar forms.
CO 3 apply counting techniques, permutations, combinations, and properties of functions to solve practical mathematical problems.
CO 4 evaluate limits and continuity of functions through computational examples and verify the arithmetic properties of continuous functions.
</td>
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<tr>
<td>9</td>
<td>
Syllabus
Unit 1: Practical based on basics of integers, real numbers and complex numbers (30 Hours)

Integers and divisibility
Computation of greatest common divisor using Euclid’s algorithm
Properties of congruences
Solutions of linear congruences
Plotting of regions in the complex numbers and conversion to polar form
Applications of DeMoivre’s theorem
Sequences and their plotting, Convergence of sequences based on plotting

Unit 2: Practical based on Introduction to basic counting and basics of functions (30 Hours)

Permutations of distinct objects
Combinations of distinct objects
Permutations and combinations of multisets
Injective, bijective, surjective functions
Inverse images of sets under functions
Limit of a function and examples
Continuity of a function
Arithmetic of continuous functions

</td>
</tr>
</table>

10	**Scheme of Examination and Assessment Pattern** Paper – 50 Marks **External Examination: Semester End External - 30 marks Time: 3:00 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) (CO1 to CO3)	(3 ×5 =15 Marks)
Q2	Attempt any Two out of Four (Two from Unit 1 and two From Unit 2). (CO 3 and CO 4)	(5 × 2 = 10 Marks)
Q3	Journal	5 (2.5 marks for each Unit 1 & Unit 2)
		Total: 30

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
		Total: 20

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: 5 × 2)

Duration: 1Hrs

While setting question paper four MCQ on module 1 and four MCQ on module 2 both.

11	**References:** 1. Niven H. Zuckerman and H. Montogomery. An Introduction to the Theory of Numbers. John Wiley & Sons. Inc. 2. David M. Burton. An Introduction to the Theory of Numbers. Tata McGraw-Hill Edition. 3. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons. 4. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons. 5. Thomas and Finney, Calculus and Analytical Geometry, Pearson 6. Ajit Kumar and S. Kumaresan, A basic course in real analysis, Chapman and Hall 7. B. V. Limaye and Sudhir Ghorpade, A course in calculus and real analysis, Springer Nature.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B. Sc.
(Mathematics)

Semester- V

Title: Computational Machine Learning

Vertical - 4
VSC - 2 Credits

with effect from
Academic Year 2026-2027

Title: Computational Machine Learning
Course Code: CHMMATHV12

Sr. No.	Heading	Particulars
1	**Description of the Course**	This introduces students to the mathematical and statistical foundations of machine learning through practical, real-world applications. The course integrates concepts from linear algebra, calculus, probability, and statistics with core machine learning techniques such as regression, classification, clustering, dimensionality reduction, anomaly detection, and probabilistic modelling. Students will explore applications including image compression, recommender systems, face recognition, fraud detection, spam filtering, and customer segmentation while understanding the underlying mathematical principles behind these algorithms. The course also provides hands-on experience with Python-based tools and libraries such as NumPy, SciPy, scikit-learn, and statsmodels for implementing and evaluating machine learning models in data-driven environments.
2	**Vertical 4**	VSC
3	**Type** **Teaching Method**	Practical Case study/Problem solving/group discussion/seminar/tech-based learning etc.
4	**Credits**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop an understanding of the mathematical foundations of machine learning through linear algebra, calculus, probability and statistics. **CO(A) 2** To explore core machine learning paradigms including supervised, unsupervised and probabilistic learning through real-world applications. **CO(A) 3** To apply mathematical and statistical techniques to analyze, model and interpret data-driven problems. **CO(A) 4** To gain practical experience with machine learning algorithms and Python-based tools for data analysis and predictive modelling.	

8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** formulate and interpret the mathematical structures/principles underlying machine learning algorithms including matrix decomposition, eigenvalue analysis, gradient-based optimization, Bayes' theorem and probability distributions and statistical inference. **CO 2** formulate, compare and critically evaluate machine learning methodologies across supervised, unsupervised and probabilistic paradigms spanning linear and logistic regression, principal component analysis, clustering, Bayesian classification, and density-based anomaly detection with respect to their underlying assumptions, objective functions and decision making. **CO 3** examine real-world data-driven problems through a mathematical lens, selecting and applying suitable algorithms and interpreting outputs to draw conclusions. **CO 4** design and implement machine learning workflows in Python, translating mathematical formulations from matrix operations, gradient computations, probabilistic inference and hypothesis testing into reproducible, structured computational solutions using industry-standard scientific libraries from Python.
9	**Syllabus** **Use Case 1: Image Compression (SVD)** • **ML Theory & Algorithm**: Unsupervised Learning / Dimensionality Reduction via Matrix Factorization. • **Real-World Application**: Reducing the file size of satellite imagery for faster transmission. • **Math Foundations**: Singular Value Decomposition (SVD), matrix factorization, and low-rank approximation. • **Python Tools**: numpy.linalg.svd, scipy.linalg. **Use Case 2: User Personalisation (Collaborative Filtering)** • **ML Theory & Algorithm**: Recommender Systems / Low-Rank Matrix Completion. • **Real-World Application**: Predicting movie ratings for users on a streaming platform. • **Math Foundations**: Matrix factorization, dot products, and cosine similarity metric spaces. • **Python Tools**: scikit-learn (pairwise metrics), scipy.sparse. **Use Case 3: Face Recognition (Eigenfaces)** • **ML Theory & Algorithm**: Unsupervised Learning / Feature Extraction via Principal Component Analysis (PCA).

	• **Real-World Application**: Unlocking smartphones using facial geometry verification. • **Math Foundations**: Eigenvectors, eigenvalues, and covariance matrices. • **Python Tools**: sklearn.decomposition.PCA. **Use Case 4: Property Valuation (Gradient Descent)** • **ML Theory & Algorithm**: Supervised Learning / Parametric Regression via Ordinary Least Squares (OLS). • **Real-World Application**: Forecasting house prices based on square footage and location. • **Math Foundations**: Linear regression, partial derivatives, gradients, and Taylor series expansion. • **Python Tools**: scikit-learn (SGDRegressor), autograd. **Use Case 5: Credit Card Fraud Detection (Logistic Regression)** • **ML Theory & Algorithm**: Supervised Learning / Empirical Risk Minimization via Binary Classification. • **Real-World Application**: Classifying financial transactions as fraudulent or legitimate in real-time. • **Math Foundations**: Sigmoid function, binary cross-entropy loss, and gradient vector calculations. • **Python Tools**: sklearn.linear_model.LogisticRegression. **Use Case 6: Neural Network Optimization (Backpropagation)** • **ML Theory & Algorithm**: How neural networks learn by adjusting weights to reduce prediction errors. • **Real-World Application**: Detecting damaged products in factory images. • **Math Foundations**: Functions, derivatives, partial derivatives, and the chain rule. • **Python Tools**: PyTorch and TensorFlow for building and training simple neural networks. **Unit 2: Probabilistic and Statistical Machine Learning** **Use Case 7: Email Spam Filtering (Naive Bayes)** • **ML Theory & Algorithm**: Supervised Learning / Generative Classifiers via Multinomial Naive Bayes. • **Real-World Application**: Sorting incoming emails into inbox or spam folders automatically.

- **Math Foundations**: Bayes' theorem, conditional independence assumptions, and posterior probabilities.
- **Python Tools**: sklearn.naive_bayes.MultinomialNB.

Use Case 8: Customer Segmentation (Gaussian Mixture Models)

- **ML Theory & Algorithm**: Unsupervised Learning / Soft Clustering via Expectation-Maximization (EM).
- **Real-World Application**: Grouping e-commerce shoppers by purchasing behaviour for targeted marketing.
- **Math Foundations**: Normal distribution, Expectation-Maximization (EM) algorithm, and latent variables.
- **Python Tools**: sklearn.mixture.GaussianMixture.

Use Case 9: Quality Control (Anomaly Detection)

- **ML Theory & Algorithm**: Unsupervised Learning / Density Estimation for Outlier Detection.
- **Real-World Application**: Monitoring industrial sensor data to predict factory equipment failure.
- **Math Foundations**: Probability density functions, central limit theorem, and z-score thresholds.
- **Python Tools**: scipy.stats, sklearn.covariance.EllipticEnvelope.

Use Case 10: Clinical Trial Outcomes (Hypothesis Testing)

- **ML Theory & Algorithm**: Statistical Inference / Frequentist Hypothesis Testing.
- **Real-World Application**: Verifying if a new medical drug significantly performs better than a placebo.
- **Math Foundations**: p-values, t-tests, Type I/II errors, and confidence intervals.
- **Python Tools**: scipy.stats.ttest_ind, statsmodels.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No.	Structure of the Question	Marks
1.	Practical Exam Attempt any five out of eight questions (four questions from each unit)	25
2.	Journal	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No	Title	Marks
1.	Quiz (MCQs/ Match the Pairs/ Answer in one sentence/ Puzzles)/	05
2.	Mini Case Study / Test comprising of problems/programs	15
	Total	**20**

11

References:

1. Pradhan, Manaranjan, and U. Dinesh Kumar. Machine Learning Using Python. Wiley,2019.
2. Pradhan, Manaranjan, and U. Dinesh Kumar. Machine Learning Using Python. Wiley,2019.
3. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. O’Reilly Media, 2016.
4. McKinney, Wes. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. 2nd ed., O’Reilly Media, 2017.
5. Klein, Bernd. Data Analysis with NumPy, Matplotlib and Pandas. Publisher not specified, 2020.
6. Müller, Andreas C., and Sarah Guido. Introduction to Machine Learning with Python: A Guide for Data Scientists. O’Reilly Media, 2016.
7. Sarkar, Dipanjan, Raghav Bali, and Tushar Sharma. Practical Machine Learning with Python. Apress, 2018.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year
(Mathematics)

Semester- V

Title: Cocurricular Course

Vertical - 6
Cocurricular Course - 2 Credits

with effect from
Academic Year 2026-2027

Title: Cocurricular Course - I

Course Code: CHMCCI6

Sr. No.	Heading	Particulars
1	**Description the Course:**	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. 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. 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.
2	**Vertical 6**	Cocurricular Course (Mandatory)
3	**Type** **Teaching Methods**	Non Theory Participation, Report Writing, Presentation etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: 1. To inculcate a spirit of active participation in cultural, social, environmental, and creative activities. 2. To enhance personal and interpersonal skills through real-life experiences and teamwork. 3. To foster a sense of responsibility, leadership, and community engagement among students. 4. To develop self-confidence and emotional well-being through creative expression and collaboration. 5. To integrate classroom learning with experiential learning for holistic growth.	
8	**Learning Outcomes**: By the end of the course, students will be able to: **LO1:** Participate meaningfully in diverse co-curricular activities and reflect on their learning experiences. **LO2:** Demonstrate improved communication, leadership, and teamwork skills. **LO3:** Exhibit increased awareness of social responsibility and civic engagement. **LO4:** Build confidence through creative, cultural, and intellectual expressions. **LO5:** Maintain a portfolio or activity log to track participation and personal development.	

9	**Syllabus** **Unit I - Suggested Areas of Participation in the activities:** • **Cultural Events:** Drama, dance, music, literary events, debates, etc. • **Social Outreach:** Blood donation, awareness campaigns, cleanliness drives. • **Clubs & Societies:** Photography, quiz, environment club, shram club, etc. • **Sports & Fitness:** College tournaments, yoga, marathons, fitness challenges. • **Institutional Events:** Foundation Day, Annual Day, College Festivals, Intercollegiate events. • **National Festivals:** Independence Day, Republic Day etc. **Unit II - Program Specific Topics** • **Workshops/Seminars:** Report Writing, Personality Development, Soft Skills, Leadership Talks. • **Speak, Show, Shine:** Presentation / Poster Presentation / Viva and Learning Experience **Mode of Evaluation:** • **Faculty Coordinator:** To guide and evaluate student progress. • **Participation Proof:** Certificates, photos, attendance records. • **Reflective Journal:** Minimum 2–3 pages summarizing experiences, learning, and growth. • **Final Viva/Presentation:** 5-minute talk on poster presentation and on overall learning.
10	**Scheme of Examination and Assessment Pattern** **Based on 3 approved Activities** **Semester End External - 30 marks**

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
	Total	**30**

Internal Examination: Continuous Evaluation – 20 marks

	Assessment / Evaluation	Marks
1.	Reflective journal	10
2.	Presentation/ poster presentation/viva	10
	Total	**20**

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

SMT. CHANDIBAI HIMATHMAL MANSUKHANI COLLEGE ★ ULHASNAGAR 421 003.

Smt. Chandibai Himathmal Mansukhani College
(Autonomous)

Third Year B.Sc.
(Mathematics)

Semester- V

Title: Community Engagement Project (CEP)

Vertical - 6
2 Credits

with effect from
Academic Year 2026-2027

Title: Community Engagement Program (CEP)
Course Code: CHMMATHV13

Sr. No.	**Indicative Topics for CEP** **30 hours (Field Work + Survey) + 15 hours (Discussion + Report Writing) Total - 45 hours**
1	Mathematics of Insurance and Risk Assessment for Community Awareness
2	Statistical Study of Employment and Unemployment Trends in the Local Area
3	Mathematical Modelling of Queueing Systems in Banks and Public Offices
4	Survey and Statistical Analysis of Digital Literacy in the Community
5	Mathematics Behind Pricing Strategies and Profit Optimization for Small Vendors
6	Application for Linear Programming in Resource Allocation for Community Welfare Programs
7	Mathematical Study of Rainfall Patterns and Their Impact on Agriculture
8	Mathematical Modelling of Population Growth and Migration Trends in the Town
9	Using Mathematics to Study Traffic Flow and Road Safety in Urban Areas
10	Mathematics Olympiad Training and Mentorship Program for School Student
11	Community Mathematics Festival: Promoting Mathematical Awareness and Engagement
12	Integration of Mathematics and Art: A Community Exhibition and Study
13	Mathematics-Based Game Development as a Tool for Learning and Engagement
14	Statistical and Mathematical Analysis of Cryptocurrency Market Trends
15	Activity-Oriented Mathematics Education for Enhancing Numerical and Financial Literacy among Underprivileged Students
16	Mathematics-Based Academic Support Programs for Children from Economically Weaker Sections
17	Demographic Data Analysis of the Local Community Using Mathematical Tools
18	A Mathematical Investigation of Sleep Patterns and Their Impact on Academic Performance
19	Applying Statistics to Analyze Nutrition and Health Trends in the Local Community
20	Survey-Based Statistical Analysis of Social and Community Issues
21	Mathematical Study of Household Waste Generation and Reduction Strategies
22	Mathematical Modelling for Effective Water Resource Management in the Town
23	Optimization of Public Transportation Systems Using Mathematical Techniques
24	Mathematical Modelling of Economic Growth Patterns of the Town
25	Statistical Analysis of Local Election Results and Voting Trends

The topics are indicative, and the faculty members should allot Community Engagement Project that are relevant and important as per the Core Subject. The Community Engagement Project may be taken individual or in a group up to 5 students with proper guidance from Faculty.

*** Please refer to the guidelines for Community Engagement Project (CEP) provided separately**

HSNC Board's

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar

(Autonomous)

Affiliated to the University of Mumbai

Bachelor of Science (Mathematics)

(Aided)

Semester – VI

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

Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar
(Autonomous)
Department of Mathematics
Course Credit Structure 2026-27

TYBSc Semester VI

Vertical	**Type**	**Course**	**Credit**	**Total**	**Course Code**
Major 1	Theory	Basic Complex Analysis	2		**CHMMATHVI1**
Major 2	Theory	Ring Theory	2		**CHMMATHVI2**
Major 3	Theory	Topology of Metric Spaces - II	2		**CHMMATHVI3**
Major 4	Theory	Advanced Real Analysis	2		**CHMMATHVI4**
Major 5	Practical	Practical based on Basic Complex Analysis	2		**CHMMATHVI5**
Major 6	Practical	Practical based on Ring Theory	2		**CHMMATHVI6**
Major 7	Practical	Practical based on Topology of Metric Spaces II and Advanced Real Analysis	2		**CHMMATHVI7**
Major Elective	Theory	Graph Theory II	2		**CHMMATHVI8**
Major Elective	Practical	Practical based on Graph Theory II	2		**CHMMATHVI9**
Major				**18**	
Minor	Theory	Numerical Methods – II	2	**Included for Applied Sciences**	**CHMMATHVI10**
Minor	Practical	Practical Based on Numerical Methods – II	2		**CHMMATHVI11**
Minor	Theory	Basics of Mathematics in Real Life – V	2		**CHMMATHVI12**
Minor	Practical	Practical Based on Basics of Mathematics in Real Life – V	2		**CHMMATHVI13**
OJT	Training	On Job Training (OJT)	4		**CHMMATHVI14**
Semester VI Total				**22**	

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester- VI

Title: Basic Complex Analysis

Vertical - 1
Major - 2 Credits

With effect from Academic Year
2026-27

Title: Basic Complex Analysis

Course Code: CHMMATHVI1

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course offers a foundational study of Complex Analysis, beginning with the geometry of the complex plane, limits, continuity, and differentiability of complex functions. Learners learn key analytic concepts through the Cauchy-Riemann equations, harmonic functions, and properties of analytic mappings. The course develops core integration techniques including contour integrals, the Cauchy-Goursat theorem, and the Cauchy Integral Formula, along with applications to Taylor series and Möbius transformations. It concludes with complex power series, Laurent series, classification of isolated singularities, and the use of residues to evaluate complex and improper real integrals. The emphasis is on conceptual understanding and analytical skills needed for further study in advanced mathematics.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To extend the ideas of real-variable calculus to functions of a complex variable through the concepts of analyticity, complex integration and power series. **CO(A) 2** To introduce learners to stereographic projection, Mobius transformations and properties of elementary functions. **CO(A) 3** To equip the learners with appropriate results such as the Cauchy-Riemann equations, Cauchy Integral Theorem, residue theorem etc. to enable them to analyze and decide complex differentiability and compute complex integrals. **CO(A) 4** To examine differentiation and integration in a power series	

8	**Course Outcomes**: Upon completion of the course, learner should be able to: **CO 1** decide complex differentiability and analyticity using the definition and Cauchy-Riemann equations based results , examine connection between analytic and harmonic function. **CO 2** state, interpret, analyse and apply definition, suitable fundamental theorems such as Cauchy-Goursat, Cauchy Integral theorem and its extension, residue theorem to evaluate contour integrals **CO 3** construct Mobius transformation, Taylor series and Laurent series expansion , derive properties of elementary functions such as exponential, trigonometric and hyperbolic functions. **CO 4** prove CR equations based results, Cauchy Goursat theorem, Cauchy Integral theorem, results related to power series such as absolute and uniform convergence, continuity and uniqueness of power series, term by term integration and differentiation of power series
9	**Syllabus** **UNIT I: Introduction to Complex Analysis** • Review of complex numbers: Complex plane, polar coordinates, exponential map, powers and roots of complex numbers, De Moivre's formula, $\mathbb{C}$ as a metric space, bounded and unbounded sets (No questions to be asked). • Point at infinity-extended complex plane, Stereographic projection. Sketching of set in complex plane. • Convergence of sequences of complex numbers and related results. Limit of a function $f : \mathbb{C} \to \mathbb{C}$, real and imaginary part of functions, continuity at a point and algebra of continuous functions. Limits involving the point at infinity. • Derivative of $f : \mathbb{C} \to \mathbb{C}$, comparison between differentiability in real and complex sense. • Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic function, if f, g analytic then $f + g, f - g, fg$ and f/g are analytic, chain rule. • Theorem: If $f'(z) = 0$ everywhere in a domain D, then $f(z)$ must be constant throughout D. • Harmonic functions and harmonic conjugate. • Mobius transformation: definitions and examples. • Exponential function, its properties. • Trigonometric functions and hyperbolic functions. **UNIT II**: **Complex Integration, Complex Power Series and Laurent's Series** • Contour integrals. Upper bounds for moduli of contour integrals • Evaluation the line integral $\int f(z)\, dz$ over $\|z - z_0\| = r$, • Cauchy-Goursat theorem, simply and multiply connected domains, and Cauchy integral formula. An extension of Cauchy integral formula. • Taylor's theorem for analytic function. • Power series of complex numbers. Radius of convergences, disc of convergence. Absolute and uniform convergence of power series. Continuity of sums of power series, integration and differentiation of power series. Uniqueness of series representation, examples. • Definition of Laurent series, Definition of isolated singularity, statement (without proof) of existence of Laurent series expansion in neighbourhood of an isolated singularity, type of isolated singularities viz. removable, pole and essential defined using Laurent series expansion, examples.

	• Statement of Residue theorem and calculation of residue. Application such as evaluation of improper integrals using residue. **Technology and AI Integration:** Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.
10	**Scheme of Examination and Assessment Pattern**

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11	**References**: 1. Brown, J. W. and Churchill, R. V., *Complex Variables and Applications*, 8th Edition, 2009, McGraw-Hill Education. 2. Greene, R. E. and Krantz, S. G., *Function Theory of One Complex Variable*, 3rd Edition, 2006, American Mathematical Society. 3. Gamelin, T. W., *Complex Analysis*, 1st Edition, 2001, Springer (Undergraduate Texts in Mathematics).

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester- VI

Title: Practical based on Basic Complex Analysis

Vertical - 1
Major - 2 Credits

With effect from Academic Year
2026-27

Title: Practical based on Basic Complex Analysis
Course Code: CHMMATHVI5

Sr. No.	Heading	Particulars
1	**Description of the Course**	This practical course provides hands-on experience in the concepts and techniques of Complex Analysis through problem-solving, visualization, and exploratory activities. Learners investigate complex functions, analyticity, harmonic functions, contour integration, and conformal mappings through guided exercises and applications. The course emphasizes the practical use of the Cauchy-Goursat Theorem, Cauchy Integral Formula, power series, Laurent series, singularities, and residue theory in solving mathematical problems. Through analytical investigations and computational tools, learners develop mathematical reasoning, visualization skills, and a deeper understanding of complex-variable techniques and their applications.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Problem solving/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To enhance the conceptual understanding of the learners about limits, continuity, differentiability and contour integration for a function of a complex variable through solving problems on these topics. **CO(A) 2** To construct Mobius transformations, examine analytic and harmonic function and properties of elementary functions. **CO(A) 3** To equip learners with advanced techniques of contour integration **CO(A) 4** To construct power series and Laurent series expansions for given domains.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** determine limit, continuity, and differentiability of complex functions using definitions and decide analyticity using the Cauchy-Riemann equations. **CO 2** compute contour integrals using definition, apply fundamental theorems such as Cauchy-Goursat, Cauchy Integral Formula and its extension to evaluate contour integrals. **CO 3** construct Mobius transformation, Taylor series expansion, determine radius of convergence of a power series, apply properties of elementary functions such as exponential, trigonometric and hyperbolic functions in problem solving. **CO 4** derive the Laurent series expansions of complex functions, classify singularities, compute residues and apply the residue theorem to solve integrals.	

9

Syllabus

UNIT I: Introduction to complex analysis

1. Limits and Continuity of Functions of Complex Variables
2. Derivatives of Functions of Complex Variables
3. Analytic Functions
4. Harmonic Function and Harmonic Conjugate
5. Complex Mapping, Mobius Transformation
6. Exponential Function and Its Properties
7. Trigonometric and Hyperbolic Functions
8. Applications of Complex Functions and Conformal Mappings: AI-Assisted Case Study: Using reference texts as mentioned, learners shall explore applications of complex functions, conformal mappings, and Möbius transformations. AI-assisted learning tools such as NotebookLM and Claude AI, together with visualization software such as GeoGebra or Desmos, may be used to investigate the geometric effects of complex mappings and to generate visual representations of transformed regions. Learners shall critically evaluate AI-generated explanations, validate findings and prepare a brief report highlighting the mathematical concepts, applications, visualizations, and conclusions of their study.

UNIT II: **Complex Integration, Complex Power Series and Laurent's Series**

1. Complex Integration
2. Cauchy's Theorem
3. Complex Power Series
4. Laurent's Series
5. Singularities
6. Calculation of Residue
7. Cauchy's Residue Theorem

Miscellaneous Theory Practical based on both units.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 2 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation	5
	Total	**20**

11

References:

1. Brown, J. W. and Churchill, R. V., *Complex Variables and Applications*, 8th Edition, 2009, McGraw-Hill Education.
2. Greene, R. E. and Krantz, S. G., *Function Theory of One Complex Variable*, 3rd Edition, 2006, American Mathematical Society.
3. Gamelin, T. W., *Complex Analysis*, 1st Edition, 2001, Springer (Undergraduate Texts in Mathematics).

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester- VI

Title: Ring Theory

Vertical - 1
Major - 2 Credits

With effect from Academic Year
2026-27

Title: Ring Theory

Course Code: CHMMATHVI2

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course introduces the fundamental concepts of rings, ideals, and factorization. It covers definitions and examples of rings with unity, integral domains, and fields; explores units, characteristics, and quotient rings; and studies prime and maximal ideals. Learners learn about Euclidean, Principal Ideal, and Unique Factorization Domains, with examples such as $\mathbb{Z}, \mathbb{Z}[i], \mathbb{Z}[\sqrt{-5}]$ and polynomial rings. Emphasis is placed on understanding divisibility, irreducibility, and the structure of commutative rings.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop learners' understanding of the fundamental definitions and properties of rings, fields, and integral domains. **CO(A) 2** To enable learners to work with ideals, quotient rings, and ring homomorphisms. **CO(A) 3** To familiarize learners with Euclidean, Principal Ideal, and Unique Factorization Domains. **CO(A) 4** To enable learners to apply the concepts of divisibility, irreducibility, and factorization in various algebraic structures.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain the fundamental concepts and properties of rings, fields, integral domains, and characteristic of rings, and identify their units and examples. **CO 2** construct ideals, quotient rings, and ring homomorphisms, and examine their properties using the Fundamental Theorem of Ring Homomorphism. **CO 3** explain the relationships among Euclidean Domains, Principal Ideal Domains, and Unique Factorization Domains, and classify rings based on their algebraic properties. **CO 4** identify reducible, irreducible, and prime elements and polynomials, and apply factorization techniques and irreducibility criteria to solve problems in integral domains and polynomial rings.	

9	**Syllabus**

UNIT I: Rings and Ideals

- Definition and elementary properties of rings (where the definition should include the existence of unity), commutative rings, integral domains and fields. Examples, including $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, $\mathbb{Z}/n\mathbb{Z}$, $\mathbb{C}$, $M_n(\mathbb{R})$, $\mathbb{Z}[i]$ $\mathbb{Z}[\sqrt{2}]$, $\mathbb{Z}[\sqrt{-5}]$, $\mathbb{Z}[X]$, $\mathbb{R}[X]$, $\mathbb{C}[X]$, $(\mathbb{Z}/n\mathbb{Z})[X]$.
- Units in a ring. The multiplicative group of units in a ring R [and, in particular, the multiplicative group F^* of nonzero elements of a field F]. Description of the units in $\mathbb{Z}/n\mathbb{Z}$. Results such as: A finite integral domain is a field. $\mathbb{Z}/p\mathbb{Z}$, where p is a prime, as an example of a finite field.
- Characteristic of a ring. Examples. Elementary facts such as: the characteristic of an integral domain is either 0 or a prime number.

  (Note: From here on all rings are assumed to be commutative with unity).
- Ideals in a ring. Intersection, sum and product of ideals. Quotient rings. Prime and Maximal ideals. Characterization of prime and maximal ideals in a commutative ring in terms of their quotient rings. Description of prime and maximal ideals in various rings.

UNIT II: Isomorphism and Factorization

- Homomorphisms and Isomorphisms of rings. Properties. Fundamental theorem of homomorphism of a ring.
- A field contains a subfield isomorphic to $\mathbb{Z}/p\mathbb{Z}$ or $\mathbb{Q}$
- Notions of Euclidean domain (ED), Principal ideal domain (PID). Examples such as $\mathbb{Z}, \mathbb{Z}[i]$ and polynomial rings. Relation between these two notions (ED $\Rightarrow PID$)
- Divisibility in a ring. Reducible, irreducible and prime elements. Examples.
- Division Algorithm and Euclidean Algorithm in $F[x]$, where F is a field.
- Properties of a norm function on the ring $\mathbb{Z}[\sqrt{d}]$, where $d \neq 1$, square free number.
- In an integral domain, prime element is irreducible, but converse is not true. In PID, prime is equivalent to irreducible.
- Irreducible polynomials in $F[x]$, examples in $\mathbb{Z}_p[x], p -$ prime. Criteria to check irreducibility of a polynomial (Without proof).
- Notion of Unique Factorization Domain (UFD). Example of non-UFD is $\mathbb{Z}[\sqrt{-5}]$. Relation between three notions (ED $\Rightarrow$ PID $\Rightarrow$ UFD) without proof. Example $\mathbb{Z}[x]$ of UFD that is not PID. In UFD, irreducible and prime are equivalent.

Technology and AI Integration: Digital tools such as GeoGebra, SageMath, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour
Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. Gallian, J. A. *Contemporary Abstract Algebra*, 10th Edition, Cengage Learning, 2023.
2. Herstein, I. N. *Topics in Algebra*, 2nd Edition, Wiley Eastern Limited, 1975.
3. Fraleigh, J. B. *A First Course in Abstract Algebra*, 7th Edition, Pearson Education, 2002.
4. Bhattacharya, P. B., Jain, S. K., and Nagpaul, S. *Abstract Algebra*, 2nd Edition, Foundation Books, New Delhi, 1995.
5. Gopalkrishnan, N. S. *University Algebra*, New Age International Publishers, 1986.
6. Artin, M. *Algebra*, 2nd Edition, Pearson Education, 2011.
7. Hungerford, T. W. *Algebra*, Graduate Texts in Mathematics, Springer, 1974.
8. Dummit, D. S. and Foote, R. M. *Abstract Algebra*, 3rd Edition, John Wiley & Sons, 2004.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester- VI

Title: Practical based on Ring Theory

Vertical - 1

Major - 2 Credits

With effect from Academic Year 2026-27

Title: Practical based on Ring Theory

Course Code: CHMMATHVI6

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This practical course introduces learners to the basic concepts of ring theory through examples and computations. It helps learners understand rings, ideals, homomorphisms, and factorization in algebraic structures. The course develops problem-solving skills and practical understanding of concepts in abstract algebra through hands-on exercises.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Problem solving/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop learners' computational understanding of rings, subrings, integral domains, units, and characteristics of rings through examples and problem-solving. **CO(A) 2** To enable learners to examine ideals, quotient rings, prime ideals, and maximal ideals in commutative rings **CO(A) 3** To develop learners' practical understanding of ring homomorphisms, kernels, images, and isomorphisms of rings. **CO(A) 4** To strengthen learners' computational skills in divisibility, irreducibility, polynomial factorization, Euclidean domains, principal ideal domains, and unique factorization domains.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain the algebraic properties of rings, subrings, integral domains, units, finite fields, and characteristics of rings, and verify them through computations and examples. **CO 2** identify ideals, quotient rings, prime ideals, and maximal ideals in commutative rings, and examine their properties. **CO 3** recall the concepts of ring homomorphisms, kernels, images, and isomorphisms, and compute kernels and images to verify isomorphisms between rings. **CO 4** identify reducible, irreducible, and prime elements and polynomials, and analyze Euclidean Domains, Principal Ideal Domains, and Unique Factorization Domains using factorization techniques and irreducibility tests.	

9	**Syllabus**
	Unit I: Practical based on Rings and Ideals **1.** Introduction to Rings and Fundamental Properties of Rings **2.** Subrings of a ring and Integral Domains **3.** Units and Finite Fields **4.** Characteristic of Rings **5.** Ideals of a ring, Quotient Rings and Ideal generated by set of elements **6.** Prime Ideals **7.** Maximal Ideals **Unit II: Practical based on Isomorphism and Factorization** **1.** Homomorphism of rings, Kernel and Image under ring homomorphism 2. Isomorphism of Rings 3. Divisibility of Elements in a Ring, Irreducible & Prime Elements 4. Division algorithm in F[X] and GCD of polynomials 5. Irreducible polynomials and Eisenstein Criterion for irreducibility 6. Euclidean Domains, Principal Ideal Domains 7. Unique Factorization Domains 8. Applications of Rings and Factorization: AI-Assisted Case Study: Using reference texts as mentioned, learners shall explore applications of rings, finite fields, and factorization in cryptography, coding theory, and digital communication. AI-assisted learning tools such as NotebookLM, Claude AI, or ChatGPT, together with SageMath or Python, may be used for conceptual understanding and computational illustration. Learners shall critically evaluate AI-generated explanations and prepare a brief report highlighting the mathematical concepts, applications, and conclusions of their study. **Miscellaneous Theory Practical based on both units.**

<table>
<tr><td>10</td><td>

Scheme of Examination and Assessment Pattern
Paper – 50 Marks
A. External Examination: Semester End External - 30 marks Time: 2 hours
Structure of Evaluation

<table>
<tr><th>Sr. No.</th><th>Particulars</th><th>Marks</th></tr>
<tr><td>1</td><td>Class Test
Paper Pattern of the Class Test:
Q1: Any four out of eight multiple choice questions
(four from unit 1 and four from unit 2) (12 Marks: 4 × 3)
Q2: Attempt any two out of four questions
(two from unit 1 and two from unit 2) (08 marks: 2 × 4)</td><td>20</td></tr>
<tr><td>2</td><td>Viva</td><td>05</td></tr>
<tr><td>3</td><td>Journal (2.5 marks for each unit 1 & unit 2)</td><td>05</td></tr>
<tr><td colspan="2">Total</td><td>30</td></tr>
</table>

B. Internal Examination: Continuous Evaluation – 20 marks

<table>
<tr><th>Sr. No.</th><th>Particulars</th><th>Marks</th></tr>
<tr><td>1</td><td>Test
Attempt any three from four Multiple Choice Questions.
(two from unit 1 and two from unit 2) (6 marks: 3×2 marks)
Attempt any one from two problem solving (4 marks: 1×4 marks)</td><td>10</td></tr>
<tr><td>2</td><td>In semester participation (Active participation)</td><td>5</td></tr>
<tr><td>3</td><td>Quiz / Case study / Seminar / Presentation</td><td>5</td></tr>
<tr><td colspan="2">Total</td><td>20</td></tr>
</table>

</td></tr>
<tr><td>11</td><td>

References:

1. Gallian, J. A. Contemporary Abstract Algebra, 10th Edition, Cengage Learning, 2023.
2. Herstein, I. N. Topics in Algebra, 2nd Edition, Wiley Eastern Limited, 1975.
3. Fraleigh, J. B. A First Course in Abstract Algebra, 7th Edition, Pearson Education, 2002.
4. Bhattacharya, P. B., Jain, S. K., and Nagpaul, S. Abstract Algebra, 2nd Edition, Foundation Books, New Delhi, 1995.
5. Gopalkrishnan, N. S. University Algebra, New Age International Publishers, 1986.
6. Artin, M. Algebra, 2nd Edition, Pearson Education, 2011.
7. Hungerford, T. W. Algebra, Graduate Texts in Mathematics, Springer, 1974.
8. Dummit, D. S. and Foote, R. M. Abstract Algebra, 3rd Edition, John Wiley & Sons, 2004.

</td></tr>
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Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B. Sc.

(Mathematics)

Semester- VI

Title: Topology of Metric Spaces - II

Vertical - 1

Major - 2 Credits

With effect from Academic Year
2026-27

Title: Topology of Metric Spaces - II
Course Code: CHMMATHVI3

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course deals with the fundamental topological concepts of Compactness and Connectedness in metric spaces and continuous functions. Learners will explore various equivalent definitions of continuity, uniform continuity and also examine significant equivalent characterizations of compact sets such as the Heine–Borel theorem and the Bolzano–Weierstrass property. The course also develops a deep understanding of connected and path-connected spaces, including various separation concepts and relationships between connectedness and continuity. Emphasis is placed on rigorous proofs, illustrative examples from real and Euclidean spaces, and applications in continuous functions and analysis.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To make learners understand continuity of functions over metric spaces and its applications. **CO(A) 2** To provide equivalent definitions of compactness in $\mathbb{R}$ and continuous image of compact sets. **CO(A) 3** To make learners understand connectedness and work with various examples and related results. **CO(A) 4** To develop learners' understanding of the concepts of notion of path connectedness, continuous image of connected, path connected sets.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** check continuity of a function on a metric space and apply its properties; prove various results about continuous, uniformly continuous functions. **CO 2** state and prove various equivalent definitions of compactness. **CO 3** examine whether a given set is connected and develop various counter examples. **CO 4** state and prove the results about connectedness and path connected metric spaces.	

9	**Syllabus**

Unit I: Continuity, Compactness-II

Continuity: Epsilon-delta definition of continuity of a function at a point from one metric space to another. Characterization of continuity at a point in terms of sequences; Characterization of continuity of a function in terms of open sets, closed sets, closure of a set and examples. Continuity of composite function. Uniform continuity in a metric space, examples (emphasis on $\mathbb{R}$). Contraction mapping and fixed-point theorem. Applications.
Compactness-II: If $A$and B are compact then $A + B$ and $A \times B$ is compact, in $\mathbb{R}$ with usual metric.

Equivalence of the following statements in $\mathbb{R}$ with usual metric:
a) Heine-Borel Property if and only if Closed and Boundedness property
b) Sequentially Compactness Property if and only if Bolzano-Weierstrass Property
c) Sequentially Compactness Property if and only if Closed and Boundedness property.

Results about continuity and compactness.

Unit II: Connected Metric Spaces

Separated sets - Definition and examples. Connected and disconnected sets. Results such as: A subset of $\mathbb{R}$ is connected if and only if it is an interval. A continuous image of a connected set is connected. Various characterizations of a connected space. Path connectedness in $\mathbb{R}^n$, definition and examples. A path connected subset of $\mathbb{R}^n$is connected, convex sets are path connected. An example of a connected subset of $\mathbb{R}^n$ which is not path connected.

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

C.

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11

References:

1. S. Kumaresan; *Topology of Metric Spaces*, Narosa Publishing House, 2nd Edition, 2011.
2. R. D. Bhat; *Intermediate Mathematical Analysis*, Narosa Publishing House, 2009.
3. E. T. Copson; *Metric Spaces*; Universal Book Stall, New Delhi, 1996.
4. D. Somasundaram, B. Choudhary; *A First Course in Mathematical Analysis*, Narosa Publishing House, 1996.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester- VI

Title: Advanced Real Analysis

Vertical - 1
Major - 2 Credits

With effect from Academic Year
2026-27

Course: Advanced Real Analysis

Course Code: CHMMATHVI4

Sr. No.	Heading	Particulars
1	**Description of the Course**	This course offers a rigorous study of sequences and series of real-valued functions with emphasis on pointwise and uniform convergence and their influence on continuity, integration, and differentiation. Learners learn to recognize when limits of functions preserve key analytical properties. The course further examines power series, including radius and interval of convergence, term-by-term operations, uniqueness of representation, and the power-series expansions of classical functions such as the exponential, sine, and cosine. Throughout the course, analytical maturity is strengthened through conceptual understanding as well as computational techniques relevant to modern applications.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives:** **CO(A) 1** To introduce the learners to the concepts of sequences and series of real-valued functions and pointwise and uniform convergence through examples and counterexamples. **CO(A) 2** To enable the learners to analyze how uniform convergence influences continuity, integration, and differentiation of functions. **CO(A) 3** To develop amongst the learners, the understanding of power series, including radius and interval of convergence, and the analytical behavior of power series. **CO(A) 4** To build the problem-solving skills of learners through term-by-term operations on power series and through studying classical functions defined by power series.	
8	**Course Outcomes:** Upon completion of the course, learner should be able to **CO 1** define and distinguish pointwise convergence and uniform convergence of sequences and series of functions using suitable examples. **CO 2** apply criteria for convergence of series of functions and verify uniform convergence using results such as the -Test, Weierstrass M-test. **CO 3** examine how uniform convergence affects continuity, differentiation, and integration of the limit function on closed and bounded intervals. **CO 4** determine the radius and interval of convergence of power series and analyse convergence and represent classical functions using power series and apply term-by-term differentiation and integration of power series.	

9	**Syllabus**

UNIT I: **Sequences and Series of Functions**

- Sequence of real-valued functions: definition and examples. Pointwise convergence of a sequence of functions: definition and examples. Uniform convergence of a sequence of functions: definition, examples.
- Relation between types of convergence: Uniform convergence implies pointwise convergence. Example to show that the converse does not hold.
- Series of functions: definition and examples. Convergence of series of functions. Weierstrass M-test and illustrative examples.
- Properties of uniform convergence: Continuity of the uniform limit of a sequence of continuous functions. Statement of conditions under which integration and differentiation of a sequence of functions converge to the integral and derivative of the uniform limit on a closed and bounded interval.
- Consequences of these properties for series of functions: term-by-term integration and term-by-term differentiation.

UNIT II: **Power Series and Applications**

- Power series in $\mathbb{R}$: definition of power series centered at the origin and at a point $a \in \mathbb{R}$. Radius of convergence and region (interval) of convergence, with examples.
- Uniform convergence of power series on compact subsets of the interval of convergence and examples.
- Term-by-term differentiation and integration of power series (statements only), with examples.
- Uniqueness of power series representation. Functions represented by power series and illustrative examples.
- Classical functions defined by power series: exponential, cosine, and sine functions. Basic properties of the above functions obtained through their power series expansions.

Technology and AI Integration: Digital tools such as GeoGebra, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. Goldberg, Richard R., *Methods of Real Analysis*, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1970.
2. Bhatt, R. D., *Intermediate Mathematical Analysis*, Narosa Publishing House, New Delhi.
3. Bartle, Robert G. and Sherbert, Donald R., *Introduction to Real Analysis*, 2nd Edition, John Wiley & Sons, 1992.
4. Goffman, Casper, *Introduction to Real Analysis*, Harper & Row Publishers, 1965.
5. Somasundaram, D. and Choudhary, B., *A First Course in Mathematical Analysis*, Narosa Publishing House, New Delhi, 1997.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B. Sc.

(Mathematics)

Semester- VI

Title: Practical based on Topology of Metric Spaces - II and Advanced Real Analysis

Vertical - 1

Major - 2 Credits

With effect from Academic Year 2026-27

Title: Practical based on Topology of Metric Spaces- II and Advanced Real Analysis

Course Code: CHMMATHVI7

Sr. No.	Heading	Particulars
1	**Description of the 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 practical course seeks to deepen conceptual understanding, promote mathematical thinking, and prepare learners for advanced studies requiring precision and rigor in mathematical analysis.
2	**Vertical 1**	Major
3	**Type** **Teaching Method**	Practical Problem solving/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop learners' skills of applying different definitions of continuity in problem solving and to learn equivalent definitions of compactness. **CO(A) 2** To enable the learners to understand various definitions of connectedness and to apply results about connected metric spaces. **CO(A) 3** To impart the techniques to decide pointwise and uniform convergence and their properties for sequence/series of functions. **CO(A) 4** To make learners understand the concepts of radius/interval of convergence, pointwise/uniform convergence of Power series and learn their various properties.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** check continuity of given function and solve problems by applying suitable definition of continuity, state the equivalent definitions of compactness and investigate compact sets. **CO 2** identify and analyze properties of connected and path connected metric spaces. **CO 3** apply various result /properties to judge pointwise and uniform convergence and derive analytic expressions. **CO 4** compute radius /interval of convergence of power series and to represent standard functions as power series and explore their properties.	

9	**Syllabus**

Unit I: Practical based on Topology of Metric Spaces- II

1. Continuous Functions on Metric Spaces
2. Equivalent characterisations of Continuity and more results
3. Uniform Continuity, Fixed Point Theorem, compactness
4. Separated, Connected and Disconnected Sets
5. Connected Sets in R and Continuous Images
6. Functional Characterization of Connectedness
7. Path Connectedness in R^n and Related Properties

Unit II: Practical based on Advanced Real Analysis

1. Pointwise and Uniform convergence of a sequence of functions
2. Pointwise and Uniform convergence of a series of functions, Weierstrass M-test
3. Continuity, differentiation, and integration of sequences and series of functions
4. Continuity, differentiation, and integration of series of functions
5. Radius of convergence and interval of convergence of power series
6. Differentiation and integration of power series
7. Properties of exponential, sine and cosine functions through power series
8. **Case study (AI integration)** : To plot graphs of various functions and check continuity, uniform continuity based on $\varepsilon - \delta$ definition using AI tool - Geogebra.

Miscellaneous Theory Practical based on both units

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 3 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	Quiz / Case study / Seminar / Presentation	5
3	In semester participation (Active participation)	5
	Total	**20**

11 **References:**

1. S. Kumaresan; *Topology of Metric Spaces*, Narosa Publishing House.
2. R. D. Bhat; *Intermediate Mathematical Analysis*, Narosa Publishing House, 2009.
3. E. T. Copson; *Metric Spaces*; Universal Book Stall, New Delhi, 1996.
4. D. Somasundaram, B. Choudhary; *A First Course in Mathematical Analysis*, Narosa Publishing House, 1996.
5. R. R. Goldberg; *Methods of Real Analysis*; Oxford and International Book House (IBH) publishers, New Delhi.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester - VI

Title: Graph Theory - II

Vertical - 1

Major Elective - 2 Credits

With effect from Academic Year 2026-27

Title: Graph theory - II

Course Code: CHMMATHVI8

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course explores advanced graph theory and combinatorics, covering vertex and edge colourings, chromatic polynomials, planar graphs, Euler's formula, network flows, and classical theorems like Brooks, Vizing, and Ford-Fulkerson. It also introduces combinatorial techniques, including Inclusion Exclusion, generating functions, recurrence relations, and Hall's theorem, with practical applications in scheduling, puzzles, map colouring, and network optimization.
2	**Vertical 1**	Major Elective
3	**Type** **Teaching Method**	Theory Lecture/group discussion/seminar/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To enable learners to analyze and evaluate graph colourings, and apply these concepts to practical problems such as scheduling, puzzles, and map colouring. **CO(A) 2** To impart understanding of planar graphs and their properties, and network flow concepts for problem solving. **CO(A) 3** To develop learners' combinatorial reasoning skills through applications of the Inclusion-Exclusion Principle, generating functions, recurrence relations, and series expansions. **CO(A) 4** To develop learners' ability to apply advanced graph-theoretic and combinatorial techniques to model, solve, and optimize real-world problems, including network flows, connectivity etc.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** define and explain the concepts of graph colouring and their applications. **CO 2** apply graph colouring and network flow techniques to solve graph problems. **CO 3** apply combinatorial methods to solve counting problems. **CO 4** analyze graph-theoretic and combinatorial models to solve optimization problems.	

9	**Syllabus**
	Unit I: Colourings of Graph and Planar Graphs Vertex colouring - Evaluation of Vertex Chromatic Number of some standard graphs, Critical Graph. Upper and lower bounds of Vertex Chromatic Number. Statement of Brook's theorem. Edge colouring - Evaluation of Edge Chromatic Number of standard graphs such as complete graph, complete bipartite graph, cycle. Statement of Vizing Theorem. Chromatic polynomial of graphs, Recurrence Relation and properties of Chromatic polynomials. Some Applications of vertex and edge colouring of a graph like timetable scheduling problem, Sudoku, map colouring etc. Definition of Planar graph. Euler formula and its consequences. Non-planarity of K_5, $K_{3,3}$. Polyhedron in R^3 and existence of exactly five regular polyhedral known as Platonic solids. Colourability of planar graphs - 5 colour theorem for planar graphs, statement of 4 colour theorem. **Unit II: Flows in Network and Combinatorics** Applications of Inclusion Exclusion Principle, Rook polynomial, Forbidden position problems. Introduction to partial fractions and Newton's binomial theorem for real power series, series expansion of some standard functions. Forming recurrence relation and getting a generating function. Solving a recurrence relation using ordinary generating functions. System of Distinct Representatives and Hall's theorem of SDR. Flows in Networks and cut in a network, value of a flow and the capacity of cut in a network, relation between flow and cut. Maximal flow and minimal cut in a network and Ford- Fulkerson theorem. **Technology and AI Integration:** Digital tools such as GeoGebra, SageMath, NotebookLM, and Claude AI can be used selectively to visualize concepts, explore multiple solution approaches and enhance mathematical communication. These tools to serve as aids to understanding and reflection while preserving rigorous analytical reasoning, proof-writing, and independent problem-solving.

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks, Time: 1 hour

Format of Question Paper

The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.

Q. No.	Structure of the Questions	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Class test (offline) The class test pattern is as follows: Q.1 Definitions/Fill in the blanks/True or False with justification: 4 marks (4 × 1) (Any **four** out of **six**) Q.2 Attempt **any two** out of **three** descriptive questions: 6 marks (2 × 3)	10
2	Open book test / Flipped classroom test / Case Study	5
3	Mini Project / Seminar / Quiz / Role Play	5
	Total	**20**

11 **References:**

1. West, Douglas B., *Introduction to Graph Theory*, 2nd Edition, Pearson Education, 2000.
2. Rosen, Kenneth H., *Discrete Mathematics and Its Applications*, 8th Edition, McGraw-Hill Education, 2021.
3. Bondy, J. A. and Murty, U. S. R., *Graph Theory with Applications*, 1st Edition, North-Holland Publishing Company, 1976.
4. Deo, Narsingh, *Graph Theory with Applications to Engineering and Computer Science*, 1st Edition, Prentice-Hall of India Pvt. Ltd., 1974. *(Reprinted editions available later.)*
5. Chartrand, Gary and Zhang, Ping, *A First Course in Graph Theory*, 1st Edition, Dover Publications, New York, 2012.
6. Choudam, S. A., *Introductory Graph Theory*, Nirali Prakashan, Pune, 2018.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B. Sc.

(Mathematics)

Semester - VI

Title: Practical based on Graph Theory - II

Vertical - 1

Major Elective - 2 Credits

With effect from Academic Year 2026-27

Title: Practical based on Graph Theory - II

Course Code: CHMMATHVI9

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This practical course provides hands-on experience in the applications of graph theory and combinatorial techniques to solve mathematical and real-world problems. Learners explore graph colouring, chromatic polynomials, planar graphs, network flows, generating functions, recurrence relations, inclusion-exclusion principle, and Hall's theorem through problem-solving activities and case studies. The course also introduces the use of basic AI tools for modelling, scheduling, assignment, and optimization problems.
2	**Vertical 1**	Major Elective
3	**Type** **Teaching Method**	Practical Problem-solving/group discussion/presentation/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop learners' practical skills in analysing graph colouring problems, including vertex colouring, edge colouring, chromatic numbers, chromatic polynomials, and planar graph properties using standard graph-theoretic techniques and theorems. **CO(A) 2** To enable the learners to apply graph-theoretical concepts and AI-assisted tools for solving real-world optimization and visualization problems such as examination timetable scheduling and map colouring. **CO(A) 3** To develop the practical competence of learners in applying combinatorial techniques such as the Inclusion–Exclusion Principle, rook polynomials, generating functions, recurrence relations, and systems of distinct representatives for solving counting and allocation problems. **CO(A) 4** To enable learners to model and analyze optimization and assignment problems using combinatorial methods, network flow techniques, and AI-assisted computational tools.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** explain graph properties and analyze the same by determining chromatic number, edge chromatic number, chromatic polynomial, and planarity **CO 2** apply graph models and graph-colouring techniques, using AI tools where appropriate, to solve scheduling and map-colouring problems. **CO 3** apply combinatorial techniques and network flow algorithms to solve discrete mathematics problems. **CO 4** evaluate graph and combinatorial models, including AI-generated solutions, for assignment, scheduling, and resource-allocation problems.	

9	**Syllabus** **Practical based on unit 1 (Colourings of Graph and Planar Graphs)** 1. Vertex Colouring and Chromatic Number of Graphs. 2. Critical Graphs and Bounds on Chromatic Number, Applications of Brook's Theorem. 3. Edge Colouring and Edge Chromatic Number. 4. Applications of Edge Colouring and Vizing's Theorem. 5. Chromatic Polynomial and Recurrence Relations. 6. Planar and Non-Planar Graphs and Euler's Formula and Platonic Solids. 7. **AI-Assisted Mini Project**: (Digital tools such as GeoGebra, NotebookLM, or Claude AI can be used selectively to visualize concepts, and enhance mathematical communication) **Examination Timetable Scheduling** Graph colouring can be used to create an examination timetable where no learner has two exams scheduled at the same time. Courses are represented as vertices, and colours represent different exam slots. **OR** **Airline Flight Scheduling and Gate Assignment** Graph colouring helps assign airport gates or time slots to flights that overlap in schedule. This minimizes resource conflicts and improves airport operational efficiency **Practical based on unit 2 (Flows in Network and Combinatorics)** 1. Applications of the Inclusion-Exclusion Principle 2. Rook Polynomials and Forbidden Position Problems 3. Partial Fractions and Newton's Binomial Theorem 4. Generating Functions of Standard Sequences 5. Solving Recurrence Relations Using Generating Functions 6. System of Distinct Representatives (SDR) and Hall's Theorem 7. Network Flows and Cuts, Maximum Flow-Minimum Cut, Ford-Fulkerson Algorithm 8. AI-Assisted Mini Project: (Digital tools such as GeoGebra, NotebookLM, or Claude AI can be used selectively to visualize concepts, and enhance mathematical communication) **Employee-to-Project Assignment Using Hall's Theorem** (This involves Creating a dataset of employees and eligible projects. Asking an AI tool, to propose assignments. Modeling the problem as a family of sets. Verifying Hall's condition manually. Or **Workforce Scheduling with Inclusion-Exclusion Constraints** (This involves Creating a scheduling problem with employee restrictions. Asking AI, to generate feasible schedules, Modeling restrictions as forbidden positions, Using inclusion-exclusion or rook polynomials to count valid schedules.) **Miscellaneous Theory Practical based on both units**

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

A. External Examination: Semester End External - 30 marks Time: 2 hours

Structure of Evaluation

Sr. No.	Particulars	Marks
1	Class Test Paper Pattern of the Class Test: **Q1**: Any **four** out of **eight** multiple choice questions (four from unit 1 and four from unit 2) (12 Marks: 4 × 3) **Q2**: Attempt **any two** out of **four** questions (two from unit 1 and two from unit 2) (08 marks: 2 × 4)	20
2	Viva	05
3	Journal (2.5 marks for each unit 1 & unit 2)	05
	Total	**30**

B. Internal Examination: Continuous Evaluation – 20 marks

Sr. No.	Particulars	Marks
1	Test Attempt **any three** from **four** Multiple Choice Questions. (two from unit 1 and two from unit 2) (6 marks: 3×2 marks) Attempt **any one** from **two** problem solving (4 marks: 1×4 marks)	10
2	In semester participation (Active participation)	5
3	Quiz / Case study / Seminar / Presentation / Mini Project	5
	Total	**20**

11 **References:**

1. West, D. B., *Introduction to Graph Theory*, 2nd Ed., Pearson Education, 2000.
2. Rosen, K. H., *Discrete Mathematics and Its Applications*, 8th Ed., McGraw-Hill Education, 2021.
3. Bondy, J. A. and Murty, U. S. R., *Graph Theory with Applications*, North-Holland Publishing Company, 1976.
4. Deo, N., *Graph Theory with Applications to Engineering and Computer Science*, 1st Ed., Prentice-Hall of India Pvt. Ltd., 1974.
5. Chartrand, G. and Zhang, P., *A First Course in Graph Theory*, 1st Ed., Dover Publications, New York, 2012.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year

(Mathematics)

Semester- VI

Title: Numerical Methods – II

Vertical - 2

Minor - 2 Credits

With effect from Academic Year

2026-27

Title: Numerical Methods – II

Course Code: CHMMATHVI0

Sr. No.	Heading	Particulars
1	**Description of the Course:**	The reason for studying this course is that numerical methods can provide solutions to applied problems when analytical methods fail or are too complicated to use. The increasing importance of numerical methods in applied sciences has led to an enhanced demand for courses dealing with the techniques of numerical analysis. This course aims to equip learners with practical skills and mathematical tools for finding interpolating polynomials and for solving ordinary differential equations with initial conditions using different numerical methods.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Theory (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To understand different interpolation methods. **CO(A) 2** To introduce various interpolation methods. **CO(A) 3** To solve ordinary differential equations: Initial Value Problems (IVP). **CO(A) 4** To gain hands-on experience by coding examples that incorporate the learned methods.	
8	**Course Outcomes:** Upon completion of the course, learner should be able to **CO 1** state interpolation formulae and single/multi step methods learnt **CO 2** understand Least square approximation and Lipschitz condition **CO 3** apply interpolation formulae and single/multi step methods learnt **CO 4** analyse interpolation methods learnt	

9	**Syllabus**

UNIT I: Interpolation

- Lagrange's Interpolation (Linear, Quadratic and higher order). Newton`s divided interpolation, Permanance property
- Piecewise Interpolation: Linear, Quadratic and Cubic.
- Finite difference operators: Shift operator, forward, backward and central difference operator, Average operator and relation between them. Difference table, Relation between finite difference operators and derivatives. Fundamental theorem of difference calculus. Factorial notation.
- Interpolating polynomials using finite differences: Gregory-Newton forward difference

UNIT II: Ordinary Differential Equations: Initial Value Problems (IVP)

- Single step methods:
  i. Taylor`s series method,
  ii. Lipschitz condition (Result on it and examples), Existence and uniqueness of solutions to first order IVP (only statement and problems on it),
  iii. Picard`s method of successive approximations,
  iv. Euler`s Method, Modified Euler`s method,
  v. Runge-Kutta method of second and fourth order,
- Multi step methods:
  i. Milne's Predictor-Corrector method.
  ii. Adams Predictor-Corrector method.

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	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

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 × 3)

11	**References:** 1. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers. 2. Madhumangal Pal (2009). Numerical Analysis for Scientists and Engineers (2nd Edition). Narosa Publishing House. 3. M. D. Raisinghania (2020). Ordinary and Partial Differential Equations ()revised edition). S. Chand 4. P. Sivaramakrishna Das and C. Vijayakumari (2014). Numerical Analysis. Pearson. 5. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson. 6. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India. 7. Earl A. Coddington (1994). An Introduction to Ordinary Differential Equations (7th edition), Prentice-Hall of India. 8. D. Somasundaram (2011). Ordinary Differential Equations: A First Course (5th reprint). Narosa Publishing House.

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year

(Mathematics)

Semester- VI

Title: Practical Based on Numerical Methods – II

Vertical - 2

Minor – 2 Credits

With effect from Academic Year

2026-27

Title: Practical Based on Numerical Methods – II

Course Code: CHMMATHVI11

Sr. No.	Heading	Particulars
1	**Description of the Course:**	The reason for studying this course is that numerical methods can provide solutions to applied problems when analytical methods fail or are too complicated to use. The increasing importance of numerical methods in applied sciences has led to an enhanced demand for courses dealing with the techniques of numerical analysis. This course aims to equip learners with practical skills and mathematical tools for finding interpolating polynomials and for solving ordinary differential equations with initial conditions using different numerical methods.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Practical Problem-solving/group discussion/presentation/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To understand different interpolation methods. **CO(A) 2** To introduce various interpolation methods. **CO(A) 3** To solve ordinary differential equations: Initial Value Problems (IVP). **CO(A) 4** To gain hands-on experience by coding examples that incorporate the learned methods.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** apply interpolation methods, finite difference formulas to obtain approximating polynomial, and apply single-step and multi-step numerical methods to solve IVP. **CO 2** estimate Least square approximation and Lipschitz condition. **CO 3** find the interpolating polynomial by interpolating methods learnt and find solution of IVP by single/multi step methods learnt. **CO 4** construct programming language code or software code that incorporates the methods learnt to find interpolating polynomial and solution of IVP.	

9	**Syllabus** **Unit 1: Practical on Interpolation** • Lagrange's Interpolation • Newton`s divided interpolation • Piecewise Interpolation • Gregory-Newton forward and backward difference Interpolation • Fundamental theorem of difference calculus. Factorial notation. • Bivariate Interpolation • Hermite Interpolation • Least square approximation **Unit 2: Practical on Ordinary Differential Equations: Initial Value Problems (IVP)** • Taylor`s series method • Lipschitz condition • Picard`s method of successive approximations • Euler`s Method and Modified Euler`s method • Runge-Kutta method of 2nd and 4th order • Milne's Predictor-Corrector method • Adams Predictor-Corrector method

10	**Scheme of Examination and Assessment Pattern**

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 3:00 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 =1 5 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)
		Total: 30

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.
- Learners 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
		Total: 20

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: 5 × 2)

Duration: 1Hrs

While setting question paper four MCQ on module 1 and four MCQ on module 2 both.

11	**References:** 1. M. K. Jain, S. R. K. Iyengar & R. K. Jain (2012). Numerical Methods for Scientific and Engineering Computation (6th edition). New Age International Publishers. 2. Madhumangal Pal (2009). Numerical Analysis for Scientists and Engineers (2nd Edition). Narosa Publishing House. 3. M. D. Raisinghania (2020). Ordinary and Partial Differential Equations (revised edition). S. Chand 4. P. Sivaramakrishna Das and C. Vijayakumari (2014). Numerical Analysis. Pearson. 5. Brian Bradie (2006), A Friendly Introduction to Numerical Analysis. Pearson. 6. C. F. Gerald & P. O. Wheatley (2008). Applied Numerical Analysis (7th edition), Pearson Education, India. 7. Earl A. Coddington (1994). An Introduction to Ordinary Differential Equations (7th edition), Prentice-Hall of India. 8. D. Somasundaram (2011). Ordinary Differential Equations: A First Course (5th reprint). Narosa Publishing House.

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

2026-27

Title: Basics of Mathematics in Real Life – V

Course Code: CHMMATHVI12

Sr. No.	Heading	Particulars
1	**Description of the Course:**	This course gives a gentle introduction to one variable calculus, which is very helpful to learners 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	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Theory (Lectures / Problem Solving / Discussion / Presentation / Case Study / Demonstration etc.)
4	**Credit**	2 Credits
5	**Hours allotted**	30 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop the notion of recurrence **CO(A) 2** To identify sequences that are convergent **CO(A) 3** To associate a Taylor series expansion to differentiable functions **CO(A) 4** To recognize the importance of continuity and differentiability in locating zeroes of functions.	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** state the definitions and examples of sequences, convergence, differentiability, derivatives, and integration. **CO 2** apply rules of sequences, recurrence relations, differentiation, and integration to solve standard and real-life problems. **CO 3** analyze the behavior of sequences and functions, including convergence, differentiability, and extrema. **CO 4** outline and apply methods to find zeroes of functions, justify/check results using logical reasoning, limit arguments, and standard theorems of calculus, construct recurrence relations, Taylor expansions, and mathematical models for real-life applications.	

9	**Syllabus**
	UNIT I: Sequences and Recurrence Relations • Sequences of real numbers and examples • Convergence of a sequence of real numbers: definition • Examples of convergent sequences • Examples of non-convergent (divergent) sequences • Sums and products of sequences (convergent sequences) • Sums and products of sequences (not necessarily convergent) • Sandwich theorem for sequences and applications • Sequences defined by recurrence relation: definition and examples • Statement for existence of solution of homogeneous recurrence relation (without proof) • Examples of solving homogeneous recurrence relations: linear and quadratic • Examples of solving homogeneous recurrence relations: cubic and quartic • Examples of non-homogeneous recurrence relations and statement for existence of solution. • Non homogeneous recurrence relation examples (root does not match with root of the associated characteristic polynomial) • Non homogeneous recurrence relation examples (root matches with a root of the associated characteristic polynomial) • Setting up recurrence relations in simple examples **UNIT II: Differentiability and Integrability of functions** • Definition of differentiability of a function • 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, mimima) • 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	Unit	Marks
1	Attempt ANY THREE out of SIX. (Each question of 5 marks)	1	15
2	Attempt ANY THREE out of SIX. (Each question of 5 marks)	2	15
	Total		**30**

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 × 3)

11 **References:**

1. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons.
2. Kenneth Rosen, Discrete Mathematics and its applications, McGraw Hill.
3. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons.
4. Brualdi, Richard A., Introductory Combinatorics, Pearson Education.

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

2026-27

Title: Practical Based on Basics of Mathematics in Real Life – V

Course Code: CHMMATHVI13

Sr. No.	Heading	Particulars
1	**Description of the Course:**	The reason for studying this course is that numerical methods can provide solutions to applied problems when analytical methods fail or are too complicated to use. The increasing importance of numerical methods in applied sciences has led to an enhanced demand for courses dealing with the techniques of numerical analysis. This course aims to equip learners with practical skills and mathematical tools for finding interpolating polynomials and for solving ordinary differential equations with initial conditions using different numerical methods.
2	**Vertical 2**	Minor
3	**Type** **Teaching Method**	Practical Problem-solving/group discussion/presentation/tech-based learning etc.
4	**Credit**	2 Credits
5	**Hours allotted**	60 Hours
6	**Marks allotted**	50 Marks
7	**Course Objectives**: **CO(A) 1** To develop the notion of recurrence **CO(A) 2** To identify sequences that are convergent **CO(A) 3** To associate a Taylor series expansion to differentiable functions **CO(A) 4** To recognize the importance of continuity and differentiability in locating zeroes of functions	
8	**Course Outcomes**: Upon completion of the course, learner should be able to **CO 1** state the rules of sequences, recurrence relations, differentiation, and integration to solve standard and real-life problems. **CO 2** analyze the behavior of sequences and functions, including convergence, differentiability, and extrema, outline methods to find zeroes of functions **CO 3** justify/check results using logical reasoning, limit arguments, and standard theorems of calculus. **CO 4** construct recurrence relations, Taylor expansions, and mathematical models for real-life applications.	

9	**Syllabus**

Syllabus

Unit 1: Practical based on sequences and recurrence relations

- Convergence of sequences of real numbers
- Arithmetic of convergent sequences
- Applications of sandwich theorem and divergent sequences
- Homogeneous recurrence relations: degree one and two
- Homogeneous recurrence relations: degree three and four
- Non homogeneous recurrence relations
- Examples of setting up recurrence relations

Unit 2: Practical based on Differentiability and Integrability of functions

- Differentiability: examples from first principles
- Arithmetic of differentiable functions
- Derivate of the inverse of a function
- Applications of Rolle's theorem and Mean value theorems
- Taylor expansion of functions at a point
- Applications of derivatives: maxima and minima
- Applications of derivatives: further examples
- Computations of simple integrals

10

Scheme of Examination and Assessment Pattern

Paper – 50 Marks

External Examination: Semester End External - 30 marks Time: 3:00 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 =1 5 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)
		Total: 30

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.
- Learners 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
		Total: 20

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: 5 × 2)

Duration: 1Hrs

While setting question paper four MCQ on module 1 and four MCQ on module 2 both.

11	**References:** 1. Bartle R. G. and Sherbert D. R., Introduction to Real Analysis, John Wiley and Sons. 2. Richard R. Goldberg, Methods of Real Analysis, John Wiley and Sons. 3. Thomas and Finney, Calculus and Analytical Geometry, Pearson 4. Ajit Kumar and S. Kumaresan, A basic course in real analysis, Chapman and Hall 5. B. V. Limaye and Sudhir Ghorpade, A course in calculus and real analysis, Springer Nature

Smt. Chandibai Himathmal Mansukhani College

(Autonomous)

Third Year B.Sc.

(Mathematics)

Semester- VI

Title: On Job Training (OJT)

Vertical - 6

4 Credits

With effect from Academic Year
2026-27

Title: On Job Training

Course Code: CHMMATHVI14

Please refer to the Guidelines separately provided for OJT

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

Board of Studies (BoS) Mathematics

Sr. No.	Name of the Faculty	Designation and College	Signature
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 Clough	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, Associate Professor, K.C. College	
9.	Dr. Pankit Gandhi	Outside University nominee Associate Professor, K.C. College	
10.	Prof. Minal Wankhede	Vice Chancellor Nominee 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 BoS Chairperson: Ms. Urmila Pillay: ____________

Name and Signature of the Dean: Dr. Neena Anand: ____________

Smt. Chandibai Himathmal Mansukhani College (Autonomous) Ulhasnagar